8-2018

Localized Teacher Supply and Demand in Arkansas: An Exploration of the Supply and Demand of Teachers in Arkansas School Districts

Leesa M. Foreman
University of Arkansas, Fayetteville

Localized Teacher Supply and Demand in Arkansas: An Exploration of the Supply and Demand of Teachers in Arkansas School Districts

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in Education Policy

by

Leesa Foreman
Portland State University
Bachelor of Arts in Social Sciences, 1997
Portland State University
Master of Science in Special Education, 1999

August 2018
University of Arkansas

This dissertation is approved for recommendation to the Graduate Council.

_____
Gary W. Ritter, Ph.D.
Dissertation Director

_____
Patrick J. Wolf, Ph.D.
Committee Member

_____
Robert Maranto, Ph.D.
Committee Member

Abstract

There have been widespread reports of an impending teacher shortage crisis in the U.S. for more than 30 years. In the U.S., there are claims of a widespread national shortage while research indicates teacher shortages are specific to certain subjects and schools. Part of the reason for the conflicting accounts is how shortage is identified and what information is used to assess it. In this study, I test whether a uniform teacher shortage exists across the state of Arkansas. I hypothesize that, rather than a universal shortage, teacher shortages are more likely to occur in certain regions and subjects. I examine the characteristics of districts with the most favorable teaching supply and those with the greatest teaching need using descriptive and multivariate analysis of data collected from district surveys along with administrative data. In this study, "supply" is defined as the ratio of applications to vacancies and "need" is defined as the ratio of vacancies to full-time equivalent (FTE) certified classroom teachers. This is the third study to use applicants to identify teacher supply, and the first to assess teacher need or shortages in this way. Results indicate teacher supply and need are unequally distributed across the state; there is no uniform teacher shortage statewide. Regarding teacher supply, I find district size, region, and urbanicity appear to drive supply. Teacher supply is most favorable for large districts with student enrollments greater than 3,500, districts in the Northwest, and suburban and city districts. Regarding teacher need, I find urbanicity and region contribute most to need and the need appears greatest for districts in cities, and districts in the Central and Southeast regions. Teacher need does not appear to be significantly influenced by district educational success, teacher salary, or district growth. Looking at the relationship between teacher supply and need, I find three clear relationships. In the Central and Southeast regions, there is lower teacher supply

and greater teacher need. In urban districts, there is both greater teacher supply and need. In higher poverty districts, there is significantly less teacher supply and more teacher need.

Acknowledgments

I would first like to extend special thanks to my dissertation committee: Gary Ritter, Patrick Wolf, and Bob Maranto. Gary, you have been a constant source of encouragement and positivity. Thank you for your valuable feedback and suggestions, and your sense of humor. Pat, I can always count on you to catch any mishap ADAA mishaps - thank you for your keen eye. Bob, thank you for your generosity and diligence in helping me get published. You all care deeply about your students and we know it.

A special thanks also goes out to two individuals who were instrumental in helping me complete certain tasks as part of this dissertation: Sarah McKenzie and Charlene Reid. Sarah, thank you for all of your help with developing the survey, helping me practice for the defense, and for talking me off the ledge when I needed it. Charlene, thank you for your Excel wizardry and patience with my million little questions.

I would also like to extend special thanks to three women who mentored and inspired me to embark on this doctoral journey: Nina Buchanan, Heather Nakakura, and Jackie Temple. Nina, I know for certain I never would have applied for or been accepted to this program if it weren't for you. Thank you for believing in me. Heather, you amaze me by all the things you manage to do, and do well, while keeping a smile on your face. Thank you for your support and encouragement even when my leaving made things more difficult for you. Jackie, you showed me it's never too late to pursue your goals. Without your example, I would never have considered pursuing a Ph.D.

To my cohort, Kaitlin Anderson, Beth (Yujie) Sude, and Dany (M. Danish) Shakeel, I am honored to have shared this experience with you. We will always be family. Thank you for the friendship, laughs, and good food. I hope you conquer the world and achieve all your dreams.

I would also like to extend thanks to the EDRE faculty – Jay Greene, Bob Costrell, Gema Zamarro, Jon Mills, and Julie Trivitt. Thank you for your wisdom and expertise. I am truly fortunate to have had the opportunity to learn with you.

To the EDRE students, staff, and alumni, I have learned something from each of you and am delighted to have joined you on this journey. Thank you for your help and support, your friendship, and high fives near and far. I look forward to all of your future successes.

To my family and friends, you helped keep me going and your support has been invaluable. Through the laughter and tears I know I can count on you. I am so very grateful for you all.

Dedication

This dissertation is dedicated to my grandmother, Margaret Foreman More, and all of my former students. I wish you could be here to share this with me. "No one can ever take your education away." You inspire me to do better every day.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

There have been widespread reports of an impending teacher shortage crisis in the U.S. for more than 30 years. The U.S. is not alone when it comes to concerns of teacher shortages; many other countries also struggle with meeting teaching needs. In fact, all industrialized countries face challenges in ensuring a sufficient supply of teachers to meet the demand (Ladd, 2007; OECD, 2005). Teacher supply may vary by country depending on salary levels and structure, and the entry requirements into teaching (Ladd, 2007; OECD, 2005; 2017). Teacher demand may vary based on the school-age population and student-teacher ratio (Ladd, 2007; OECD, 2005; 2017). As in the U.S., throughout the world shortages are common in cities and rural areas, and in math and science (Ladd, 2007).

In the U.S., there are perceptions of a widespread national shortage while research indicates teacher shortages are specific to certain subjects and schools. Part of the reason for the conflicting accounts is how "teacher shortage" is identified and the information used to assess it. Shortages can be influenced by a number of factors from the supply side (an increasing number of retirees, turnover and attrition, or a decline in enrollment in preparation programs) and the demand side (increasing student enrollment, reductions in class size, or the desire to re-staff schools to pre-recession levels). Many factors can influence the lack of alignment between the demand for, and availability of, teachers in Arkansas as well.

Motivation

The Arkansas Department of Education (ADE) reports statewide teacher shortage areas each school year. The ADE references the decline in the number of enrollees in education preparation

programs as particular cause for concern. However, a review of the number of education program "completers" over the past ten years suggests that the trend in program graduates has remained constant and is somewhat positive. It is possible that there could be a shortage in some regions and subjects but a surplus in others. I would expect there to be a surplus of teachers in the Northwest and a shortage of teachers in the Southeast, as well as a surplus of elementary teachers and shortage of math and science teachers. Furthermore, continuing to have persistent shortage areas over time suggests there may be an issue with the way in which shortages are being identified and/or the means by which they are addressed.

The state's primary strategy to address shortages has been to increase supply by increasing recruitment into education preparation programs and offering incentives such as bonuses and loan forgiveness. Arkansas should consider additional information when assessing teaching supply and demand, and defining shortages. In particular, information on the number of applications and vacancies, along with turnover and retention, should be collected at the district level rather than the state level. This would aid in identifying exactly where the need is and inform strategies to address that need. It is one thing to focus on increasing the overall supply of teachers, it is another thing to get teachers to where they are needed most. In this study, I identify the distribution of teacher supply and need at the district-level looking at the characteristics of districts in an effort to understand how the issue of teacher shortage might differ across different settings.

Study Purpose

This study focuses on the teacher quantity shortage rather than the teacher quality shortage. The purpose of this research is to test whether a uniform teacher shortage exists across the state of

Arkansas. If so, there should be similar numbers of vacancies in similar subjects across districts of varying sizes, urbanicity, and regional locations. I hypothesize that, rather than a uniform shortage, teacher shortages are more likely to occur in certain regions and subjects. I further examine whether there is a surplus of elementary and English/language arts teachers as the literature indicates. I expect to find more applications for elementary than middle or high school, and more for English/language arts than math and science teachers.

In this study, I conduct descriptive analyses of the teacher labor market in Arkansas to identify what the true level of need is statewide, and where shortages are actually occurring. Of particular interest is the teaching need and supply in districts with greater numbers of low income and minority students. Multivariate regression is used to identify the characteristics of districts with the greatest need and those with the most favorable teaching supply. The analysis includes data collected from semi-structured phone interviews, online surveys, and district administrative data which includes demographics, academic performance, and teacher salaries. In this study, I specifically address the following questions:

1. What are the characteristics of districts that have the most favorable teaching supply?
2. Does supply differ by school level or subject?
3. What are the characteristics of districts that have the greatest need for teachers?
4. Does need differ by school level or subject?

In this study, "supply" is defined as the ratio of applications to vacancies and "need"[1] is defined as the ratio of vacancies to full-time equivalent staff. This is the third study to use information on the teacher application pool to assess teacher shortages or identify teacher supply

[1] The term "need" is used interchangeably with "demand" throughout the paper.

and need in this way. The findings are intended to help inform recruiting and hiring practices of districts around the state and aid the Arkansas Department of Education in identifying which areas are in greatest need.

In Chapter 2, I review the literature related to the teacher labor market and teacher shortages in the U.S., and specifically in Arkansas. The data and methodology are discussed in Chapter 3. In Chapter 4, the results are presented first for supply and then need. Finally, a discussion of the findings, policy implications, and recommendations are provided in Chapter 5.

Chapter 2: Review of the Literature

There is widespread belief, fueled by ongoing media reports, of an impending teacher shortage crisis in the U.S. The phrase "teacher shortage" has increased in media coverage in the U.S. "from about 275 mentions in 2011 to 3,977 in 2016" (Dee & Goldhaber, 2017, p. 3). Teacher shortage reports often refer to the growing student population, looming teacher retirements of baby boomers, and decreasing enrollment in educator preparation programs as causes for concern. This impending crisis has been impending and a crisis for more than 30 years (Cross, 2016).

Critical to addressing the problem is clearly analyzing where shortages exist rather than incorrectly assuming there is a global or overall teacher shortage. Shortages can be influenced by a number of factors from the supply side (an increasing number of retirees, turnover and attrition, or a decline in enrollment in preparation programs) and the demand side (increasing student enrollment, reductions in class size, or the desire to re-staff schools to pre-recession levels) in the teacher labor market. Many factors can influence the lack of alignment between the demand for and availability of teachers. To better understand the issues and factors that contribute to the problem, in the next section I discuss the unique and important characteristics of teacher labor markets that affect the supply of and demand for teachers.[2]

[2] In researching the literature on teacher labor markets and teacher shortage, an initial database search included JSTOR, EBSCO, ERIC, Web of Science, and Google Scholar using the search terms "teacher shortage", "teacher labor market", "teacher supply and demand", "Arkansas teacher shortage", "Arkansas teacher labor market", and "Arkansas teacher supply and demand". From the sources found in these searches, additional sources were identified using their references.

Teacher Labor Market

There are several unique and important characteristics of teacher labor markets that affect the supply of and demand for teachers, including workforce demographics, the market's localized nature, competition from within and outside the sector, the compensation structure, and the options available to address shortages. The teacher labor market is different from other labor markets as it is highly unionized, based mostly in the public (non-profit) sector, and the workforce is predominantly female, white, with almost all having college degrees (Belfield, 2005; Loeb & Reininger, 2004). Additionally, the labor market for teachers does not respond to increases in the price of skill the way it does in non-teaching professions due to the salary structure (Eide et al., 2004), and compensation is not commensurate with college graduates in other fields (Konoske-Graf et al., 2016). Teacher salaries and alternative labor market options affect both the quantity and quality of the teacher workforce (Eide et al., 2004). Because there are limited opportunities to vary pay due to uniform salary schedules, teachers seek other benefits related to better working conditions (Belfield, 2005).

Another unique feature of the teacher labor market is that it is highly localized with hiring decisions largely made by school level leaders (Engel & Cannata, 2015). Geographic proximity matters both to prospective teachers and employers (Engel & Cannata, 2015). On the supply side, teachers make decisions about which districts and schools to apply to, and whether or not to take positions that are offered (Engel & Cannata, 2015). Research shows that teachers tend to seek and find jobs close to home, where they grew up, to their training institutions, and their student teaching placements (Boyd et al., 2005; Cannata, 2010; Engel & Cannata, 2015; Goldhaber et al., 2014; Krieg et al., 2016; Malatras et al., 2017; Podgursky, 2006; Reininger, 2012). On the demand side, district and school leaders decide who to make offers to among the

applicant pool and some districts have residency requirements (Engel & Cannata, 2015). However, there is little research on the process principals use to hire teachers (Engel & Cannata, 2015). It is unclear if shortages persist due to the decisions made by teachers or administrators (Engel et al., 2014; Hanushek et al., 2004). Shortages will further be influenced by variations in salary offered by competing districts in geographically constrained markets (Hanushek et al., 2004).

In the teacher labor market, school districts compete not only with each other but in dozens of labor markets including the private and nonprofit sectors (especially for math and science teachers) (Schug & Holohan, 2004). Shortages in some subjects and surpluses in others can be attributed to salary schedules, which set one salary for all teachers as if they had the same marketable skills and same opportunity costs, or other opportunities available in the working world (Schug & Holohan, 2004). Opportunity wages affect both entry and exit into the profession (Hanushek et al., 2004). Salaries specified by the salary schedule set both a price floor and a price ceiling. The price floor attracts those with fewer opportunities in other fields and more people into the field than there are positions (e.g. elementary teachers) (Schug & Holohan, 2004). The price ceiling discourages those from entering education who have better opportunities in other markets (e.g. math or technology teachers) (Schug & Holohan, 2004).

It is expected that labor markets that systematically pay below market rates to those with higher opportunity costs, those with alternative employment options, would have higher turnover (Schug & Holohan, 2004). The inability to reward individuals relative to their opportunity costs and skill is a constraint on the efficient use of teacher inputs (Belfield, 2005). Those with the highest opportunity costs outside of teaching are most likely to leave (Eide et al., 2004), and opportunity costs for teachers in different subjects differ substantially (Murnane & Steele, 2007).

Shortages will occur as those with greater opportunities find positions outside of education. Additionally, those in surplus areas will be shifted to shortage areas as administrators are forced to hire the readily available teachers from the surplus pool, resulting in a reduction in quality and, potentially, a mismatch of teacher training to the topics they are required to teach (Schug & Holohan, 2004). School districts often respond to shortages by filling positions with out of field or ineffective teachers rather than leaving them vacant (Murnane & Steele, 2007).

Teacher labor market equilibrium occurs when the number of teachers willing to teach is equal to the number of positions offered to these teachers by districts (Murnane & Steele, 2007). Supply and demand theory defines shortage as any imbalance between labor demand and supply – the inability to fill vacancies at current wages with individuals qualified for those positions (Ingersoll & May, 2011; Sutcher et al., 2016). To address shortages, supply needs to increase and/or demand needs to decrease. Districts can respond to shortages by any combination of recruiting more teachers, increasing class sizes, or reducing turnover and attrition.

Organizational theory suggests some employee turnover is good, however, high levels of turnover are both a cause and effect of ineffectiveness and low performance (Ingersoll, 2001; 2003). Although turnover in education is less than it is in many other industries (Bureau of Labor Statistics, 2018; Malatras et al., 2017; Papay, n.d.), there is no definitive benchmark on employee attrition across countries or professions in the U.S. (Behrstock-Sherratt, 2016). Yet the revolving door of teacher turnover is costly to districts, schools, and students in terms of money, time, school culture, and effectiveness. To expect there to be no vacancies or attrition is unrealistic. The question then is, what level of shortage is acceptable or expected? There is no definitive answer. Despite the fact that we will never know the optimal level of teacher turnover,

it remains worthwhile to examine the extent to which turnover and teacher demand varies across different types of districts.

Teacher Shortages

The national policy debate on whether a national teacher shortage exists is muddled by the variation in reporting. There may well be areas of teacher shortage across the country, but to refer to it as a national shortage seems incorrect. Some researchers find support for a universal shortage while others find evidence that teacher shortages are specific to certain subjects and schools. Part of the reason for these conflicting reports is how shortage is being identified and what information is being used to assess it.

Universal Shortage?

There is evidence suggesting that teacher shortages are widespread nationally. Both insufficient supply and excess demand drive the discussion. Insufficient teacher supply is supported by the fact that fewer high school graduates appear to be interested in education as a major and fewer college students are interested in careers in teaching (Aragon, 2016; USDOE, 2015). Additionally, many educator preparation programs have seen declining enrollments in the last decade (Malatras et al., 2017; Sutcher et al., 2016). Specifically, teacher preparation program enrollments have declined by a third and program graduates have declined by almost a quarter, between 2009 and 2014 (Sutcher et al., 2016).

Rather than insufficient supply, some researchers argue that teacher shortages are driven by excess demand caused by attrition (leavers) and turnover (movers) (Ingersoll, 2001). While retirements account for a small proportion of total turnover, about half of turnover is attributed to teachers transferring or moving to other schools (Ingersoll, 2001; 2003). Regardless of the

reason, movers and leavers have the same effect at the school level - decreasing staff that needs to be replaced (Ingersoll, 2003). Shortages result when the demand increases due to large numbers of teachers leaving (Ingersoll, 2001). Research indicates that the rate of teacher turnover has historically been higher than turnover in many other occupations such as nursing, which is also predominantly female with persistent staffing problems (Ingersoll, 2001; 2002; 2003).

However, teacher turnover is not the only driver of demand. Teacher demand is driven by student enrollment, class size policy, fiscal capacity, and wage level as well (Murnane & Steele, 2007). The number of new teacher hires is estimated to increase by 29% between 2011 and 2022 to meet growing student enrollments (Hussar & Bailey, 2014). Class size reductions further increase the demand for new teachers (Ingersoll, 2003), as do the efforts of districts to return to pre-recession staffing levels (Sutcher et al., 2016). Shrinking teacher supply and growing teacher demand along with the "revolving door" problem contribute to a state of perpetual shortage (Russell, 2005; Sutcher et al., 2016). The research related to the factors of supply and demand suggest a widespread national shortage.

Localized Shortages?

Contrary to the research supporting a universal teacher shortage nationally, other researchers find evidence that there is no global or overall teacher shortage, but instead a shortage of teachers in certain subjects and locales experienced by every state. In fact, there is evidence there are more than enough teachers produced annually and the demand related to turnover has remained steady. Sufficient supply is supported by the steady increase in the number of new teacher candidates since the 1980s (Cowan et al., 2016; Dee & Goldhaber, 2017; Ingersoll, 2003; Russell, 2005). Even though only about half of teachers who complete preparation programs are hired in public

schools in a typical year, the supply of new teacher graduates exceeds the number of new hires nationally (Cowan et al., 2016; Dee & Goldhaber, 2017; Ingersoll, 2003). In addition, the "reserve pool", which includes delayed entrants and former teachers who left but later return, also contributes to overall supply (Ingersoll, 2003; Murnane & Steele, 2007).

Regarding teacher demand, studies find teacher turnover rates have improved and been fairly stable since 2004-05 with a 5-year attrition rate of about 17%, and half of those expected to return (Di Carlo, 2015; Raue & Gray, 2015). More recent research indicates the rate of turnover in education is improving and is less than in other industries (Bureau of Labor Statistics, 2018; Malatras et al., 2017; Papay, n.d.), with reports of fewer teacher shortages in 2011-12 than in 1999-00 (Aragon, 2016; Hussar & Bailey, 2014).

Rather than a universal national shortage, teacher shortages are specific to grades or subjects, districts, schools, or geographic regions (Dee & Goldhaber, 2017; Murnane & Steele, 2007; Murphy et al., 2003). Shortages are typically concentrated in urban and rural districts, districts serving economically disadvantaged students, and districts with large numbers of minority students (Dee & Goldhaber, 2017; Ingersoll, 2001; Malatras et al., 2017; Murphy et al., 2003). Additionally, there have been annual shortages in special education, science, and English as a second language (ESL) in almost every state since 1990 (Cross, 2016; Malatras et al., 2017; Sutcher et al., 2016; Weiss, 2018). As shortages are unevenly distributed across schools and districts, it appears incorrect to assume there is an overall universal teacher shortage.

Identification and Assessment Challenges

Part of the confusion related to this policy debate can be explained by the information being used and how teacher shortage is being identified. In terms of supply, there are differences when using education program enrollee, candidate, or graduate data. The number of students reported as enrolled in education programs will differ depending on whether that information is based on students who have applied and been accepted to education programs or on those who have declared education as their major. Additionally, candidates may have completed the requirements of licensure but not yet graduated. If supply reflects the number of individuals willing and able to teach (Behrstock-Sherratt, 2016), a surplus of teachers being trained does not mean there are enough graduates produced for each field (Ingersoll, 2003). In other words, the aggregate number of teachers is not as important as the number of teachers per field and geographic area. Furthermore, teacher recruitment will not solve staffing problems if issues related to teacher retention are not addressed (Ingersoll, 2001).

In terms of demand, if demand represents the number of teachers a district wishes to employ (Behrstock-Sherratt, 2016), vacancy information is useful to collect. How a district defines a vacant position and when that information is reported will matter. A vacant position could be any position filled by a new teacher, and include teacher movement within schools. Or a vacant position might only include positions that are advertised, or those left unfilled. Moreover, vacancy rates will differ depending on whether that information is collected before the end of a school year, over the summer, or at the start of the following school year. Districts can define vacancies very differently (Barnum, 2018) and some states like Arizona and Indiana do not even track teacher vacancies (Will, 2016). What's more, it is unclear how many unfilled

teaching positions or long-term substitutes are employed by districts at the start of the school year (Murnane & Steele, 2007; Murphy et al., 2003).

Further adding to the confusion is the fact that "teacher shortage" is not clearly or consistently identified or assessed, and can be indicated by a variety of factors. Determinations of teacher shortages may be based solely on evaluations of decreasing supply, indications of increasing demand, or differences between supply and demand. Estimates for supply could be based on the number of teacher preparation program students enrolled, new teacher certifications, the number of anticipated retirees, the number of unemployed certified teachers, or the number of applications per vacancy (Behrstock-Sherratt, 2016; Lindsay et al., 2016). Assessments of demand might be derived from the number of vacancies a district has, the number of vacancies to full-time teaching staff, the number of teachers needed to maintain student-teacher ratios, the number of emergency credentials, or the number of teachers leaving the profession (Behrstock-Sherratt, 2016; Lindsay et al., 2016). The methods used to examine teacher supply and demand depend on the questions being asked and the available data sources (Lindsay et al., 2016). Data on vacancies is not readily available and application data is not usually collected at all.

The U.S. Department of Education (Cross, 2016) provides some guidance by defining a "teacher shortage area" as a specific grade, subject, or geographic area in which the state determines there is an inadequate supply of elementary or secondary school teachers. In determining shortage areas, unfilled positions, positions filled by alternative, temporary, or emergency certification, and positions filled by teachers teaching out of their field of preparation are all included (Cross, 2016, p. 3). This definition for teacher shortage focuses more on unmet demand and leaves the determination of adequate supply to the State to define. Even with this

guidance, it is not clear what evidence constitutes a shortage (Dee & Goldhaber, 2017). Depending on the information being used to measure teacher shortages, research outcomes and reporting on the issue will vary. For example, if we count program graduates, this approach leads to a very high number in the supply category and would lead researchers to say that there is no shortage. However, if instead we only count applicants for open positions, this approach would lead to a lower number and thus we would be more likely to find shortages.

Distribution Considerations

In addition to looking at the quantity of teaching need, the distribution of teaching need should be considered as well (Murphy et al., 2003; Russell, 2005). Teachers have historically been inequitably sorted across schools with less-qualified teachers in high-poverty, high-minority, and low-performing schools (Hanushek et al., 2004; Loeb & Reininger, 2004; Murnane & Steele, 2007). High-poverty schools have higher turnover rates than affluent schools (Ingersoll, 2001; Malatras et al., 2017). There are higher turnover rates in schools with higher proportions of minority students (Loeb & Reininger, 2004). Urban schools have more turnover than rural or suburban schools (Ingersoll, 2002). Southern and western states also tend to have greater teacher shortages (Murphy et al., 2003). As the nation's population has grown more diverse, the demographic composition of the teacher workforce has remained predominantly white and less diverse (Ingersoll & May, 2011; Konoske-Graf et al., 2016; Murnane & Steele, 2007; Murphy et al., 2003).

Not only should we consider the inequitable distribution of teachers by geographic area, the distribution of teachers by content areas should also be examined. The demand for STEM (science, technology, engineering, and math) and special education teachers is and has been greater than that for elementary, English, and social studies teachers (Cowan et al., 2016). In

fact, National Center for Education Statistics data indicates there have been annual shortages since 1990 (NCES) in special education, science, and ESL in almost every state (Hussar & Bailey, 2014; Malatras et al., 2017). Meanwhile, education programs in many states are overproducing candidates in low-demand subjects (Aragon, 2016; Behrstock-Sherratt, 2016).

Effect on Teacher Quality

In addition to the distribution of teaching need, the impact teacher shortages have on the quality of teachers should also be taken into account. Sutcher et al. (2016) note that there are currently not enough qualified applicants for teaching positions to meet the demand in all locations and fields. Thousands of teachers were hired on emergency or temporary credentials in 2015 and 2016 (Sutcher et al., 2016), and considering the number of teachers teaching out of field, there may be more of a teacher quality shortage than a teacher quantity shortage (Murphy et al., 2003), particularly in math, science, special education, and ESL. Although there is not much evidence that teacher certification matters, it may matter more for these areas of chronic teacher shortage (Goldhaber, 2002; Maranto & McShane, 2012; Wayne & Youngs, 2003). Teacher shortages force school systems to lower certification standards (Stotsky, 2015) or hire under-qualified individuals to fill openings resulting in lower school performance (Ingersoll, 2003). In addition, the localized nature of hiring may exacerbate the unequal distribution of teachers across schools (Engel & Cannata, 2015). Attracting high quality applicants will require the profession to differentiate the pay structure, offer incentives, and/or improve workplace conditions.

Possible Remedies

Much of the research related to the teacher labor market tends to focus on the characteristics and policy levers associated with influencing teacher supply, in particular, focusing on how supply can be maximized through greater recruitment and demand reduced through increased retention. Faced with teacher shortages, schools and districts can respond by increasing class sizes, re-allocating specialized/support staff, assigning teachers from other fields, hiring uncredentialed teachers or substitutes, or canceling classes (Barnum, 2018). All of these options may reduce (or enhance) teacher quality and negatively (or positively) impact student achievement and success.

To alleviate teacher shortages, the primary strategy has been to increase the supply of new teachers into (or back to) the profession. These efforts include recruiting more teachers into education programs and alternative certification programs (Dee & Goldhaber, 2017; Malatras et al., 2017; Podgursky, 2016), initiating "grow your own" approaches (Yaffe, 2016), providing easier licensing reciprocation between states (Dee & Goldhaber, 2017; Eide et al., 2004), hiring earlier (Dee & Goldhaber, 2017), offering incentives (e.g. signing bonus, loan forgiveness), and increasing compensation (Hanushek et al., 2004; Murnane & Steele, 2007). Increasing compensation through universal pay increases is often discussed but is not likely to be very effective or cost-efficient (Dee & Goldhaber, 2017; Podgursky, 2006), and potentially could increase the retention of both high- and low-quality teachers (Hanushek et al., 2004).

Yet efforts focused only on recruitment fail to address retention issues (Aragon, 2016). "Pouring more water into the bucket will not be the answer if the holes are not first patched" (Ingersoll, 2003, p.17). As the main reasons for teacher attrition have to do with job dissatisfaction related to compensation, preparation, lack of support, and working conditions (Ingersoll, 2001; Ingersoll & May, 2011; Malatras et al., 2017; Sutcher et al., 2016), these issues

must be addressed as well. Policies targeted to address attrition and turnover have included implementing mentorship/induction programs (Konoske-Graf et al., 2016), improving workplace conditions (e.g. facilities, materials) (Belfield, 2005), and providing more opportunities for advancement (Aragon, 2016; Malatras et al., 2017). Purposeful student teaching placement could further influence the distribution of teacher quality across districts by giving schools and districts an early look at prospective teachers and connecting hard-to-staff schools with highly qualified candidates (Goldhaber et al., 2014; Krieg et al., 2016; Maier & Youngs, 2009). In combination, these strategies may induce teachers to stay and/or attract more, better teachers.

The evidence supports a "national" teacher shortage if one considers it to be a shortage of teachers in certain subjects and locales experienced by every state rather than a universal shortage of teachers in all grades and subjects. It appears there is enough overall supply to meet demand (Weiss, 2018), however, the misconception that the overall supply of teachers needs to increase persists (Cowan et al., 2016). The specific type and nature of teacher shortage areas, specifically looking at the mismatch between the areas of need and the fields of the teachers being produced, is needed to better inform policy responses (Cowan et al., 2016; Weiss, 2018). As the teacher labor market tends to be local (Engel & Cannata, 2015; Podgursky, 2006), it is important to examine shortages at the local level rather than at a national level. How the problem is identified will inform policy recommendations and suggested remedies.

Arkansas Teacher Shortages

Turning to the local context of this study, I examine the issue of teacher shortages in Arkansas. The Arkansas Department of Education (Pfeffer & Servedio, 2015) uses its own supply and demand formula to identify shortage areas. Teacher supply focuses on the pipeline of incoming

teachers and uses the number of students enrolled in educator preparation programs[3] as well as the number of first time licenses issued (Pfeffer & Servedio, 2015). Using 2015 data, the most recent Arkansas Educator Preparation Performance Report indicates greater decreases in the number of program enrollees than program completers, with 36.3% fewer teachers enrolled in traditional and alternative education programs (ADE, 2016b; 2017a). For demand, the ADE uses the number of classes taught by long-term substitutes or teachers out of their area of licensure, and the number of teachers who retired in the previous year or who have the potential to retire in the near future (Pfeffer & Servedio, 2015). Shortage area scores are calculated, based on the supply and need factors, and shortage areas identified if the score for need is greater than supply (Pfeffer & Servedio, 2015). The following critical academic shortage areas have been identified for the 2016-17 school year: agriculture science and technology, art, computer science, family and consumer science, French, library media, mathematics, physical science (chemistry, physics), Spanish, and special education (ADE, 2016a; Cross, 2016; Pfeffer & Servedio, 2015).

I have concerns that this methodology for identifying teacher shortages does not make use of all the relevant information affecting both supply and demand. For supply, the ADE should consider using the number of education program completers, which more accurately reflects those able to fill vacant positions, rather than focusing on the number of program enrollees, which can fluctuate depending on when and what information is being used. For demand, student enrollment rates and teacher turnover should be included as well. In particular, demand calculations appear only to account for teacher replacement and do not factor in growing enrollments (Pfeffer & Servedio, 2015). Student enrollment in public elementary and secondary schools in Arkansas is projected to increase by 1.6% by 2022, with most of the growth expected

[3] Educator preparation programs include both traditional and alternative certification routes.

in grades 9-12 (Hussar & Bailey, 2014). Between 2004-05 and 2014-15, student enrollment in the state grew by 4.5% while the total number of certified teachers employed grew by 3.4% (ADE, 2016b). Without factoring in growing enrollments, teacher need will remain higher than estimated. In addition, non-retirement attrition and turnover are not factored into demand, even though approximately 15% of teachers leave the profession after the first year, 31% after three years, and 36% after five years (ADE, 2016b).[4]

Arkansas reflects trends seen at the national level. As with the rest of the nation, not all education program graduates in Arkansas receive a teaching license or actually end up teaching (Office for Education Policy, 2005). The number of teachers produced each year falls short of the number hired in Arkansas public schools (ADE, 2017a). Of those enrolled in education programs, only 63% were preparing for licenses in critical shortage areas (ADE, 2016b). The biggest factor contributing to teacher shortages in Arkansas appears to be teachers teaching out of their licensure area, leaving the state, or not teaching at all (Office for Education Policy, 2005). Furthermore, teachers seem to be concentrated in urban areas or college towns around the state, near to where they received their training (Barnett & Blankenship, 2005).

Policies implemented to address teacher shortages in the state are primarily focused on attracting teachers (increasing supply) rather than retaining teachers (decreasing demand). Most superintendents believe greater resources (funds) are needed to attract highly-qualified teachers (Barnett & Blankenship, 2005). As some schools are more concerned with filling vacancies than with the quality of the candidates, with administrators finding themselves in the position to have to hire whoever applies, focusing on increasing (and possibly redistributing) the teaching supply

[4] District level retention does not factor in teacher movement between schools within a district (ADE, 2016b).

in the state makes sense (Maranto & Shuls, 2012). Incentives to attract teachers to critical shortage areas have included grants and student loan forgiveness programs (ADE, 2016b; Office for Education Policy, 2005). Additional incentives are offered to draw teachers to hard-to-staff areas and can include moving expenses for particular regions (geographic areas), bonuses for working in high-priority districts, and bonuses for teaching in STEM fields (ADE, 2016b). However, new strategies to address teacher retention are identified as part of Arkansas' Every Student Succeeds Act Plan (ADE, 2017b). These strategies include providing advanced licensure levels to retain effective teachers and personalized mentoring support related to the teacher evaluation system (ADE, 2017b; Howell, 2017).

Literature Review

As this study focuses on the teacher labor market in Arkansas, I review other state studies on teacher supply and demand to examine how they have evaluated and reported this information. I began with the state evaluations included in the works by Aldeman (2018) and Behrstock-Sherratt (2016), which provided 19 state reports. Next, I conducted a Google search for each of the remaining U.S. states using each state's name, "teacher supply and demand" or "teacher shortage", and ".gov" to find any other reports generated by states. This search yielded eight additional states for a total of 27 state reports addressing teacher supply, demand, supply and demand, and/or shortages. A summary of these reports is presented in Table 1.

I find a lot of variation in the focus and information used by states to examine teacher supply and demand. One state focused only on the supply side (New York), two states focused only on the demand side (Alaska and Nebraska), and only 16 of the 27 states specifically discussed teacher shortage areas. To examine teacher supply, most states used information on education program participants (enrollees, candidates, or completers), teacher certification, new

Table 1: State Reports of Teacher Supply and Demand (Alaska–Delaware)

Author(s)	Year	State	Information Used for Supply	Information Used for Demand	Teacher Shortage Areas	Report Findings
Hill & Hirshberg	2013	Alaska		Turnover rates		Turnover has declined slightly but not significantly; annual turnover rates vary widely among rural districts (7-52%); less turnover of teachers with <10yr experience if trained in state; 80% who leave, leave school system entirely; 64% of teachers hired from outside state
Pfeffer & Servedio	2015	Arkansas	Ed program enrollment, newly licensed, license areas	Long-term substitutes, out of field assignments, retirements, projected retirements	Math, science, SPED, computer science, foreign language, art, ag science, consumer science	About 10% expected retirement, more licenses in non-shortage areas
Suckow & Lau	2017	California	New teacher credentials, ed program enrollment, alt cert enrollment	Estimated teacher hires, waivers issued		Increase in initial teaching credentials; increase in number of teaching permits has decreased number of fully-credentialed teachers (by 1%)
Reichardt et al.	2003	Colorado	Information on existing workforce, new hires, attrition	Enrollment and growth rates, teacher retirement, attrition, transfer rates, ratio of school-age-population-to-teachers by county (similar to a pupil-teacher ratio)	Foreign language, SPED	Enrollment increasing but varies by region; number of teachers increasing faster than enrollment; retirement increasing but attrition steady (11% leavers, 11% movers)
Connecticut State Dept. of Education	2012	Connecticut	Total number of certified positions (past 5 yrs), median number of **applicants,** teacher certification	**Vacancies** - total number of available positions (past 5 yrs), unfilled positions, long-term substitutes	Bilingual, SPED, math, science, speech/language, foreign language	Shortage areas fairly consistent; little change in total number of positions, vacancies; number of vacancies declined somewhat but median number of applicants per position increased
Sherretz et al.	2013	Delaware	New hires and attrition	Attrition, **vacancies**, retirement projections	Foreign language, HS math & science	Teacher hires decreased but hiring occurring earlier; 41% hired are new to teaching; increase in teachers leaving with 7% of teachers expected to retire

Table 1: State Reports of Teacher Supply and Demand (Continued – Florida-Kentucky)

Author(s)	Year	State	Information Used for Supply	Information Used for Demand	Teacher Shortage Areas	Report Findings
Office of Economic and Demographic Research	2000	Florida	Estimated at state level - education program graduates, percentage of graduates from other fields who have entered teaching, and state transfers (assumes no change in relative wages or non-pecuniary factors)	Estimated at county level - enrollment growth, replacement for leavers (assumes no change in class sizes)	Elementary, SPED	State supplies 60% of education program grads, remaining teachers come from out of state; demand appears constant due to increasing retirment and declining enrollment
Stephens et al.	2015	Georgia	Education program completers, alt cert completers, new hires, retention rates, returning to service (reserve pool), attrition	Attrition, mobility, hiring from reserve pool, enrollment, attrition, policy changes		Enrollments increasing; 13% of new teachers leave after 1yr, 44% after 5yrs; HS teacher attrition highest especially in math, foreign language, science; attrition higher in high poverty schools; 25-30% of new teacher hiring from reserve pool; number of ed program completers declining; alt cert and out of state hiring increased
Linder & McHugh	2017	Idaho	Education program completers, teacher certification, attrition	Attrition		33% of teachers licensed annually do not teach; attrition steady at 10% (8% nationally); 76% of attrition due to leavers
Meeks & Koch	2014	Illinois	Retention from previous year, newly certified, re-entering personnel, education program enrollees and completers	Enrollments, unfilled positions	Speech/language, bilingual, Chicago	Retention rates remain high (92.7%); increase in number of certificates issued; decrease in number of re-entries; pipeline indicates "fairly robust" supply; enrollment declining; workforce decreasing
Hicks, M.J.	2015	Indiana	Education program graduates, attrition	Enrollment, turnover, retirement	STEM, SPED	Demand is static or declining with low turnover; excess supply; low attrition (17%)
Ford Seiler et al.	2012	Kentucky	Education program completers, teacher certification, new hires, retention, attrition	Attrition and mobility rates, enrollment, unfilled positions, emergency certification	HS science, ELL	Teacher shortages declining (unfilled and emergency cert are <0.5%); emergency cert decreasing while alt cert increasing (1/5 of new teadhers); education degree areas disproportionate to demand

Table 1: State Reports of Teacher Supply and Demand (Continued – Maryland-New Hampshire)

Author(s)	Year	State	Information Used for Supply	Information Used for Demand	Teacher Shortage Areas	Report Findings
Maryland State Dept. of Education	2017	Maryland	New hires, teacher attrition, projected education program graduates, candidates, and enrollees, retired/rehired	School age population, enrollment, attrition	ELL, foreign language, math, science	Enrollment declined; teacher-student ratio steady; attrition increased (7%) at/below nation; early career retention improved; ed program grads is constant (though enrollment decreasing); conditional certifications decreased
Levin et al.	2015	Massachusetts	New hires, transfers, retention	Enrollment, teacher-student ratios		Enrollment decreasing; slower expected rate of decline in supply (<2%) leading to eventual surplus; new teachers decreased but teacher transfers (across districts, out of state) increased
Nguyen & Onstad	2017	Minnesota	New licenses, transfers, retention from previous year, returning to service, attrition	Enrollment, teacher-student ratios, attrition, **vacancies**		Increase in number of full-time teachers; enrollment increased; retirements increased; 15% leave after 1 yr, 26% after 3 yrs
Katnik, P.	2017	Missouri	Teacher certification	Enrollment and attrition based on national data, unfilled positions	SPED, elementary, speech/language, math, science, ELL, foreign language	Initial certifications decreasing; teaching assignments increasing due to increasing enrollment; shortages in certain subjects and geographic areas
Watson et al.	2017	Montana	Education program graduates	Projected ed workforce supply-demand gap		Oversupply of elementary and MS teachers; undersupply of HS teachers and counselors
Nebraska Dept. of Education	2018	Nebraska		Enrollment, unfilled positions	ELA, science, SPED, speech/language, foreign language	Most unfilled positions in the SE (27%) and largest districts (>10,000); main reasons for unfilled positions - no appplicants, no qualified applicants
Cook Smith & Mackin	2006	New Hampshire	Education program completers, teacher certification, attrition	Attrition	Math and science, SPED	Workforce relatively stable; more novice teachers; most new teachers come from state programs; increases in alt cert; supply appears to be adequate in elementary and social studies though few seeking credentials in critical need areas

Table 1: State Reports of Teacher Supply and Demand (Continued – New York-South Carolina)

Author(s)	Year	State	Information Used for Supply	Information Used for Demand	Teacher Shortage Areas	Report Findings
Engage NY	2013	New York	Education program completers (not those already working as teachers), alt cert		Bilingual, ELL, foreign language, math, reading, science, SPED	Decrease in ed program completers; decrease in new teachers hired; most new hires in charters; half of completers in elementary
Zagorsky et al.	2013	Ohio	New teacher license holders	Enrollment, **reduced FTE**, retirement, posted **vacancies**		Fewer teachers needed due to declining birth rates; high levels of retirement will continue but level off; over 25% of new teachers licensed in early childhood or P-3, few in math & science; 1/6 with ed degrees never licensed
Berg-Jacobson & Levin	2015	Oklahoma	Education program completers, certification areas	Enrollment, teacher-student ratio, teacher mobility	ELA, social studies, science; HS more than MS	Ed program completers most commonly elementary, early childhood, ELA; alt certs declined while emergency certs increased; out of state hires constant; reserve pool has increased; leavers have increased; expect completers to decline; demand expected to grow minimally (due to enrollment and teacher-student ratio increases); supply expected to vary by region
Oregon Dept. of Education	2015	Oregon	Education program completers, first time licenses	Job postings, hiring fairs, provisional licenses	Varies by subject, region	Decrease in ed program completers but increase in first-time licenses (attributed to out of state) has led to surplus; low rate of provisional licenses
Garrett, J.	2018	South Carolina	New teachers entering, attrition	Attrition, unfilled positions		Increasing vacancies and departures; decreasing hires from ed programs (-25%); increasing hires from alt cert and out of state; increase in unfilled positions; attrition and movers about same; 22% leavers are first year teachers

Table 1: State Reports of Teacher Supply and Demand (Continued – Tennessee-Wisconsin)

Author(s)	Year	State	Information Used for Supply	Information Used for Demand	Teacher Shortage Areas	Report Findings
Bruce et al.	2009	Tennessee	Retention, attrition, reserve pool	Enrollment and teacher-student ratio (by grade groups - K-3, 4-8, 9-12, per LEA), mobility, attrition	ELL, music/art, grade 8, vocational	Teachers with higher salaries more likely to stay; teachers with less than Master's degree more likely to stay; more experienced teachers less likely to move but more likely to leave (retirement); enrollments expected to grow
Chastain et al.	2017	Washington	Education program graduates, attrition	Enrollment, K-3 class size reduction policy, emergency certification, out of field assignments, attrition		Emergency certification increasing; out of field teaching mostly decreasing but still high in math, science, ELA, elementary; full-day kindergarten and K-3 class size reduction drives elementary need; enrollment increasing; ed program graduates decreasing, yet number of novice teachers increasing
Goff et al.	2018	Wisconsin	Education program completers and enrollees, average number of **applicants** for each vacancy classification rank ordered, applicant origin, attrition	**Vacancies**, emergency credentials, mobility, attrition, duration on job market		High attrition among low-supply positions; there are 2 external appicants for every 1 internal applicant for most positions, but more 1:1 for low-supply positions; increase in emergency credentials (even with high-supply positions)

hires, and retention. To assess teacher demand, information on teacher turnover, attrition, and student enrollments were used most.

Of the 27 states, only Connecticut and Wisconsin included applicant information in their measurement of teacher supply. Wisconsin used the average number of applicants for each vacancy classification and then rank ordered positions as low-, medium-, and high- supply (Goff et al., 2018). Additionally they examine mobility and attrition across the supply categories, and the origin of applicants (whether internal - from within the state, or external - from outside the state). Four states incorporated vacancy information (Delaware, Minnesota, Ohio, and Wisconsin) as part of the evaluation of teacher demand, and only Ohio used full-time equivalent (FTE) teaching position information as well. These exceptional cases are noted in the tables in red font. Delaware used vacancy information to understand when positions were advertised and how many were filled internally (Sherretz et al., 2013), and Minnesota identified unfilled positions with their vacancy information (Nguyen & Onstad, 2017). In Ohio, vacancies are used to track changes in employment trends and FTE is used to track the reduction in the number of teaching positions each year (Zagorsky et al., 2013). Wisconsin used vacancy information to determine the three supply classifications (Goff et al., 2018).

Findings from these state reports indicate a lot of variation in their scope and outcomes for supply and demand. Several states found decreases in education program completers (Georgia, New York, Oklahoma, Oregon, Washington) and Maryland found the supply of program graduates to be constant. Maryland found increasing attrition, while Indiana found attrition to be decreasing, and Colorado and South Carolina found attrition to be steady. However, with regard to teacher shortage areas, there do appear to be some consistent trends. Among the states that evaluated teacher shortages, there appear to be consistent shortages in

math, science, SPED, ELL, and foreign language. The variation in supply and demand reported by states and the relative consistency of teacher shortage subject areas across states aligns with the research previously discussed.

Purpose of the Study

This study focuses on the teacher quantity shortage rather than the teacher quality shortage, but economic theory suggests that shortages can lead to decreases in quality, and this appears to be the case in the teacher labor market. The purpose of this research is to test whether a uniform teacher shortage exists across the state of Arkansas. I hypothesize that, rather than a uniform shortage, teacher shortages are more likely to occur in certain regions and subjects. In addition, I descriptively present the characteristics of districts with the most favorable teaching supply and those with the greatest teaching need. The findings are intended to help inform recruiting and hiring practices of districts around the state and aid the Arkansas Department of Education in identifying which areas are in greatest need. Examining the quality of the teacher pipeline in Arkansas is a future extension of this research.

Contribution to the Literature

This research contributes to the literature on teacher shortages in two distinct ways. First, I examine teacher supply and demand at the district level by grade and subject using information collected from school districts on the number of vacancies and accompanying applications. Secondly, I define supply and demand (need) differently. In this study, "supply" is defined as the ratio of applications to vacancies and "need" is defined as the ratio of vacancies to full-time equivalent certified classroom teachers. This is the third study to use application information to identify teacher supply and the first to examine teacher need and shortages in this way.

Chapter 3: Methods

In this study, I conduct descriptive analyses of the teacher labor market in Arkansas to identify what the true level of need is statewide and where shortages are actually occurring, using collected data along with administrative data. I use multivariate regression to identify the characteristics of districts with the greatest need and those with the most favorable teaching supply. In this chapter, I present the data and methods used in detail, describe the analytic sample, and discuss the limitations.

The research questions I aim to answer about teacher supply and need in Arkansas include:

1. What are the characteristics of districts that have the most favorable teaching supply?
2. Does supply differ by school level or subject?
3. What are the characteristics of districts that have the greatest need for teachers?
4. Does need differ by school level or subject?

Data

Sources of data for this study include interviews with district superintendents, an online survey given to all districts to identify the number of vacancies and applications for grade and subject level positions, and state administrative data on district enrollment, demographics, academic achievement, and finances.

Interviews

As a first step in developing the online survey, I conducted semi-structured interviews with district superintendents from across the state to begin to identify the level of teacher need

statewide, where shortages or surpluses may be occurring, and how that need is being met. In an effort to gather information from districts in a variety of settings, I purposefully selected districts based on location (and somewhat on size). Seventeen districts were identified, of which eight agreed to participate in interviews. Of the eight superintendents, two were from districts located in the Northwest, four from the Central region, one from the Southwest, and two from the Southeast. Two of the eight were superintendents of charter organizations. Interviews were semi-structured and all but one was conducted over the phone in February and March 2017. Interview questions specifically asked about the numbers of vacancies and applications by grade and/or subjects, teacher attrition and movement, and hiring practices. The interview protocol can be found in Appendix L and interview questions in Appendix M. From the interview process and responses, I refined questions for the online survey to be sent out to all districts.

Online Survey

Through this survey, I aimed to gather information on the level of teacher need statewide and where shortages or surpluses may be occurring. Informed by my discussions with superintendents, I developed the online survey to ask the appropriate questions that district human resource representatives could feasibly answer.[5] The survey specifically asked about the

[5] Three different surveys were created based on district size (small, midsize, and large) to accommodate the variation in range of possible responses. For example, when asking about the number of applicants per school level and subject (i.e. number of middle school math and science position applicants) small districts were provided a survey with a 0-50 range for responses while large districts were provided a survey with a 0-200 range for responses. The same questions were asked in each of the surveys. The only difference between the surveys was the number ranges provided for responses. "Small" districts were identified as those with student enrollments less than 1,500 students, "Midsize" districts included those with student enrollments between 1,500–3,500 students, and "Large" districts were those with student enrollments greater than 3,500. In addition to providing a more tailored survey to districts of varying sizes, this also allowed me to monitor response rates by district size to ensure

number of vacancies by grade level and subjects, the number of applications for those vacancies, whether all vacancies were filled and how that need was met for unfilled positions, recruitment strategies, sources for new hires, teacher preparation program partnerships, incentives, and reasons for attrition. Of particular interest for this study are the responses regarding the number of vacancies and applications as this information is directly tied to the way in which I define and measure teacher supply and demand (need). I define teacher supply as the ratio of applications to vacancies and teacher need as the ratio of vacancies to full-time equivalent classroom positions. Survey instruments can be found in Appendix M.

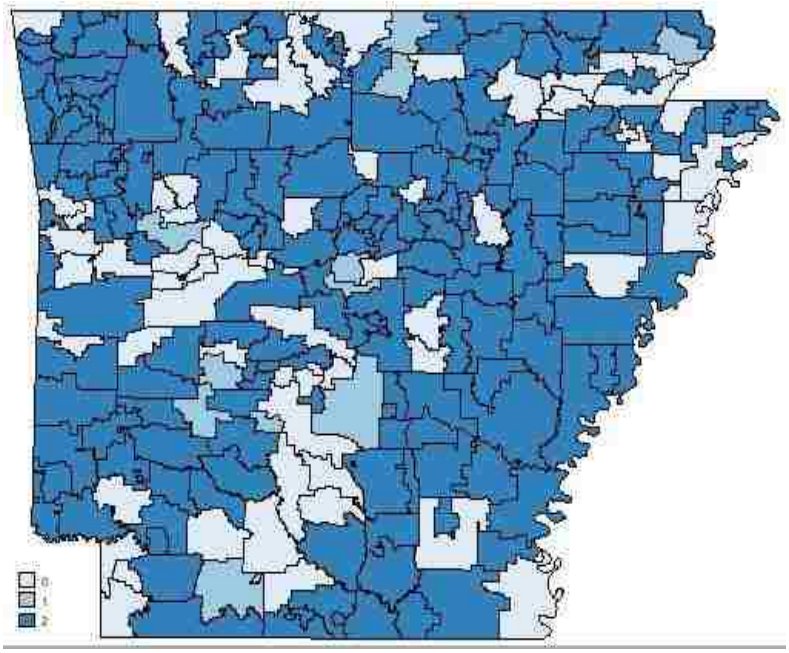
I emailed surveys to every district in April 2017 and collected them through early June 2017. Paper versions of the surveys were available but never requested. Email reminders and requests were sent weekly and personal phone calls made to districts June 1-2, 2017. Of the 262 districts surveyed, the overall response rate was 74.4%. Table 2 shows response rates by district size. Figure 1 displays which districts around the state responded to the survey.

Table 2: Survey Response Rates

	Survey Type				
	Small	Midsize	Large	Short	Total
N of Districts	179	53	30	104	262
N of Responses	106	32	20	37	195
Response Rate	59.2%	60.4%	66.7%	35.6%	74.4%

Note: A shorter survey was created and sent to the 104 districts that had not completed the survey by the initial deadline.

representative participation. A shorter/condensed survey was also created in the last two weeks of data collection to induce more districts to respond.



Notes: 0 = No survey; 1= Incomplete survey; 2= Completed survey.
Does not include/reflect charter school districts. (Source: U.S. Census Bureau, 2016)

Figure 1: Map of Arkansas School District Respondents

Administrative Data

From the Office for Education Policy (OEP) website at the University of Arkansas, I downloaded and compiled district administrative data in May 2017. Data collected from this site included: information on enrollment and demographics (race/ethnicity, free and reduced price lunch (FRL) status) for school years 2012-13 through 2016-17; educational success information (ACT Aspire data for school years 2015-16 and 2016-17, Grade 11 ACT data for school years 2015-16 and 2016-17, graduation rate for school years 2014-15 and 2015-16); and the most recent district finance data available (for teacher salary, FTE classroom positions for the 2015-16 school year). The OEP also provided de-identified information on teacher assignments by school to create estimates of school level and subject FTE. From the National Center for Education Statistics, I downloaded the most recent urbanicity designation information (2014-15) in August

2017. Information on the state education regions (used by the OEP) comes from the Arkansas Association of Educational Administrators.

Analytic Sample

With any analysis using self-reported data, there will be concerns of response bias. How representative of the state as a whole are the districts that responded to the survey? Are the districts that responded different from those that did not respond? Overall, it appears the districts included in the sample are representative of districts statewide. In Tables 3 and 4, I examine the characteristics of districts that responded to the survey relative to all districts in the state on the variables of interest and, in Tables 5 and 6, I compare districts that responded to those that did not.

Variables of Interest

The categorical variables of interest include district size, urbanicity, and region. A categorical variable is used for district size, as the underlying distribution of enrollment is not believed to be linear. As seen in Figure 2, the distribution of district enrollment is positively skewed with the majority of districts having student enrollment less than 2,500 and a few with enrollment greater than 5,000. I use the same district size categories[6] used for developing and administering the online survey, with "Small" districts as those with enrollment less than 1,500 students, "Midsize" districts as those with enrollment between 1,500 and 3,500 students, and "Large" districts as those with enrollment greater than 3,500 students. Urbanicity is determined by the NCES urban-locale framework (2017b) and identifies districts as city, suburb, town, or rural. There are five

[6] Size categories are informed by the distribution of district enrollments.

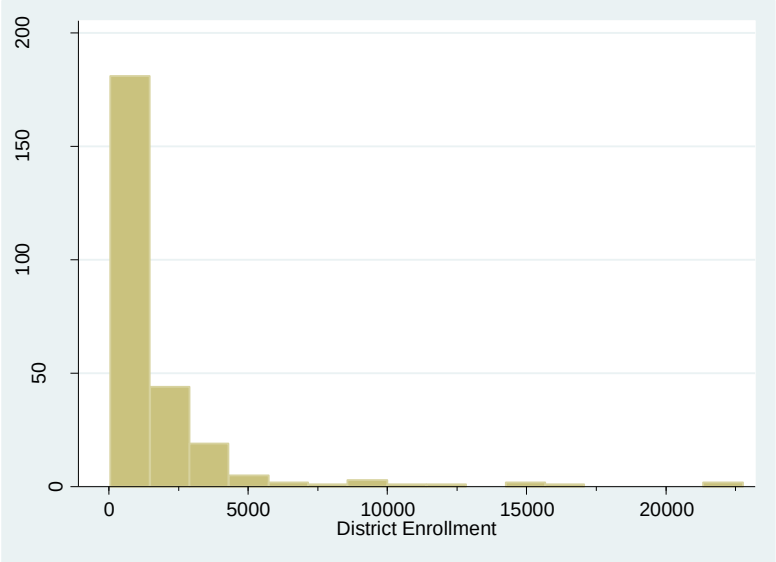


Figure 2: Distribution of District Enrollment, 2016-17

education regions in the state identified as the Northwest, Northeast, Central, Southwest and Southeast by the Arkansas Association of Educational Administrators (2017).

The continuous variables of interest include district demographics and achievement, as well as a composite measure of educational success, beginning teacher salary for new teachers, and a district growth measure. The educational success composite includes district percent proficiency on the ACT Aspire math and reading assessments (state assessment), district graduation rate, and average district math and reading score on the 11th grade ACT exams. All items are standardized (with mean = 0, standard deviation = 1) and a composite created in which one quarter weight is given to each of the average ACT Aspire math score, the average ACT Aspire reading score, the graduation rate, and a composite of the 11th grade ACT reading and math scores.[7] The final educational success indicator has a mean of 0.05 standard deviation units

[7] Prior to standardizing, the mean percent proficient on the ACT Aspire math was 43%, the mean percent proficient on the ACT Aspire reading was 38%, the mean high school graduation rate was 88%, and the mean 11th grade ACT score in math and reading were both 18.

with a standard deviation of 0.71. The educational success indicator is only reported for districts with all information required to create the variable. For teacher salary, I use the district salary for new teachers with a Bachelor's degree and no experience.[8] The district growth measure was created to account for changes in student enrollment over a 5-year period from 2012-13 to 2016-17, relative to the first year (2012-13). Differences in enrollment between years is averaged, divided by enrollment in 2012-13, and converted to percent. The district growth measure is expressed in equation 1. Mean district growth for the state over the five-year period was 0.69%.

$$\delta = \left\{ \frac{\sum Enrollment_{(t2\text{-}t1)} + Enrollment_{(t3\text{-}t2)} + Enrollment_{(t4\text{-}t3)} + Enrollment_{(t5\text{-}t4)}}{4} \right\} \div Enrollment_{t1} * 100 \quad (1)$$

Where,

δ represents district growth, and

t represents an enrollment year.

Looking at the summary statistics describing the categorical variables in Table 3, I find the analytic sample to be representative of all districts statewide. Seventy-four percent of all districts are included in the sample, with at least 70% district representation within each category, with the exception of suburban districts and charter schools (both 63%). Turning to the continuous variables of interest in Table 4, a comparison of means indicates that the districts included in the sample are almost identical on all measures to districts statewide. On average, the sample has greater district growth than the state overall.

[8] Salary not reported for Arkansas School of the Blind, Arkansas School of the Deaf, Division of Youth Services Schools, Arkansas Virtual Academy, and Quest Middle School of Pine Bluff.

Table 3: Descriptive Statistics of Categorical Variables of Interest: Analytic Sample vs. All Districts, 2016-17

Variable	Sample Frequency	Percent of Sample	Arkansas Frequency	Percent of All Districts	Sample as Percent of All Districts
Dependent (Categorical)					
Total	195		262		74%
District Size					
1- Large (> 3,500)	23	12%	30	11%	77%
2- Mid-size (1,500-3,500)	38	19%	53	20%	72%
3- Small (< 1,500)	134	69%	179	68%	75%
Urbanicity (CCD Indicator)					
1- Urban	24	12%	31	12%	77%
2- Suburb	10	5%	16	6%	63%
3- Town	45	23%	64	24%	70%
4- Rural	111	57%	144	55%	77%
Region					
1- NW	56	29%	79	30%	71%
2- NE	51	26%	67	26%	76%
3- Central	38	19%	54	21%	70%
4- SW	27	14%	38	15%	71%
5- SE	23	12%	24	9%	96%
Charter	15	8%	24	9%	63%

Table 4: Descriptive Statistics of Continuous Variables of Interest: Analytic Sample vs. All Districts, 2016-17

	Analytic Sample					All Districts				
Variable	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Independent										
Teacher Need (Vacancies/FTE)	186	0.12	0.14	0	1.23			N/A		
Teacher Supply (Applicants/Vacancies)	183	5.12	6.09	0	42.43			N/A		
Vacancies	192	15.89	32.25	0	282.00			N/A		
Classroom Teachers (FTE)	189	140.71	226.40	5	1,801.83	256	131.20	201.48	4.03	1,801.83
Applicants	186	93.49	258.23	0	1,727.00			N/A		
Dependent (Continuous)										
Enrollment	195	1,943	3,229	62	22,759	262	1,822	2,897	56	22,759
Log Enrollment	195	6.97	0.99	4.13	10.03	262	6.95	0.98	4.03	10.03
% FRL	194	66%	0.15	0.23	1.00	261	65%	0.16	0	1.00
% White	195	69%	0.28	0	0.98	262	70%	0.28	0	0.98
Educational Success Indicator (sd)	183	0.04	0.71	-2.53	1.66	243	0.05	0.71	-2.53	3.50
% Proficient ACT Aspire Math	195	43%	0.14	0	0.83	262	43%	0.14	0	0.93
% Proficient ACT Aspire Reading	195	38%	0.12	0.04	0.68	262	38%	0.12	0	0.89
Gr.11 ACT Math	186	18.03	1.28	14.30	21.40	247	18.10	1.43	14.30	27.00
Gr.11 ACT Reading	186	18.32	1.72	13.80	23.50	247	18.41	1.87	13.80	28.40
Graduation Rate	186	88%	0.12	0	1.00	246	88%	0.11	0	1.00
Base Teachr Pay (BA, 0yrs)	191	$ 34,058	3,199	29,580	47,016	257	$ 34,020	3,145	29,000	47,016
% District Growth (over 5yrs)	188	0.79%	7.87	-7.32	79.81	250	0.69%	6.99	-7.32	79.81

Note: No FTE reported in the 2015-16 finance database for Arkansas Connections Academy, Future School of Fort Smith, and Jacksonville North Pulaski County SD.

Next, I examine differences in characteristics between districts that responded to the survey and those that did not. In Tables 5 and 6, I find significant differences between districts in the sample and non-respondents for districts in the Southeast region, and marginally significant differences for rural districts. There are no significant differences found for any other district characteristics.

Table 5: Analytic Sample Equivalency (Categorical Variables)

(Categorical Variables)	**Analytic Sample**	**Non-Respondents**	**Difference**	**p-value**
Number of Districts	195	67	128	
% of All Districts (n=262)	74%	26%	49%	
District Size				
1- Small (< 1,500)	69%	67%	2%	0.766
2- Mid-size (1,500-3,500)	19%	22%	-3%	0.733
3- Large (> 3,500)	12%	10%	1%	0.930
Urbanicity (CCD Indicator)				
1- Urban	12%	10%	2%	0.877
2- Suburb	5%	9%	-4%	0.131
3- Town	23%	28%	-5%	0.245
4- Rural	57%	49%	8% *	0.091
Region				
1- NW	29%	34%	-6%	0.390
2- NE	26%	24%	2%	0.714
3- Central	19%	24%	-4%	0.445
4- SW	14%	16%	-3%	0.828
5- SE	12%	1%	10% **	0.034
Charter	8%	13%	-6%	0.735

Notes: *** p<0.01, ** p<0.05, * p<0.1. P-value based on chi-squared test. Most recent urbanicity data from NCES (2014-15) does not include seven districts included in this analysis (2016-17). Of the 7 districts, 5 are included in the analytic sample, 2 are included in non-respondents. The most recent NCES district urbanicity information from 2014-15 identifies 290 districts in the state including charter schools. There were 262 districts in the state in the 2016-17 school year. Of the 290 districts identified in 2014-15, 255 include demographic information in 2016-17 and are represented here.

Table 6: Analytic Sample Equivalency (Continuous Variables)

(Continuous Variables)	**Analytic Sample**	**Non-Respondents**	**Difference**	**p-value**
Number of Districts	195	67	128	
Number of Charter Schools	15	9	6	
Mean District Enrollment	1,943	1,468	475	0.247
% FRL	66%	63%	3%	0.187
% White	69%	71%	-3%	0.529
Educational Success Indicator (sd)	0.04	0.08	(0.04)	0.703
% District Growth (over 5 years)	0.79%	37%	-36%	0.676
Base Teacher Pay (BA, 0-yrs)	$34,058	$33,909	$149	0.740
Classroom Teachers FTE	152	114	38	0.231
Graduation Rate	88%	90%	-2%	0.273
% Proficient ACT Aspire Math	43%	43%	1%	0.742
% Proficient ACT Aspire Reading	38%	38%	0%	0.981
Mean Grade 11 ACT Math	18.03	18.28	(0.25)	0.235
Mean Grade 11 ACT Reading	18.32	18.66	(0.34)	0.219

Note: *** p<0.01, ** p<0.05, * p<0.1

Another way of looking at the differences between respondents included in the sample and non-respondents is by district size, urbanicity, and region. In Table 7, I consider average district enrollment, district percent free and reduced price lunch, and district percent white by district size for districts included in the sample and districts that did not respond to the survey. For large districts, respondents in the sample tend to be less white and have higher FRL rates than non-respondents. There were no significant differences found between the sample and non-respondents for any other category and variable examined.

Next, I examine average district enrollment, district percent FRL, and district percent white by urbanicity in Table 8, for districts included in the sample and non-respondents. I find suburban districts in the sample to be more advantaged (lower percent FRL, higher percent white) than suburban districts, and town districts in the sample were much less white than

districts that did not respond. There is a marginally significant difference found between districts included in the sample and non-respondents for average enrollment in city districts.

Table 7: District Demographics: Analytic Sample, Non-Respondents by District Size, 2016-17

	Analytic Sample				Non-Respondents			
District Size	N of districts	Averge District Enrollment	% FRL	% White	N of districts	Averge District Enrollment	% FRL	% White
Large	23	8,672	59%	53%	7	4,886	52%	70%
Midsize	38	2,126	61%	67%	15	2,253	61%	67%
Small	134	348	69%	72%	45	675	66%	73%
Overall	195	1,943	66%	69%	67	1,468	63%	71%

Note: No significant differences between sample and non-respondents for each category and variable of interest.

Table 8: District Demographics: Analytic Sample, Non-Respondents by Urbanicity, 2016-17

	Analytic Sample				Non-Respondents			
Urbanicity	N of districts	Averge District Enrollment	% FRL	% White	N of districts	Averge District Enrollment	% FRL	% White
City	24	6,008	63%	36%	7	1,148	57%	37%
Suburb	10	4,510	47%	74%	6	4,212	55%	57%
Town	45	1,933	68%	57%	19	1,971	65%	69%
Rural	111	882	68%	82%	33	822	67%	83%
Overall	190	1,943	66%	69%	65	1,468	63%	71%

Notes: The most recent NCES district urbanicity information (2014-15) identifies 290 districts including charter schools. There were 262 districts in the state in the 2016-17 school year. Of the 290 districts, 255 include demographic information in 2016-17 and are represented here. Significant difference of $p<0.1$ found between sample and non-respondents for district enrollment for city districts only.

In Table 9, I compare average district enrollment, district poverty rate (percent FRL), and district percent white by region for survey respondents and non-respondents. Within the Central and Southeast regions, respondents have lower percentages of white students compared to districts that did not respond to the survey. In addition, for respondents within the Southwest

region it appears that these districts had higher rates of poverty than districts that did not respond. There were no significant differences found between the sample and non-respondents for any other category and variable examined.

Table 9: District Demographics: Analytic Sample, Non-Respondents by Region, 2016-17

	Analytic Sample				Non-Respondents			
Region	N of districts	Averge District Enrollment	% FRL	% White	N of districts	Averge District Enrollment	% FRL	% White
NW	56	2,450	62%	82%	23	1,453	60%	80%
NE	51	1,398	67%	80%	16	1,418	68%	78%
Central	38	3,022	62%	53%	16	1,711	60%	60%
SW	27	1,165	71%	63%	10	1,306	66%	64%
SE	23	1,050	75%	45%	2	895	72%	50%
Overall	195	1,943	66%	69%	67	1,468	63%	71%

Note: No significant differences between sample and non-respondents for each category and variable of interest.

Differences between district respondents and non-respondents are only marginally significant for urban districts. Overall, districts included in the sample appear to be reasonably representative of districts statewide.

Descriptive Analysis

I first examine the raw relationships between the factors of supply (applications to vacancies) and the variables of interest (district size, urbanicity, region, poverty rate, racial/ethnic diversity, educational success, beginning teacher salaries, and district growth). District size is presented in deciles of enrollment as well as a categorical variable, urbanicity and region are described by category, and the remaining variables are provided by quintile. The relationship between the factors of need (vacancies to FTE classroom teaching positions) and the same variables of interest are explored and presented in the same way.

Multivariate Analysis

Outcome Measures (Dependent Variables)

There are two dependent variables of interest; one for supply and one for demand that are directly derived from the district survey responses about the number of vacancies and applications for grade level and subject positions. I define teacher "supply" as the ratio of applications to vacancies, expressed in equation 2.

$$Y_1 = \text{Supply Ratio} = \text{reported applications} / \text{reported vacancies} \quad (2)$$

Often, measures of teacher supply focus on the teacher pipeline and the number of education program graduates entering the workforce. There are two issues with using this method as the primary measure of supply: 1) it tends to focus on teacher supply statewide and not at the district level; and 2) having an adequate number of new teachers statewide does not mean they are filling positions in districts that need them most, nor does having an overall inadequate state supply reflect surpluses that may still occur in more desirable districts. By examining the ratio of applications to vacancies at the district level, I get a more direct, localized, measure of teacher supply and can investigate the relationship district characteristics may have on supply.

In addition to examining overall teacher supply, I also investigate teacher supply by school level and subject area in the same way. For teacher supply by school level I use application and vacancy information for elementary (K-4), middle school (5-8), and high school (9-12) levels. For teacher supply by subject I focus on the number of applications and vacancies reported for math and science, and language arts (and social studies) subjects.

For the outcome measure of teacher need (demand), I use the number of vacancies for grade level and subject positions from the district survey responses and full-time equivalent certified teaching staff reported from the 2015-16 district finance data. I define teacher "need" as the ratio of vacancies to FTE, or the fraction of the teacher workforce the district needs to replace each year, expressed in equation 3.

$$Y_2 = \text{Need Ratio} = \text{reported vacancies} / \text{classroom teachers} \quad (3)$$

Unlike other measures of teacher need that focus on estimates of teacher retirees as the driver, this measure of need reflects the demand created by both teacher turnover and changes in student enrollment. As with supply, in addition to looking at overall teacher need, I also examine teacher need by school level and subject area in the same way. I compiled the FTE by school level and FTE by subject data information using de-identified information on teacher assignments by school from the Office for Education Policy. Using this information, I was able to link teachers to districts and use job code information included to identify grade levels and subjects. From this job code and school assignment information, teachers were identified as elementary (K-4), middle (5-8), or high school (9-12) based on grade assignments and math, science, language arts, and social studies for subject assignments. While an imperfect method, the approach provided the best means to estimate classroom teacher FTE by school level and subject.

Independent Variables

There are several independent district characteristics that may influence the extent to which school districts have a greater or lesser supply of teachers than other districts, which will in turn

be related to teacher shortages. Independent variables included in the regression model include: district enrollment (size), urbanicity, region, poverty rate (FRL), race/ethnicity (white), educational success indicator (composite), teacher salary (BA, 0-years), and district growth measure (5-year average). Regression analyses statistically control for any minor differences in demographic characteristics. District enrollment (by size), region, and urbanicity are categorical indicator variables.

Multivariate Regression Model(s)

I conduct Ordinary Least Squares (OLS) regression analysis with heteroskedastic-robust standard errors (Angrist & Pischke, 2009; White, 1980) to determine the characteristics of districts associated with teacher supply and need. The same OLS models are used for both supply and need and the fully specified models are defined in equations 4 and 5 below. In total, there are nine models presented each for supply and need. Initially, simple models are run for district enrollment (using the categorical variable district size), urbanicity, and region separately without variables controlling for demographics, educational success, teacher salary, or district growth. Next, models that include both district enrollment (district size) and region are run, both with and without control variables. Finally, models including both region and urbanicity are run, with and without control variables. The same models are used for the additional school level and subject analyses.

OLS Regression Models (Supply).

$$Y_1 = \beta_0 + \beta_1\gamma + \beta_2\theta + \beta_3 X + \beta_4\varphi + \beta_5\lambda + \beta_6\delta + \varepsilon \quad (4)$$

OLS Regression Model (Need).

$$Y_2 = \beta_0 + \beta_1\gamma + \beta_2\theta + \beta_3 X + \beta_4\varphi + \beta_5\lambda + \beta_6\delta + \varepsilon \quad (5)$$

Where,

- Y_1 represents a given outcome of interest (overall supply, supply by school level, or supply by subject area),
- Y_2 represents a given outcome of interest (overall need, need by school level, or need by subject area),
- γ is an indicator for district size (or urbanicity),
- θ is an indicator for region,
- X represents district demographic characteristics (FRL status, race/ethnicity),
- φ represents district educational success,
- λ represents beginning new teacher salary,
- δ represents district growth, and
- ε represents the error term.

Limitations

Limitations to the study include concerns regarding the accuracy and reliability of the self-reported responses on the superintendent survey. While some districts were likely very thoughtful and thorough in their responses regarding the number of vacancies and applications provided, it is expected many districts offered best estimates rather than exact numbers. In addition, not all surveys were fully completed. Of the 195 districts included in the sample and subsequent analyses, 11 provided incomplete surveys.

There may also be concerns regarding the inclusion of charter school responses. It could be argued that charter school districts' needs and hiring practices are different and should not be included. I would argue that charter districts are competing to attract teachers the same as traditional public school districts and that many fully licensed and certified teachers find positions in charter districts as well.[9] In addition, there are relatively few charter school districts included (15 of the 195).[10] In favor of being more inclusive and using as much of the data

[9] However, licensure and certification often is not required of public charter school teachers.
[10] Additional analyses were conducted which excluded charter schools. There was no effect on the outcomes or changes in significance to the findings.

available as possible, charter schools and incomplete survey responses are kept in the sample and used for all analyses.

Finally, this is a descriptive study with the purpose of determining the association between certain district characteristics and teacher supply and need in the state of Arkansas. Causal inferences cannot be ascertained. The findings of this study are unique to the Arkansas context for the 2016-17 school year.

Chapter 4: Results

The purpose of this study is to test whether a uniform teacher shortage exists across the state of Arkansas. I hypothesize that, rather than a uniform shortage, teacher shortages are more likely to occur in certain regions and subjects. I further examine whether there is a surplus of elementary and English/language arts teachers as the literature indicates. I expect to find more (relative to need) elementary than middle or high school teachers, and more English/language arts than math and science teachers. Specifically, my objective in this study is to answer the following questions related to teacher supply and need in Arkansas:

1. What are the characteristics of districts that have the most favorable teaching supply?
2. Does supply differ by school level or subject?
3. What are the characteristics of districts that have the greatest need for teachers?
4. Does need differ by school level or subject?

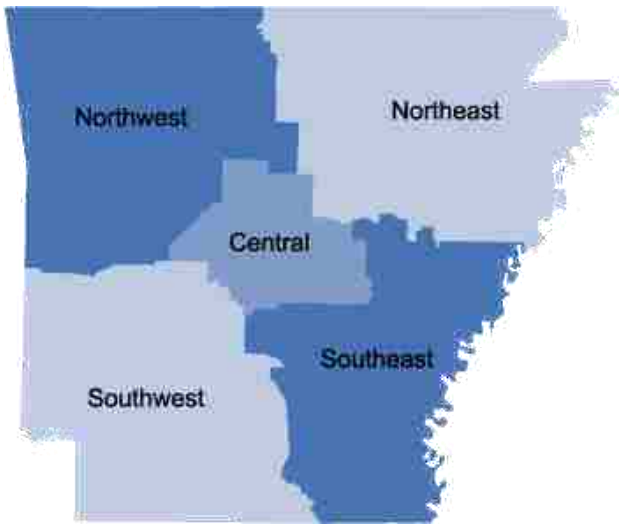
Teacher Supply

> **Research Question 1.** What are the characteristics of districts that have the most favorable teaching supply?

Descriptive Analysis

Which district factors drive supply? When examining the characteristics of districts that might contribute to teacher supply, the literature suggests that district size, urbanicity, poverty, and racial/ethnic diversity will be factors to consider (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Murnane & Steele, 2007; Murphy et al., 2003). From the 2017 district

survey, I define "supply" as the ratio of applications over vacancies.[11] As district size and urbanicity are strongly correlated with each other and certain regions in the state are more urban than others, I will examine these factors separately and not place them in a model simultaneously. It is also likely that schools in different regions face different levels of teacher supply due to the relative attractiveness of each region. For reference, the five education regions in the state referred to are displayed in Figure 3. Therefore, I examine the extent to which teacher supply is related to these factors as well as district poverty rate, racial/ethnic diversity, academic educational success, beginning teacher salaries, and district growth as these may also influence teacher supply. As many of these district characteristics may be related to each other (e.g. district size and teacher salary, district racial/ethnic diversity and region), I present correlations in Table 20. Initially, I examine bivariate supply relationships, however, any of these relationships might be confounded by other factors. Subsequently, I follow up using regression analyses to determine which consistent independent relationships remain.



(Source: Arkansas Association of Educational Administrators, 2017)

Figure 3: Education Regions of Arkansas

[11] The mean unit of supply across the state is approximately 6 applicants per vacancy.

How is teacher supply related to district size (enrollment)?[12] It is likely that larger districts will have more positions than smaller districts due to the fact that larger districts have more amenities and more opportunities for employment. For enrollment, I first present district enrollment by decile and then as a categorical variable using the same district size categories as those used for developing and administering the online survey. "Large" districts are defined as those with enrollment greater than 3,500 students, "Midsize" districts are those with enrollment between 1,500 and 3,500 students, and "Small" districts are those with enrollment less than 1,500 students.

Examining district enrollment by decile in Table 10, as expected, I find the largest districts, in decile 10, have the greatest teacher supply (8.0), which is nearly twice as much as any other decile. Districts with enrollments of between 900-1,000 students (decile 6) have the least teacher supply at 2.9. This means that the largest districts receive 8 applications for every vacant position while districts with 900-1,000 students get about 3 applications. Note that the mean unit of teacher supply statewide is approximately 5 applications for every vacancy. Districts in the remaining deciles have similar teacher supply ranging from 3.0-4.6, with most (60%) having fewer than 4 applications per vacancy. Figure 4 shows the relationship between the average numbers of district applications to vacancies for districts in each decile.

In addition to examining district size by enrollment decile, I also use the categorical variable for district size in Table 11 and find similar results. Here, "large" districts again have the greatest supply of teachers (7.9), almost double that of "small" districts (4.0) and more than

[12] Regression models using enrollment as a continuous variable are included in Appendices A and I. There is little difference in significance between using enrollment as a continuous or categorical variable.

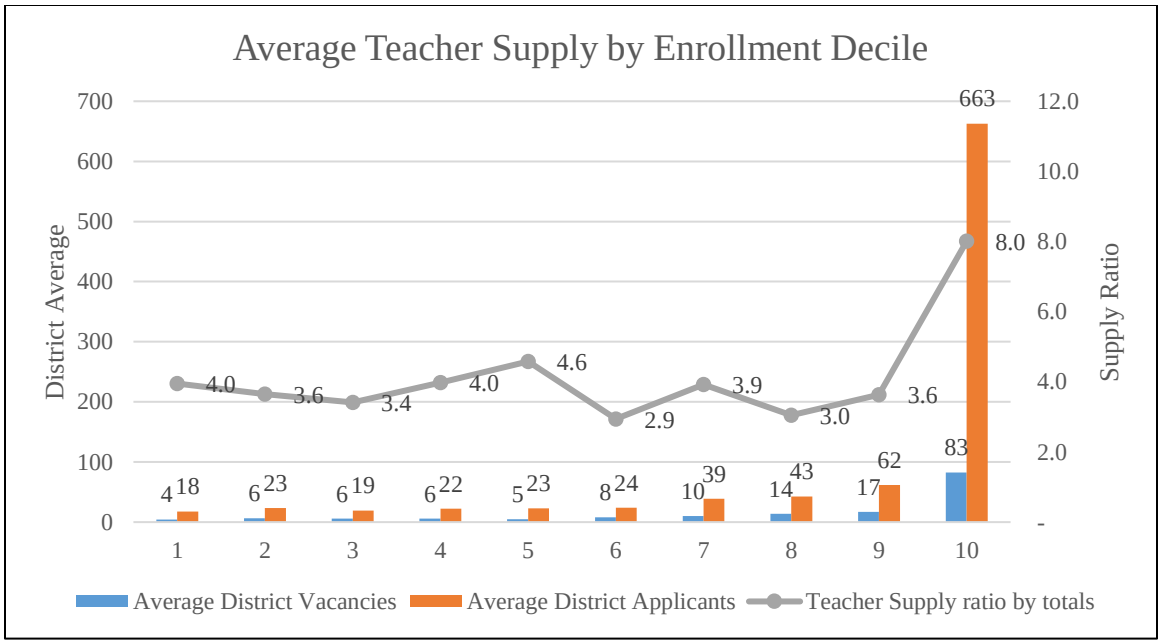
double that of "midsize" districts (2.8). In other words, when a vacancy is posted in a large school district, there are roughly 8 applications for the position, while there are fewer than 4 applications in small districts and fewer than 3 in midsize districts. Figure 5 illustrates the relationship between the average numbers of district applications to vacancies for each type of district. While the relationship between teacher supply and district size exists in bivariate analyses, it could be confounded by the fact that large districts will be concentrated in more urban areas and those areas are concentrated in certain regions of the state. As both enrollment by decile and by category are similar, and enrollment does not appear to be linear, I use the categorical variable in multivariate analysis.

Table 10: Teacher Supply by Enrollment Decile[13]

Decile range		Decile	N of districts	N responses	Total Vacancies	Total Applicants	Teacher Supply ratio by totals
56-371	smallest	1	27	18	80	316	**4.0**
384-487		2	26	17	108	394	**3.6**
493-599		3	26	21	119	406	**3.4**
614-779		4	26	17	96	382	**4.0**
781-905		5	26	20	100	458	**4.6**
908-1,180		6	27	15	122	359	**2.9**
1,188-1,567		7	26	23	229	898	**3.9**
1,583-2,111		8	26	19	267	814	**3.0**
2,248-3,693		9	26	16	272	989	**3.6**
3,829-22,759	largest	10	26	18	1,489	11,930	**8.0**
		Total	262	184	2,882	16,946	**5.9**

Note: Mean enrollment for 2016-17 = 1,821

[13] Survey response rates for deciles 1, 4, 6, and 9 were between 56-67%, while at least 73% of districts in the remaining deciles provided information on the survey for this factor.



Note: Decile 1 = Smallest, Decile 10 = Largest

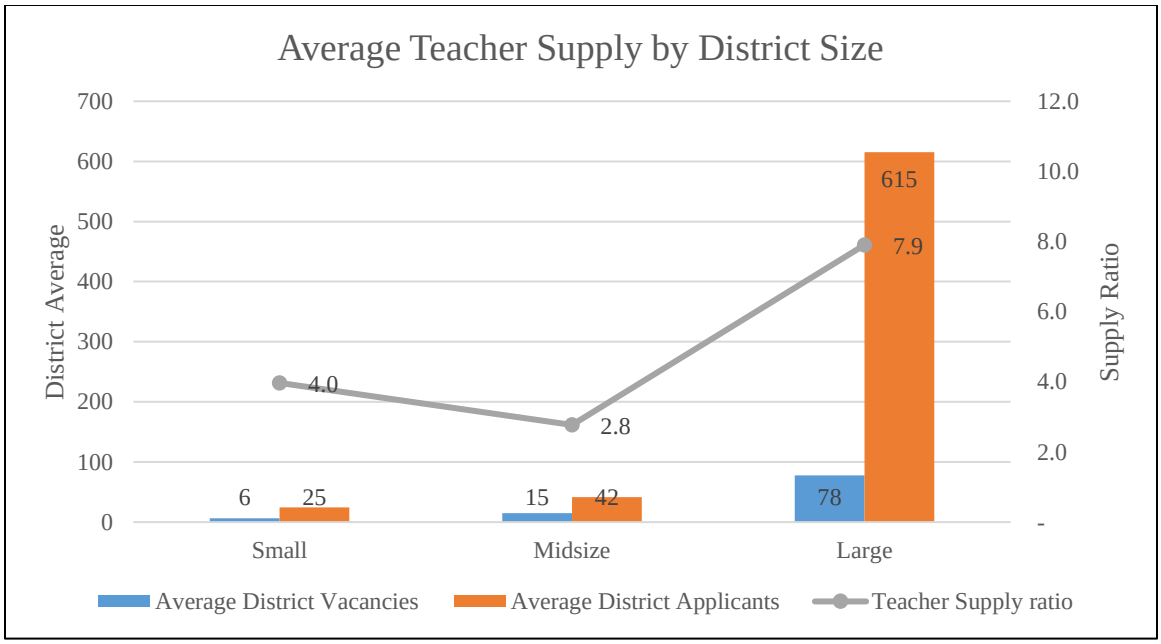
Figure 4: Average Teacher Supply by Enrollment Decile

Table 11: Teacher Supply by District Size[14]

Size range	District Size	Type	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
< 1,500	Small	1	181	128	793	3,145	**4.0**
1,500-3,500	Midsize	2	51	36	541	1,499	**2.8**
> 3,500	Large	3	30	20	1,557	12,302	**7.9**
	Total		262	184	2,891	16,946	**5.9**

Note: Mean Enrollment 2016-17 = 1,821

[14] Sixty seven percent of large districts and more than 70% of small and midsize districts provided information on the survey for this factor.



Note: Small district is <1,500, Midsize is 1,500-3,500, Large is >3,500

Figure 5: Average Teacher Supply by District Size

How is teacher supply related to urbanicity? The urbanicity of a district may also influence teacher supply (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2002; 2003; Malatras et al., 2017; Murphy et al., 2003; Will, 2016). More urban districts will be able to attract more teachers as more people want to live in urban areas that offer more attractions and activities. In addition, there are more educator preparation programs offered in and around the urban areas of the state.

Urbanicity is another way to consider and measure district size, as it is related to the population of a particular area. Using the NCES (2017b) urban-locale framework[15], there are four basic urbanicity designations for school districts: "City", "Suburb", "Town", and "Rural". A "City" is defined as an urban area with a population of around 100,000 or more. Fayetteville

[15] The most recent NCES district urbanicity information from 2014-15 identifies 290 districts in the state including charter schools (NCES 2017a). There were 262 districts in the state in the 2016-17 school year.

School District would be an example of a district designated as “City”, as would the capital city of Little Rock. A “Suburb” is outside a city but still within an urban area. An example of a district designated as “Suburb” would include Farmington School District. A “Town” is approximately 10-35 miles from a city/suburb, and Mountain Home School District would be an example of a “Town” district. “Rural” is considered at least five miles from a city/suburb and approximately 10 miles from a town. An example of a “Rural” district would include West Fork School District.

In Table 12, as expected, city districts have the largest supply of teachers (8.3), more than double that of districts in towns (3.8) and almost double that of rural districts (4.0). That is to say, for every vacancy in city school districts, there are an average of approximately 8 applications for the position, while there are fewer than 4 applications in town and rural districts. Figure 6 illustrates the relationship between average district vacancies and applications by urbanicity. While this simple analysis points to a relationship between urbanicity and teacher supply, it is certainly correlated with the fact that the majority of rural districts (74%) are small districts, and most of the rural and small districts are concentrated in the Northwest region.

Table 12: Teacher Supply by Urbanicity[16]

NCES Urban-Locale Designation	Type	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
City	1	36	23	985	8,171	**8.3**
Suburb	2	20	10	287	1,771	**6.2**
Town	3	75	42	675	2,550	**3.8**
Rural	4	159	104	632	2,542	**4.0**
	Total	290	179	2,579	15,034	**5.8**

Note: The most recent NCES district urbanicity information from 2014-15 identifies 290 districts in the state including charter schools (NCES 2017a). There were 262 districts in the state in the 2016-17 school year.

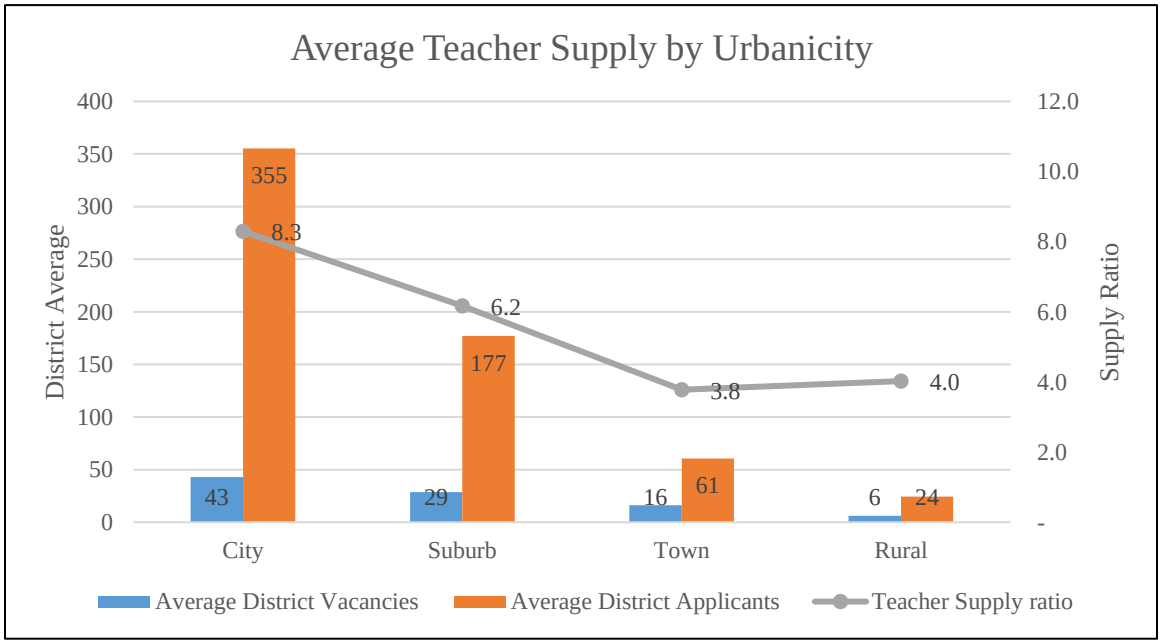


Figure 6: Average Teacher Supply by Urbanicity

How is teacher supply related to district growth? It is reasonable to assume that increases or decreases in student enrollment in a district over time will influence the number of vacancies a district has (Lindsay et al., 2016; Murnane & Steele, 2007; Murphy et al., 2003). It

[16] More than 64% of city and rural districts, and more than 50% of suburban and town districts provided information on the survey for this factor.

may also be an indicator as to the desirability of a particular region. One would expect that districts with more growth would have more vacancies and, thus, more applications. In contrast, districts with decreasing student enrollments would have fewer vacancies and likely fewer applications. It is not clear, therefore, whether the supply should go up or down related to growth. To evaluate this, a district growth measure was created to account for changes in student enrollment over a 5-year period from 2012-13 to 2016-17, relative to the first year (2012-13).

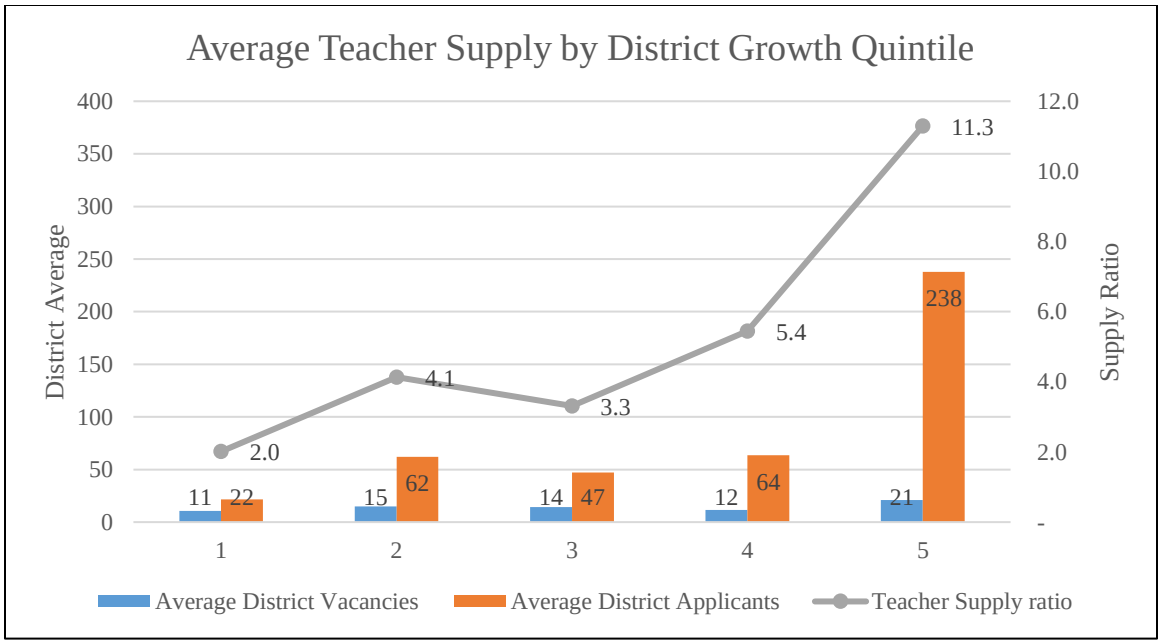
Looking at the quintiles of district growth in Table 13, I find that districts with the most positive growth (quintile 5 at 11.3) had five times more teacher supply than districts with the most negative growth (quintile 1 at 2.0). In other words, districts with the most growth saw an average of 11 applications for each advertised vacancy. Meanwhile, districts with the greatest decreases in enrollment saw an average of 2 applications per vacant position. Figure 7 illustrates the relationship between average district vacancies and applications by district growth.

Table 13: Teacher Supply by District Growth (5-year) Quintile[17]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
(-7.3) - (-1.84)	most -	1	50	39	420	846	**2.0**
(-1.81) - (-0.63)		2	50	33	495	2,047	**4.1**
(-0.61) - 0.302		3	50	40	568	1,883	**3.3**
0.309 - 1.48		4	50	30	351	1,911	**5.4**
1.49 - 79.8	most +	5	50	35	737	8,323	**11.3**
		Total	250	177	2,571	15,010	**5.8**

Notes: Mean District Growth 2012-13 to 2016-17 = 0.69%. Average growth over five years relative to the first year, 2012-13.

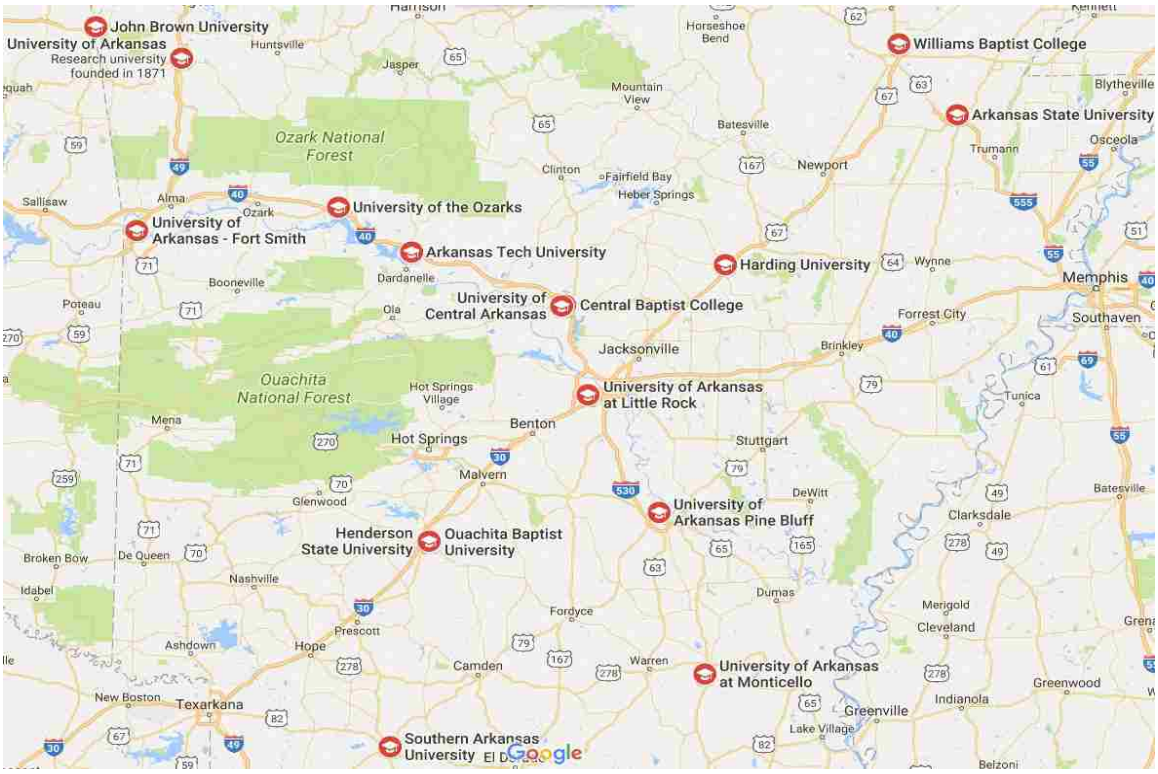
[17] More than 60% of districts in quintiles 2 and 4, and at least 70% of districts in the remaining quintiles provided information on the survey for this factor.



Note: Quintile 1 = Least growth, Quintile 5 = Most growth.

Figure 7: Average Teacher Supply by District Growth (5-year) Quintile

How does teacher supply vary by region? Different regions of the state may be more attractive or may have more opportunities available for teachers looking for positions, which may influence the number of applications. Additionally, the literature suggests that many teachers find positions close to home and/or in proximity to their training institutions (Barnett & Blankenship, 2005; Boyd et al., 2005; Goldhaber et al., 2014; Krieg et al., 2016). Therefore, it is likely that there would be increased teacher supply (driven by more applicants) in the Northwest region, as that is where the state's flagship university is located, and in the Central region, as there is a concentration of teacher education institutions located there. Figure 8 illustrates the concentration of teacher preparation institutions in these areas of Arkansas.



(Source: Google, 2017)

Figure 8: Arkansas Teacher Preparation Programs

In Table 14, as hypothesized, I find that districts in the Northwest have the greatest supply of teachers (10.1), far more than that found in any other region. However, districts in the Central region (4.5) do not share the same teacher supply advantage. Districts in the Southeast (1.4) and the Southwest (2.5) have the lowest teacher supply. Districts in the Northeast have supply similar to the state average (5.9). In other words, for a vacancy posted in Northwest school districts, there are an average of 10 applications for the position, while there are fewer than 2 applications in districts in the Southeast and fewer than 3 in Southwest districts. Figure 9 illustrates the relationship between average district vacancies and applications by region. While there appears to be a relationship between region and teacher supply, it is not consistent and may be correlated with the fact that the Northwest and Central regions are the most urban areas with 73% of large districts located there.

Table 14: Teacher Supply by Region[18]

Region	Type	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
NW	1	79	55	796	8,079	**10.1**
NE	2	67	48	519	3,048	**5.9**
Central	3	54	33	1,080	4,887	**4.5**
SW	4	38	25	212	522	**2.5**
SE	5	24	23	284	410	**1.4**
	Total	262	184	2,891	16,946	**5.9**

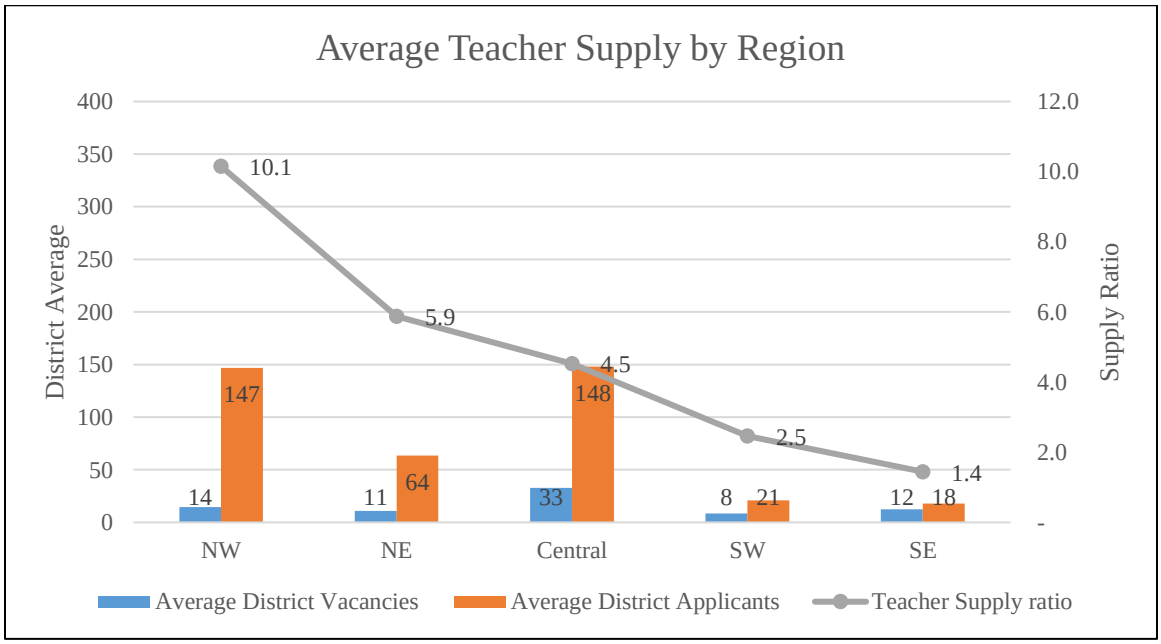


Figure 9: Average Teacher Supply by Region

How is teacher supply related to district poverty rate? The literature shows that highly disadvantaged schools and districts (i.e. more poor, more minorities) often have more vacancies and new teachers due to difficulties in attracting and retaining teachers (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Malatras et al., 2017; Murnane & Steele, 2007;

[18] More than 70% of districts in the Northeast, Central, and Southeast, and more than 61% of districts in the Northwest and Southwest provided information on the survey for this factor.

Murphy et al., 2003). As such, one would expect that districts with lower poverty rates would have greater teacher supply due to the increased number of applicants wanting to teach in these districts. Put plainly, more people would prefer to work in more affluent areas than in poor areas.

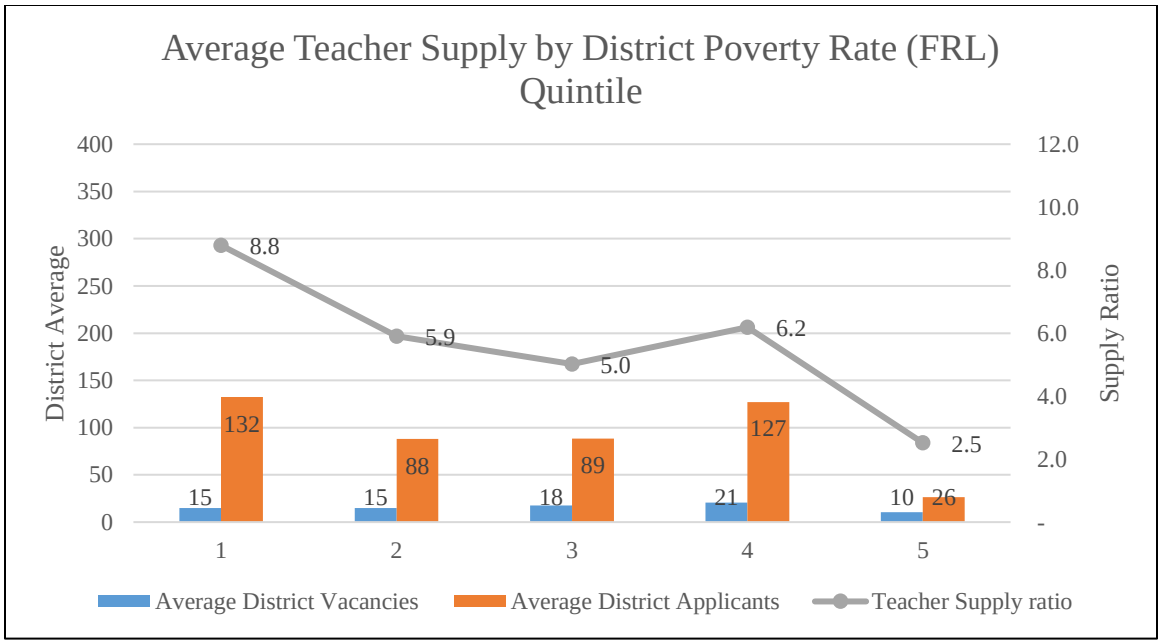
District poverty rate is based on the federal free and reduced price lunch status and is reported by quintile in Table 15. As anticipated, I find that districts with the highest percentage of FRL students (the poorest) have the lowest teacher supply (2.5) while the least poor districts have the highest teacher supply (8.8). This means that the wealthiest districts have nearly 9 applications per vacant position while the poorest districts have between 2 and 3 applications per vacancy. Figure 10 illustrates the relationship between average district vacancies and applications by poverty quintile. While the initial analysis indicates a relationship between district poverty level and teacher supply, high poverty is often associated with very urban or very rural areas.

Table 15: Teacher Supply by District Poverty Rate (FRL) Quintile[19]

Quintile range		**Quintile**	**N of districts**	**N of responses**	**Total Vacancies**	**Total Applicants**	**Teacher Supply ratio**
0-0.54	least poor	1	56	36	542	4,763	**8.8**
0.55-0.64		2	52	35	521	3,077	**5.9**
0.64-0.71		3	51	37	652	3,276	**5.0**
0.72-0.76		4	53	38	781	4,833	**6.2**
0.77-1	most poor	5	49	37	388	976	**2.5**
		Total	261	183	2,884	16,925	**5.9**

Note: Mean %FRL 2016-17 = 65%. Poverty rate for Northwest Classical Academy not reported.

[19] More than 64% of districts in quintiles 1 and 2, and at least 72% of districts in the remaining quintiles provided information on the survey for this factor.



Note: Quintile 1 = Least poor, Quintile 5 = Most poor

Figure 10: Average Teacher Supply by District Poverty Rate (FRL) Quintile

How is teacher supply related to district racial/ethnic diversity? Highly disadvantaged schools and districts not only have higher poverty rates but also tend to have higher percentages of minority students (Aragon, 2016; Dee & Goldhaber, 2017; Loeb & Reininger, 2004; Murnane & Steele, 2007; Murphy et al., 2003). As with poverty, it is probable that there would be greater teacher supply in districts with less racial/ethnic diversity. That is, more diverse districts will have fewer applicants. However, in Arkansas, there is an interesting dynamic where some of the poorest districts in rural areas serve nearly all white students. Thus, the relationship in this case is unclear.

Using the percent of white students in a district as a measure of diversity,[20] presented in quintiles, in Table 16, I find that districts with the lowest percentage of white students (quintile

[20] Further examination of teacher supply by the district percentage of Hispanic and black students is presented in Appendix B. Teacher supply is greatest in districts that are more than

1) have the lowest teacher supply (4.9), however, districts with the highest percentage of white students (quintile 5) have similar teacher supply (5.3). In other words, the least white districts and the whitest districts both have approximately 5 applications for each vacant position. Figure 11 illustrates the relationship between average district vacancies and applications by white quintile. Further analysis indicates that both the whitest and least white districts are also among the smallest districts in the state.[21] Additionally, I find that the largest districts in the Northwest are also the whitest. These reasons likely contribute to the similar rates of teacher supply. Moreover, some of the urban districts in central Arkansas have relatively high levels of teacher supply and serve large percentages of minority students.

Table 16: Teacher Supply by District Race/Ethnicity (White) Quintile[22]

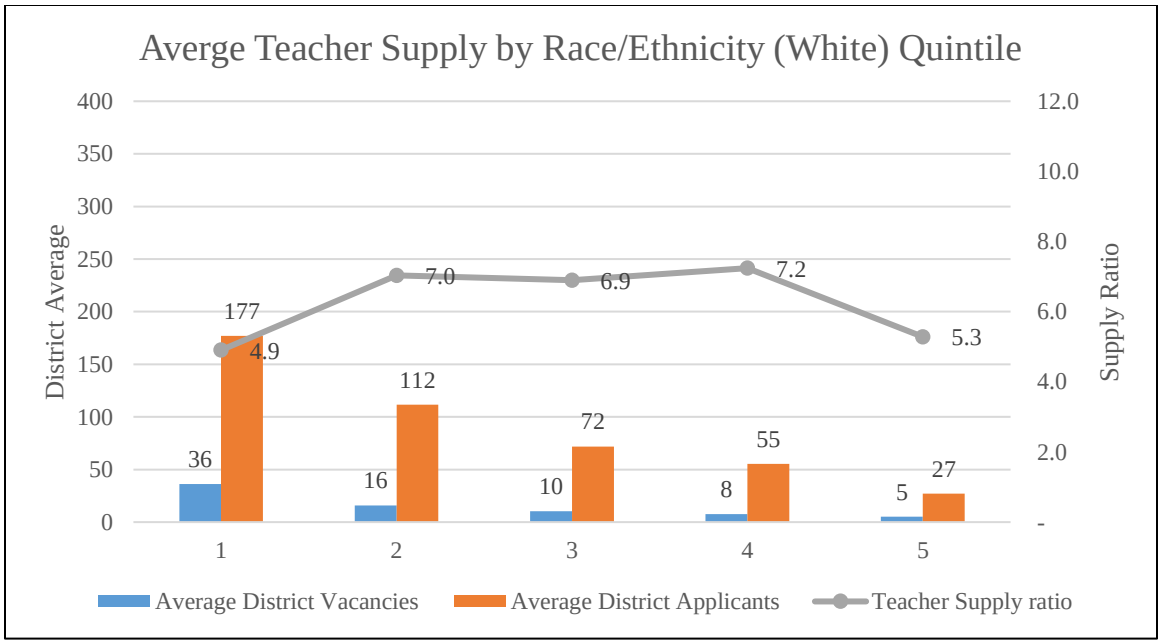
Quintile range		**Quintile**	**N of districts**	**N of responses**	**Total Vacancies**	**Total Applicants**	**Teacher Supply ratio**
0-0.44	least white	1	54	41	1,479	7,254	**4.9**
0.47-0.71		2	53	36	571	4,018	**7.0**
0.72-0.87		3	51	35	365	2,517	**6.9**
0.88-0.93		4	60	43	328	2,375	**7.2**
0.94-0.98	most white	5	44	29	148	782	**5.3**
		Total	262	184	2,891	16,946	**5.9**

Note: Mean %White 2016-17 = 70%

10% Hispanic (even when excluding districts in the Northwest region), and in districts that are 0.01-0.10% black.

[21] A table summarizing the race/ethnicity (white) quintiles by small districts is included in Appendix C.

[22] More than 66% of districts in quintiles 2, 3, and 5, and more than 72% of districts in quintiles 1 and 4 provided information on the survey for this factor.



Note: Quintile 1 = Least White, Quintile 5 = Most White

Figure 11: Average Teacher Supply by District Race/Ethnicity (White) Quintile

How is teacher supply related to district educational success? As teachers seek vacant positions, it is possible they may look to apply to higher achieving schools and districts assuming higher achieving students would be easier to teach (Aragon, 2016; Hanushek et al., 2004; Loeb & Reininger, 2004). However, it is also possible that student achievement may be higher in districts with a steady supply or surplus of teachers. While I cannot determine the particulars or the direction of the relationship, I can look at the association between district student educational success and teacher supply.

To examine how teacher supply might be related to educational success, I created a district educational success indicator that includes district percent proficiency on the ACT Aspire math and reading assessments (state assessment), district graduation rate, and district average math and reading score on the 11th grade ACT exams. All items were standardized and a composite created in which one quarter weight was given to each of the average ACT Aspire

math score, ACT Aspire reading score, graduation rate, and composite of the 11th grade ACT reading and math scores.[23] The final composite has a mean of 0.05 standard deviation units with a standard deviation of 0.71. Using this measure, I examine the extent to which the "overall success" of a district (based on student achievement and graduation rate) is related to teacher supply.

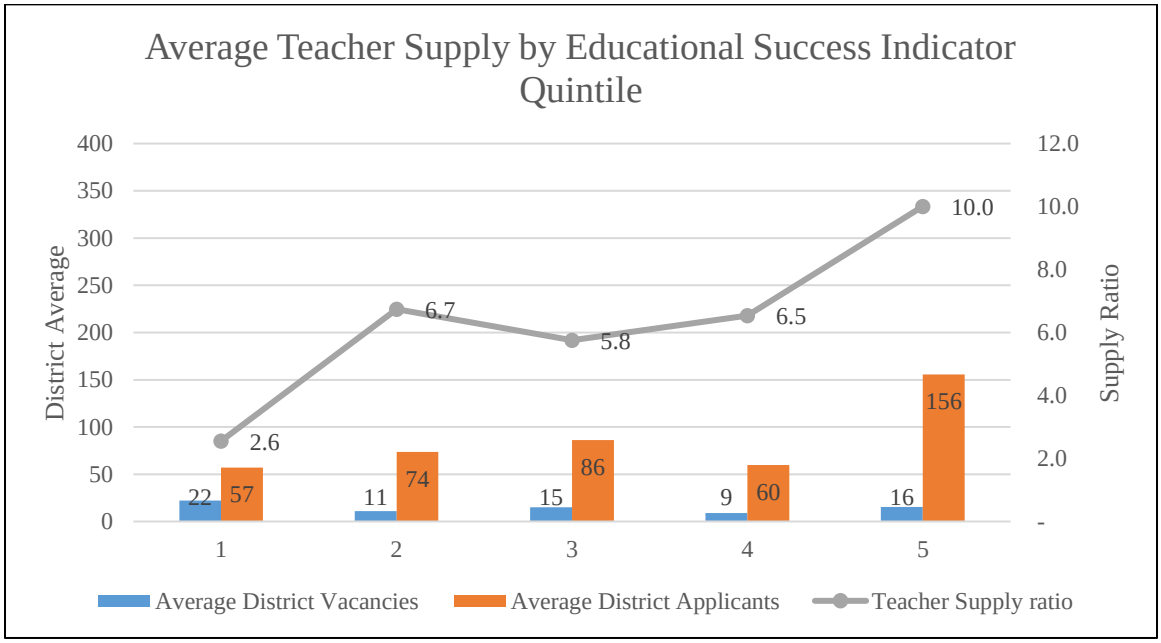
In Table 17, I find the relationship does not appear to be perfectly linear. Districts with the highest educational success (quintile 5 at 10.0) have almost four times more teacher supply than districts with the lowest educational success (quintile 1 at 2.6). That is to say, for every vacant position in the highest achieving districts, there are an average of nearly 10 applications for the position, while there are fewer than 3 applications per position in the lowest achieving districts. Figure 12 illustrates the relationship between average district vacancies and applications by educational success. While there appears to be a relationship between educational success and teacher supply, educational success is also often related to socioeconomic advantage and urbanicity.

[23] Prior to standardizing, the mean percent proficient on the ACT Aspire math was 43%, the mean percent proficient on the ACT Aspire reading was 38%, the mean high school graduation rate was 88%, and the mean 11th grade ACT score in math and reading were both 18.

Table 17: Teacher Supply by District Educational Success Indicator Quintile[24]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
(-2.5) - (-0.47)	lowest	1	49	35	779	1,991	**2.6**
(-0.45)- (-0.07)		2	49	36	393	2,648	**6.7**
(-0.06) - 0.254		3	48	31	463	2,667	**5.8**
0.257 - 0.542		4	49	34	310	2,028	**6.5**
0.548 - 3.5	highest	5	48	36	560	5,604	**10.0**
		Total	243	172	2,505	14,938	**6.0**

Notes: Mean for 2016-17 = 0.05 SD. Educational Success = (0.25) ACT Aspire Math + (0.25) ACT Aspire Reading + (0.25) Grad rate + (0.25) Gr.11 ACT Math-Reading Composite. Total number of districts reflects those with all the data required to create an Educational Success Indicator (composite). Districts missing graduation rate or assessments are not included.



Note: Quintile 1 = Lowest, Quintile 5 = Highest

Figure 12: Average Teacher Supply by District Educational Success Indicator Quintile

How is teacher supply related to salary offered to new teachers? Variation in teacher salaries among districts may also influence teacher supply, with higher paying districts attracting

[24] More than 65% of districts in quintiles 3 and 4, and at least 71% of districts in the remaining quintiles provided information on the survey for this factor.

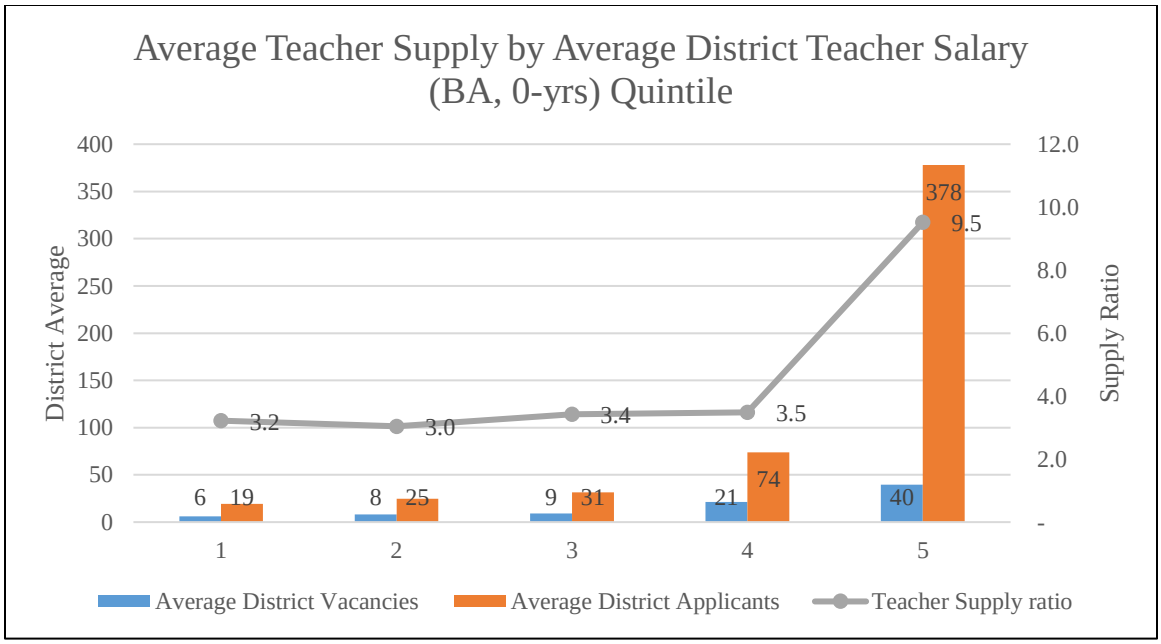
more applicants (Hanushek et al., 2004; Loeb & Reininger, 2004). As such, one would expect the highest paying districts to have the greatest teacher supply. Looking at beginning teacher salary (Bachelor's degree with no experience) by quintile in Table 18, as expected, districts with the highest teacher salary have by far the greatest teacher supply. In fact, quintile 5 (the highest at 9.5) has almost three times more teacher supply than the remaining quintiles (between 3.0 – 3.5). This means that the highest paying districts have between 9 and 10 applications per vacant position on average while districts in the remaining quintiles have about 3 applications per vacancy. Figure 13 illustrates the relationship between average district vacancies and applications by beginning teacher salary.

Table 18: Teacher Supply by Average District Teacher Salary (BA, 0-years) Quintile[25]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
$29,000 - 31,400	lowest	1	52	36	216	695	**3.2**
31,440 - 32,250		2	51	34	277	843	**3.0**
32,305 - 33,508		3	52	30	275	941	**3.4**
33,774 - 36,832		4	51	36	763	2,663	**3.5**
36,886 - 47,016	highest	5	51	30	1,191	11,337	**9.5**
		Total	257	166	2,722	16,479	**6.1**

Notes: Mean Teacher Salary (BA, 0yrs) 2016-17 = $34,020. Salary not reported for Arkansas School of the Blind, Arkansas School of the Deaf, Division of Youth Services Schools, Arkansas Virtual Academy, and Quest Middle School of Pine Bluff.

[25] More than 71% of districts in quintile 4 and between 58-69% of districts in the remaining quintiles provided information on the survey for this factor.



Note: Quintile 1 = Lowest salary, Quintile 5 = Highest salary

Figure 13: Average Teacher Supply by District Average Teacher Salary (BA, 0-years) Quintile

To recap the descriptive relationships thus far, I categorize districts as those with the least favorable teaching supply (supply ratio less than 1.5), average teaching supply (ratio between 1.5 and 7.0), or most favorable teaching supply (ratio greater than 7.0).[26] In Table 19 below, I find 26% of districts in the sample represented in the least favorable teaching supply category. Relative to the state, over-represented in the least favorable category are small districts with student enrollments of less than 1,500, districts in towns, districts in the Central and Southeast regions, poorer districts, more racially diverse districts, the lowest achieving districts, and districts with the most growth. In the most favorable teaching supply category, I find 25% of districts in the sample represented. Relative to the state, it appears large districts with enrollments greater than 3,500, urban and suburban districts, districts in the Northwest, wealthier districts, whiter districts, the highest achieving districts, higher paying districts, and districts with

[26] Categories determined by percentile ranking with 1.5 at the 25th percentile and 7.0 at the 75th percentile.

the least growth are over-represented in the most favorable category. As many of these factors are related to each other, I turn to multivariate analysis to disentangle these relationships.

Table 19: Summary of Teacher Supply Indicators

Indicators	Least Favorable Teacher Supply (<1.5)	Average Teacher Supply	Most Favorable Teacher Supply (>7)	Sample Total	State Total
N of Districts	48	89	46	183	262
% of Sample	26%	49%	25%	100%	
Supply Range	0 - 1.45	1.5 - 6.8	7 - 42.4	0 - 42.4	
Mean Supply	0.55	3.37	13.28	5.7	
District Size					
% Small (< 1,500)	69%	74%	61%	69%	68%
% Midsize (1,500 - 3,500)	21%	19%	15%	19%	20%
% Large (> 3,500)	10%	7%	24%	12%	11%
Urbanicity					
% City	13%	11%	15%	13%	14%
% Suburb	4%	3%	11%	5%	8%
% Town	31%	18%	22%	22%	29%
% Rural	52%	64%	48%	57%	61%
Region					
% NW	15%	24%	54%	29%	30%
% NE	25%	26%	24%	25%	26%
% Central	25%	21%	11%	20%	21%
% SW	13%	18%	9%	14%	15%
% SE	23%	11%	2%	12%	9%
Mean Enrollment	1,487	1,608	3,184	1,972	1,822
Mean % FRL	71%	67%	61%	66%	65%
Mean % White	58%	70%	76%	68%	70%
Mean Educational Success (sd)	-0.30	0.04	0.37	0.03	0.05
Mean Beginning Teacher Salary (BA, 0-yrs)	$33,903	$33,374	$35,666	$34,092	$34,020
Mean % District Growth	1.00%	0.92%	0.47%	0.83%	0.69%

Notes: Supply categories determined by percentile ranking with 1.5 at the 25th percentile and 7.0 at the 75th percentile. Sample Total includes all districts with supply ratios (with both application and vacancy information). Educational success Indicator is in standard deviation units.

Multivariate Analysis

What is driving teacher supply? Based on the descriptive analyses presented above and correlations in Table 20 below, it appears teacher supply is likely predicted by district size, urbanicity, district poverty level, and district racial/ethnic diversity. Specifically, I find that district enrollment, educational success, new teacher starting salary, percent white and district size are significantly positively correlated with supply while poverty level is significantly negatively correlated with supply. Urbanicity is significantly correlated with many factors including the components of supply (significantly negatively correlated with applications and vacancies) but not directly with supply.[27] District growth does not appear to be correlated with any other factors.

Multivariate models will be able to unpack these effects and provide more information as to the independent relationship between these factors and teacher supply. Even so, highly correlated variables will impact regression models which include both, and make it difficult to determine impacts separately. To avoid such issues of multicollinearity, urbanicity and district size will be included in separate models as they are likely driving the same variation. Enrollment and region are somewhat related, but there is enough variation in enrollment within regions that I will include both variables in the same models. Therefore, several models will be presented and discussed.

[27] Urbanicity is included in the correlation matrix as there is an ordinal nature to this measure.

Table 20: Correlations: Variables Associated with Supply

	Supply	Total Vacancies	Total Applicants	Enrollment	District Growth	Achievement	Tsalary Ba0Yrs	FRL	White	District Size	Urbanicity
Supply	1										
Total Vacancies	0.06	1									
Total Applicants	0.51***	0.77***	1								
Enrollment	0.29***	0.73***	0.73***	1							
District Growth	0.01	0.03	0.01	0.01	1						
Educational Success	0.31***	-0.03	0.16**	0.11*	0.28***	1					
Tsalary Ba0Yrs	0.36***	0.43***	0.55***	0.61***	0.23***	0.25***	1				
FRL	-0.30***	-0.02	-0.15**	-0.19***	-0.23***	-0.66***	-0.44***	1			
White	0.14*	-0.29***	-0.15**	-0.18***	0.01	0.62***	-0.19***	-0.39***	1		
District Size	0.16*	0.63*	0.50*	0.82*	0.21*	0.13	0.58*	-0.32*	-0.31*	1	
Urbanicity	-0.12	-0.54*	-0.38*	-0.66*	-0.04	0.13	-0.49*	0.06	-0.47*	0.48***	1

Note: *** p<0.01, ** p<0.05, * p<0.1

Multivariate Regression Models

There are three types of multivariate regression analysis models presented in Table 21: 1) separate models for district enrollment (using the categorical variable district size), urbanicity and region, without variables controlling for demographics, educational success, teacher salary, or district growth; 2) models with both district enrollment (district size) and region, with and without control variables; and 3) models with both region and urbanicity, with and without control variables. Results for nine regression models in total are presented.

Results of Multivariate Regression

The descriptive data suggests the main drivers of teacher supply are district enrollment (using the categorical variable)[28], urbanicity, and region. In Table 21, I examine separately simple models for each (models 1-3). The first three individual models confirm the descriptive results.[29] Model 1 examines the association between teacher supply and district enrollment (by size) and shows that large districts receive roughly 6 more applications than small districts and 5 more applications than midsize districts. Model 2 looks at the relationship between teacher supply and urbanicity. Results indicate that suburban districts are more advantaged, receiving about 6 more applications than rural districts, 2 more applications than city districts, and 4 more applications

[28] Multivariate regressions using enrollment as a continuous (linear) variable are included in Appendix A. The categorical variable for enrollment was used because enrollment is not believed to be linear.

[29] The descriptive supply (and need) ratios are based on weighted averages for each group while the simple regressions are based on unweighted averages (treat districts in an unweighted way). Therefore, the descriptive ratios and simple regression coefficients show slightly different relationships. See Appendix D for an example of the descriptive and regression supply comparisons.

Table 21: Predictors of Supply

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region (no controls)	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity (no controls)	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Midsize districts (1,500-3,500)	0.900			0.921	-0.294	-0.367			
	(1.119)			(1.056)	(1.043)	(1.263)			
Large districts (> 3,500)	5.674**			6.574***	5.505***	4.631*			
	(2.319)			(2.366)	(2.054)	(2.368)			
City (urbanicity 1)		3.284					5.122*	6.969**	8.188**
		(2.218)					(2.640)	(2.973)	(3.534)
Suburb (urbanicity 2)		5.798**					6.342**	5.572**	5.736**
		(2.711)					(2.804)	(2.767)	(2.881)
Town (urbanicity 3)		1.347					1.825*	2.269*	2.026
		(1.078)					(1.082)	(1.274)	(1.351)
NE (Region 2)			-2.447*	-1.946	-1.435	-0.843	-1.634	-1.250	-0.672
			(1.416)	(1.327)	(1.262)	(1.297)	(1.333)	(1.275)	(1.273)
Central (Region 3)			-4.577***	-5.863***	-6.313***	-5.388***	-6.144***	-6.131***	-4.780***
			(1.191)	(1.261)	(1.448)	(1.610)	(1.789)	(1.780)	(1.726)
SW (Region 4)			-4.018***	-3.440***	-2.905**	-2.179*	-2.904**	-1.892	-1.321
			(1.260)	(1.195)	(1.162)	(1.259)	(1.140)	(1.202)	(1.291)
SE (Region 5)			-5.884***	-5.086***	-4.408***	-3.738***	-5.120***	-3.329***	-2.755**
			(1.206)	(1.091)	(1.065)	(1.023)	(1.124)	(1.239)	(1.211)
District %FRL					-10.99***	-7.440		-6.474	-3.234
					(4.200)	(6.765)		(4.604)	(6.364)
District %White					-1.866	-1.994		2.810	0.967
					(1.655)	(2.519)		(2.493)	(2.667)
Educational Success						1.226			1.928*
						0.166			0.102
Teacher Salary BA, 0-yrs (in $1,000s)						(0.202)			(0.201)
						0.166			0.102
District Growth						(0.202)			(0.201)
						(0.203)			(0.179)
Constant	4.277***	3.999***	7.916***	6.908***	15.65***	7.203	6.240***	7.881	3.088
	(0.393)	(0.346)	(0.986)	(0.803)	(4.021)	(8.750)	(0.809)	(4.966)	(8.672)
Observations	183	178	183	183	182	165	178	177	165
R-squared	0.089	0.069	0.116	0.222	0.271	0.295	0.202	0.258	0.328

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Constant: Small districts, NW = Region 1, Rural. Mean unit of supply = 5.12 (equivalent to 5 applicants per vacancy).

than town districts.[30] Model 3 focuses on teacher supply and region and reveals that districts in all regions receive fewer applications than districts in the Northwest. In fact, districts in the Southeast receive the fewest applications with 6 fewer than districts in the Northwest, 2 fewer than those in the Southwest and Central regions, and 3 fewer applications than districts in the Northeast.[31] Standing alone, the individual models confirm what I find in the descriptive relationships.

As a reminder, enrollment and urbanicity are highly correlated and as both are measures of district size, I do not include them in models together. The remaining six models combine region with each measure of district size; models 4-6 include enrollment and region, models 7-9 include region and urbanicity. When either measure of district size (enrollment or urbanicity) and region are included in models together, it appears the influence of district size persists. In models 4 and 7, while the coefficients change slightly the relationships do not. In model 4, large districts continue to have a supply advantage. In model 7, suburbs have the best advantage followed by city and town districts. In both models, the supply disadvantage in the Northeast no longer matters, dependent on district size.

Models where measures of district size (enrollment or urbanicity) are combined with region are preferred. It appears that region and district size matter separately and when combined in models together the results change somewhat but the relationships are not undermined. Adding region and measures of district size in models together adds more variation, provides better estimates, and increases predictive power of the models.

[30] There are 20 districts identified as suburban statewide, only 10 of those are included in the analyses.
[31] The variation in teacher supply by region is presented in Appendix E.

In models 5 and 8, I examine the extent to which including student characteristics such as race and poverty in the combined models influence the estimates. In these models, again the coefficients change somewhat but the relationships do not. However, I find that poverty matters more when using enrollment rather than urbanicity, and the supply disadvantage in the Southwest no longer matters in the model using urbanicity. While I find the coefficient on poverty is in the predicted direction in both models, it is not consistently significant. Race does not appear to matter in either model. It may be that controlling for region also controls for race as the racial compositions of regions differs a lot (see Table 9).

Finally, in models 6 and 9, I examine whether including educational success, teacher salary,[32] and district growth[33] affect the estimates. Adding these new indicators marginally improves the overall predictive power of the model and reduces the magnitude of many of the coefficients as more variation is accounted for by the new indicators. These models hint at a relationship between district educational success and supply as both models are nominally positive but only one is significant. Poverty points in the expected direction but is no longer significant. Again, race does not matter in either model.

The results of the regressions support the theme that region and district size matter, regardless of how district size is operationalized. I consistently see the following relationships influencing teacher supply:

- large districts have a supply advantage relative to small and midsize districts;

[32] Analyses using a categorical variable of teacher salary are included in Appendix F. Teacher salary remains insignificant whether using the continuous or categorical variable.
[33] Analyses using the natural log of district growth are included in Appendix G. District growth remains insignificant whether using percentage or log percentage.

- suburban and city districts have a supply advantage relative to rural and town districts; and
- districts in the Northwest and Northeast have greater supply than districts in the other regions.

Other indicators included in the models mostly move in the predicted direction but some do not, perhaps because they are sharing the same variation. The key drivers of teacher supply continue to be district size and region.

Research Question 2. Does supply differ by school level or subject?

How does supply vary by subject and grade level? The literature indicates that teacher supply will vary by school level and subject (Behrstock-Sherratt, 2016; Cowan et al., 2016; Cross, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Malatras et al., 2017; Murnane & Steele, 2007; Murphy et al., 2003). Therefore, I examine teacher supply by elementary, middle, and high school levels defined by the grades used in the online survey. Teacher supply for elementary includes all applications and vacancies for kindergarten through grade 4, middle school includes those for grades 5 through 8, and high school includes grades 9 through 12. Per the literature, I expect to find greater teacher supply at the elementary level and more evidence of shortages at the secondary level.

In addition to school level, I look at teacher supply by subject, in particular, math and science compared to language arts (and social studies).[34] On the survey, questions about vacancies and applicants were asked about general subject areas rather than specific class types.

[34] I assumed positions available at the middle school level would be advertised as both 'math and science' or 'language arts and social studies' together. At the high school level, I assumed math, science, language arts, and social studies positions would be advertised separately.

The subjects in the survey presented here included middle school math and science[35]; high school math and science; middle school English/language arts and social studies; and high school English/language arts. I expect to find greater teacher supply in language arts than in math and science.

Contrary to expectations, I find greater teacher supply associated with the middle school level (Table 22 and Figure 14). In fact, in Table 22, I find elementary and high school have the same teacher supply while there appears to be 2 more applications per vacancy at the middle school level.

Table 22: Teacher Supply by School Level (Raw Differences)

School Level	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
Elementary	156	1,406	6,149	**4.4**
Middle School	137	884	5,827	**6.6**
High School	163	1,226	5,367	**4.4**

[35] Grade 5 may or may not be included in the middle level subjects' responses. On the survey, questions related to grade 5 positions were asked as if those would have had a self-contained core classroom teacher. Math and science does not include computer science or career technical education (CTE) courses.

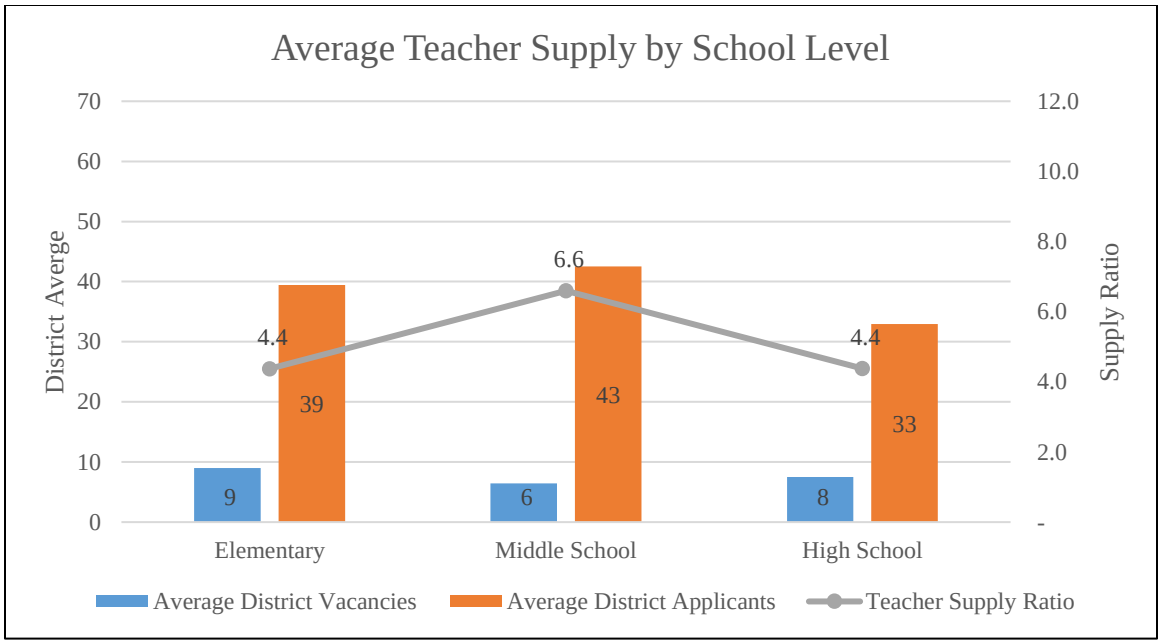


Figure 14: Average Teacher Supply by School Level (Raw Differences)

Multivariate analyses included in Appendix H, examine the predictors of teacher supply by school level as well. I find similar results to those in the overall analysis of teacher supply presented above. In particular, there is a consistent teacher supply advantage for larger districts, particularly at the middle level (Appendix Tables H1-H3). The teacher supply advantage for suburban districts persists at the middle and high school levels, but not at the elementary level. Again it appears that districts in the Central, Southwest, and Southeast regions are at a consistent disadvantage, with a greater disadvantage at the middle level. For example, large districts have almost 8 more middle level applications per position relative to small districts, suburban districts have 9 more middle level applications per vacancy relative to rural districts, and districts in the Southeast have 7 fewer middle level applications relative to those in the Northwest.

Turning to the relationship between subject area and teacher supply, as expected, I find greater teacher supply associated with English/language arts than with math and science, particularly at the middle school level (Table 23 and Figure 15). Table 23 shows the middle

school level has a teacher supply advantage over the high school level in these subjects. In fact, I find middle school English/language arts (and social studies) has the largest teacher supply at 10.1 while high school math and science has the lowest teacher supply at 2.8. In other words, for every middle school English/language arts and social studies position there are an average of 10 applications while there are fewer than 3 applications per high school math and science vacancy.

Table 23: Teacher Supply by Subject Area (Raw Differences)

Subject	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
MS Math & Science	61	174	992	**5.7**
HS Math & Science	82	270	751	**2.8**
MS ELA & SS	52	138	1,391	**10.1**
HS ELA	57	124	841	**6.8**

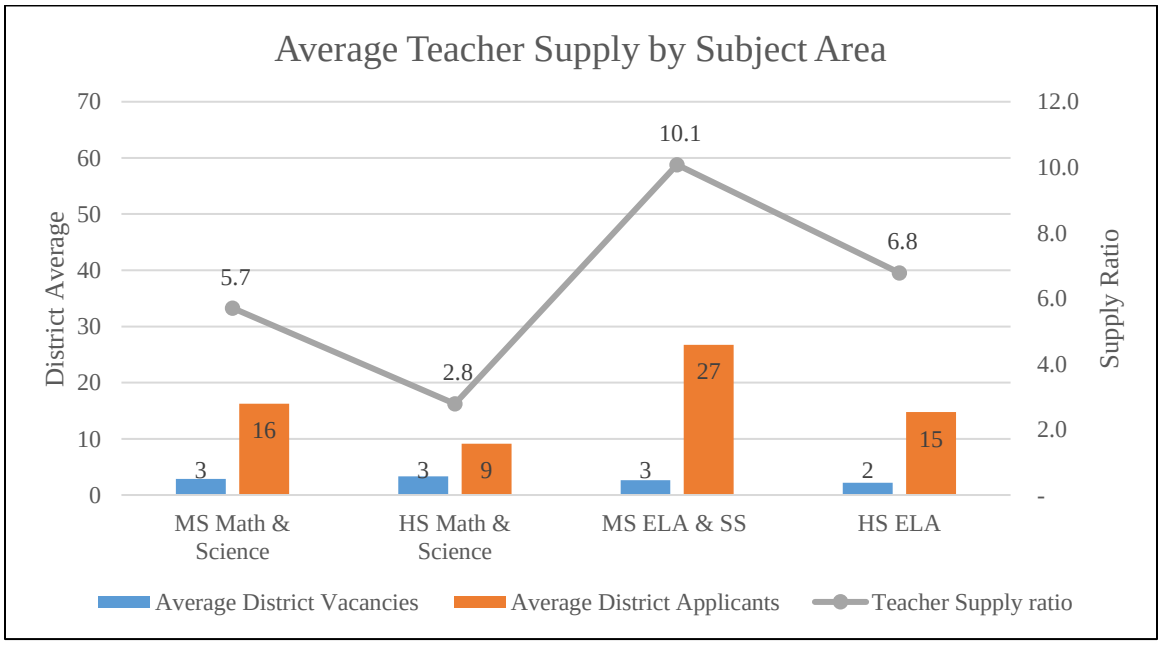


Figure 15: Average Teacher Supply by Subject Area (Raw Differences)

The multivariate analyses included in Appendix H, further examine the predictors of teacher supply by subject area. As with the examination of teacher supply by school level, I find a teacher supply advantage for large districts, however, this advantage is not significant in middle school math and science (Appendix Tables H4-H7). Suburban districts appear to have greater teacher supply, but it is not significant in middle school math and science. Middle school subjects appear to have a greater teacher supply disadvantage than high school subjects in all regions, relative to the Northwest. In particular, districts in the Northeast, Southwest, and Southeast see a larger significant teacher supply disadvantage for middle school math and science. The supply disadvantage for districts in the Central, Southwest, and Southeast regions for English/language arts and social studies is much larger at the middle school level. The teacher supply disadvantage in the Southeast is the greatest and persists across subjects and levels. For example, relative to small districts, large districts have almost 13 more applications per position in the area of middle school English/language arts and social studies. Similarly, suburban districts have 12 more applications per vacancy relative to rural districts, and districts in the Southeast have 15 fewer applications relative to those in the Northwest for these positions (Appendix Table H6).

In sum, these results indicate that teacher supply is most favorable at the middle school level, which is not what was expected based on the literature. Teacher supply is also positively associated with English/language arts (and social studies), as expected. The supply advantages appear to be greater for large districts while the supply disadvantages seem to vary somewhat depending on subject and region.

Supply Summary

I find that district size, urbanicity, and region have the most influence on teacher supply across Arkansas. In particular, districts that have the most favorable teaching supply are larger districts with enrollments greater than 3,500. Districts in the Northwest appear to have a significant advantage in attracting teachers, as do urban and suburban districts. Districts that face a greater challenge in attracting teaching supply are those in the Central, Southwest, and Southeast regions and those in rural areas. Examining teacher supply by school level and subject area, I find the middle school level and English/language arts have a significant advantage in attracting teachers.

Teacher Need

> **Research Question 3.** What are the characteristics of districts that have the greatest need for teachers?

Descriptive Analysis

Which district factors drive need? The teacher shortage literature suggests that the districts with the highest turnover are those that are large and urban, small and rural, and those with a higher percentage of poverty and higher percentage of minority students (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Murnane & Steele, 2007; Murphy et al., 2003). As teacher need is related to turnover, I examine the relationships between teacher need and district enrollment (size), urbanicity, and state regions. Again using the 2017 district survey, I define "need" as the ratio of vacancies over full time equivalent classroom teacher positions. FTE includes the number of K-12 certified personnel employed by the district as K-12 classroom teachers, librarians, counselors, psychologists, and other K-12 certified, non-administrative

employees paid from the Teacher Salary Fund (ADE, 2017c). Certified employees paid from federal funds are not included.[36] Essentially, my "need" represents what fraction of the teacher workforce the district needs to replace each year.

As with teacher supply, I examine district size and urbanicity separately and do not place them in a model together due to their strong correlations with each other and certain regions in the state. Region is modeled separately as districts in different regions likely face different levels of teacher need based on their ability to attract and retain teachers. Additionally, I look at the extent to which teacher need is related to district poverty rate, racial/ethnic diversity, educational success, beginning teacher salaries, and district growth, which may also influence teacher need. Correlations for these district characteristics are presented in Table 34. As previously, I first examine bivariate relationships between teacher need and these factors, any of which might be confounded by other factors, and then follow up using regression analyses to determine which consistent independent relationships remain.

How is teacher need related to district size (enrollment)?[37] One would expect that larger districts would provide more opportunities for teachers. With more opportunity, there is likely more teacher movement and turnover resulting in a greater need for teachers. However, it is also possible that small districts would have greater teacher need as they may have more difficulty in attracting applicants and keeping positions filled. Once again, I present district enrollment first by decile and then as a categorical variable.

[36] The mean unit of need is approximately 0.09 vacancies per 1 FTE classroom position, or 9 vacancies per 100 classroom positions.
[37] Regression models using enrollment as a continuous variable for need are included in Appendices A and I.

Using district enrollment by decile in Table 24, I find the greatest teacher need is found in the smallest districts, with districts in decile 1 having the most need (0.18). Interestingly, I find districts in deciles 2 and 3 have about the same rate of teacher need as the largest districts in decile 10 (0.10-0.11). The least teacher need is found in districts with enrollments of between 2,200-3,700 students in decile 9 (0.05). Note that the mean unit of teacher need statewide is approximately 9 vacancies for every 100 full time classroom teacher positions. This means that the smallest districts with enrollments of less than 375 students have 18 vacancies for every 100 FTE positions, or realistically for these small districts, roughly 2 vacancies for every 10 positions. In addition, districts with enrollments between 375-600 and districts with enrollments greater than 3,700 all have 10-11 vacancies per 100 available full time teaching positions. Figure 16 shows the relationship between the average numbers of district vacancies to full time classroom teacher positions in each decile.

In addition to examining district size by enrollment decile, I also use the categorical variable for district size in Table 25 and find somewhat similar results. I find that large districts with student enrollment greater than 3,500 have the greatest teacher need (0.10). However, when categorizing small districts as those with student enrollments less than 1,500, I find small districts have similar teacher need (0.08) to that of midsize districts (0.07). In other words, in a large school district there are an average of 10 vacancies for every 100 full time classroom positions, while there are approximately 8 vacancies per 100 posts in small and midsize districts. Figure 17 illustrates the relationship between average district vacancies and full time classroom positions for each type of district. While initial analysis indicates a relationship between teacher need and district size, it should be noted that large districts are concentrated in more urban areas, and those areas are found in certain regions of the state. Although using the "small" category for

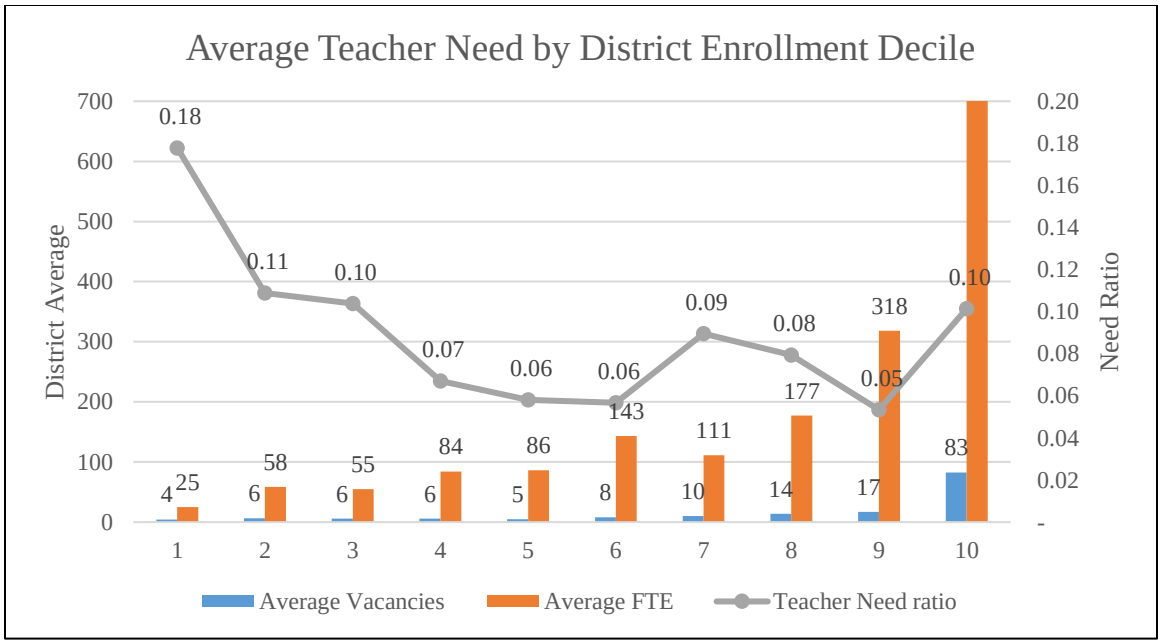
this variable masks the high teacher need of the smallest districts, once again enrollment does not appear to be linear so I use the categorical variable in the multivariate analysis.

Table 24: Teacher Need by Enrollment Decile[38]

Decile range		Decile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
56-371	smallest	1	27	18	80	450	**0.18**
384-487		2	26	17	108	991	**0.11**
493-599		3	26	21	119	1,146	**0.10**
614-779		4	26	17	96	1,430	**0.07**
781-905		5	26	20	100	1,720	**0.06**
908-1,180		6	27	15	122	2,148	**0.06**
1,188-1,567		7	26	23	229	2,555	**0.09**
1,583-2,111		8	26	19	267	3,366	**0.08**
2,248-3,693		9	26	16	272	5,095	**0.05**
3,829-22,759	largest	10	26	18	1,489	14,685	**0.10**
		Total	262	184	2,882	33,587	**0.09**

Note: Mean enrollment for 2016-17 = 1,821

[38] Survey response rates for deciles 1, 2, 4, 6, 9 and 10 were between 56-69%, while between 73-88% of districts in the remaining deciles provided information on the survey for this factor.



Note: Decile 1 = Smallest, Decile 10 = Largest

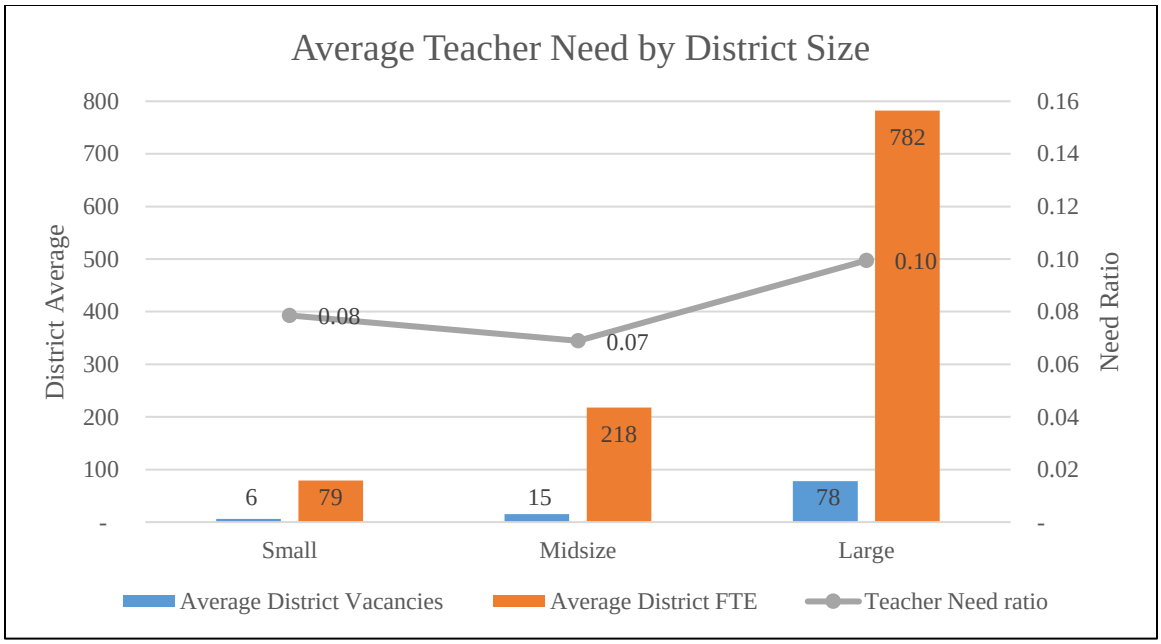
Figure 16: Average Teacher Supply by Enrollment Decile

Table 25: Teacher Need by District Size[39]

Size range	District Size	Type	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
< 1,500	Small	1	181	128	793	10,088	**0.08**
1,500-3,500	Midsize	2	51	36	541	7,849	**0.07**
> 3,500	Large	3	30	20	1,557	15,650	**0.10**
	Total	Total	262	184	2,891	33,587	**0.09**

Note: Mean Enrollment 2016-17 = 1,821

[39] Sixty seven percent of midsize districts and 71% of small and large districts provided information on the survey for this factor.



Note: Small district is <1,500, Midsize is 1,500-3,500, Large is >3,500

Figure 17: Average Teacher Need by District Size

How is teacher need related to urbanicity? The literature indicates teacher turnover is higher in urban districts, which will contribute to the number of vacancies in those districts (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2002; 2003; Malatras et al., 2017; Murphy et al., 2003). Similarly, rural districts also have difficulty attracting and retaining teachers (Aragon, 2016; Dee & Goldhaber, 2017; Malatras et al., 2017; Murphy et al., 2003; Will, 2016). As urbanicity designations are connected to population size, it is another way to consider and measure district size.

In Table 26, I find that city districts have the greatest need for teachers (0.10), almost double that of suburban districts (0.06). Districts in suburbs (0.06), towns (0.07), and rural areas (0.07) have similar rates of teacher need. That is to say, there are 10 vacancies for every 100 teachers in city school districts, but fewer than 7 vacancies per 100 positions in suburban, town, and rural districts. Figure 18 illustrates the relationship between average district vacancies and

full time classroom positions by urbanicity. While this initial analysis indicates a relationship between urbanicity and teacher need, it may also be influenced by the fact that the majority of urban districts are located in the Central region (68%).

Table 26: Teacher Need by Urbanicity[40]

NCES Urban-Locale Designation	Type	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
City	1	36	23	985	10,085	**0.10**
Suburb	2	20	10	287	4,928	**0.06**
Town	3	75	42	675	9,010	**0.07**
Rural	4	159	104	632	9,518	**0.07**
	Total	290	179	2,579	33,540	**0.08**

Note: The most recent NCES district urbanicity information from 2014-15 identifies 290 districts in the state including charter schools (NCES 2017a). There were 262 districts in the state in the 2016-17 school year.

[40] More than 64% of city and rural districts, and more than 50% of suburban and town districts provided information on the survey for this factor.

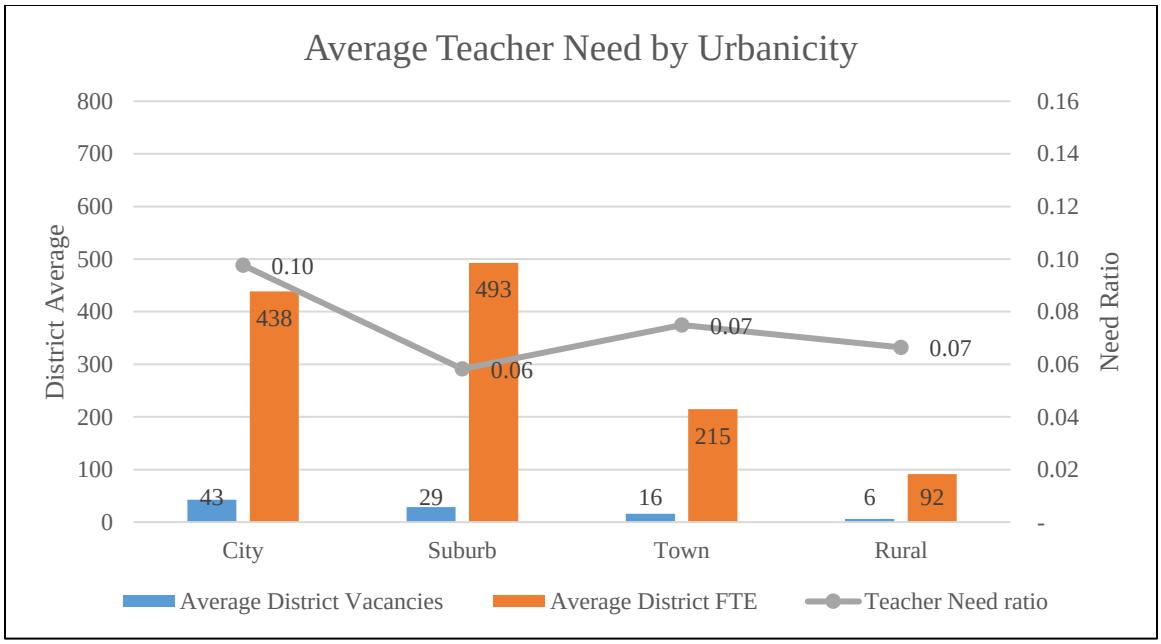


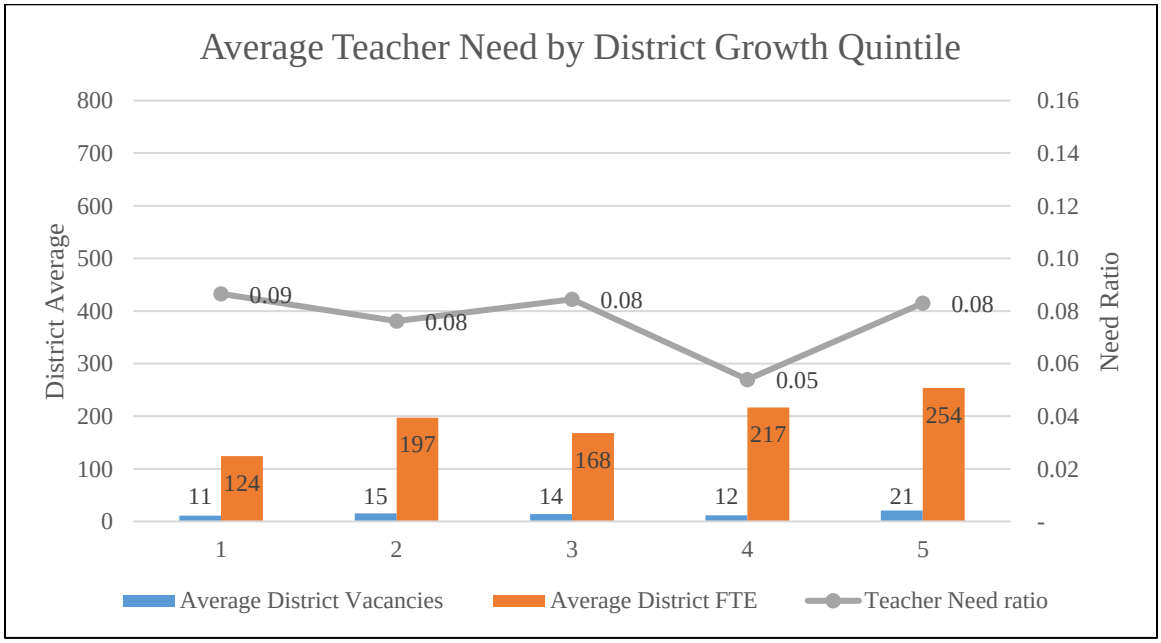
Figure 18: Average Teacher Need by Urbanicity

How is teacher need related to district growth? One would expect that growing districts would have more vacancies as new schools open, meanwhile, districts with decreasing student enrollments would require fewer teachers, relative to the entire faculty (Lindsay et al., 2016; Murnane & Steele, 2007; Murphy et al., 2003). Using the same district growth measure used previously, contrary to expectation, in Table 27 I find the rate of teacher need does not differ greatly between quintiles. Districts with the most positive growth and districts with the most negative growth have almost the same rate of teacher need (0.08 - 0.09). This lack of variation suggests that district growth may not greatly contribute to teacher need. However, particular regions of the state have seen considerable district growth while other regions have not or have seen declines in enrollment. Figure 19 illustrates the relationship between average district vacancies and full time classroom positions by district growth.

Table 27: Teacher Need by District Growth (5-year) Quintile[41]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
(-7.3) - (-1.84)	most -	1	50	39	420	4,853	**0.09**
(-1.81) - (-0.63)		2	50	33	495	6,500	**0.08**
(-0.61) - 0.302		3	50	40	568	6,726	**0.08**
0.309 - 1.48		4	50	30	351	6,504	**0.05**
1.49 - 79.8	most +	5	50	35	737	8,883	**0.08**
		Total	250	177	2,571	33,466	**0.08**

Notes: Mean District Growth 2012-13 to 2016-1717 = 0.69%. Average growth over five years relative to the first year, 2012-13.



Notes: Quintile 1 = Least growth, Quintile 5 = Most growth

Figure 19: Average Teacher Need by District Growth (5-year) Quintile

How does teacher need vary by region? Regions in the state vary in the amenities and opportunities they offer to prospective teachers. Certain regions, such as the Delta in Eastern Arkansas, may have greater difficulty than others in attracting teacher candidates. In Table 28,

[41] More than 60% of districts in quintiles 2 and 4, and at least 70% of districts in the remaining quintiles provided information on the survey for this factor.

as anticipated, I find support for the relationship between region and teacher need. Districts in the Central (0.11) and Southeast (0.14) regions have the greatest teacher need. The Northwest (0.07), Northeast (0.08), and Southwest (0.06) have similar teacher need but far less than the Central and Southeast. In other words, there are 11-14 vacancies per 100 teachers in districts in the Central and Southeast, while there are fewer than 8 vacancies per 100 teachers in districts in the Northwest, Northeast, and Southwest. This pattern suggests that districts in the Central and the Southeast face greater challenges with teacher turnover than do other districts across the state. However, the Central region is the most urban part of the state and the Southeast is one of the most rural. Figure 20 illustrates the relationship between average district vacancies and FTE classroom teachers by region.

Table 28: Teacher Need by Region[42]

Region	Type	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
NW	1	79	55	796	11,773	**0.07**
NE	2	67	48	519	6,842	**0.08**
Central	3	54	33	1,080	9,503	**0.11**
SW	4	38	25	212	3,502	**0.06**
SE	5	24	23	284	1,967	**0.14**
	Total	262	184	2,891	33,587	**0.09**

[42] More than 70% of districts in the Northwest and Northeast, more than 61% of districts in the Central and Southwest, and 96% of districts in the Southeast provided information on the survey for this factor.

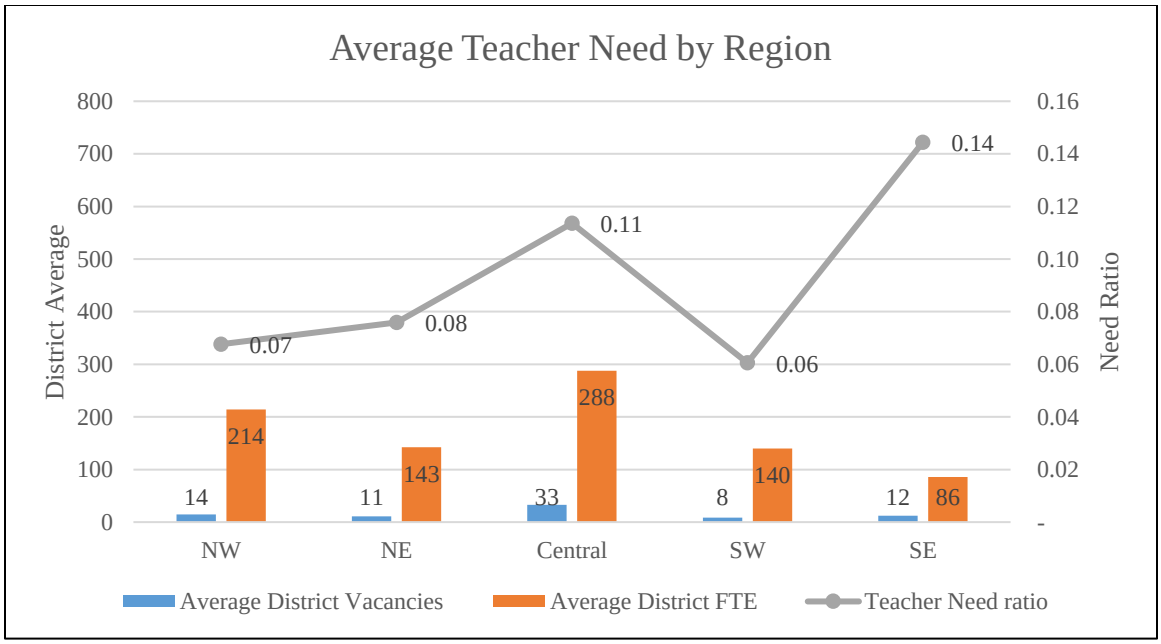


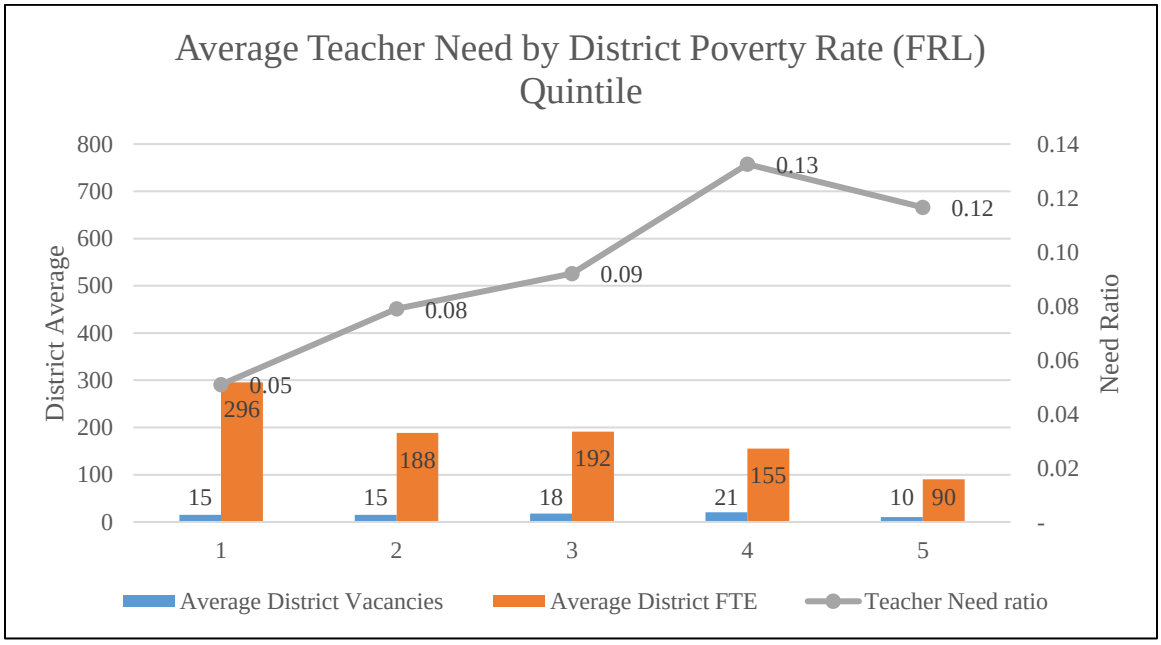
Figure 20: Average Teacher Need by Region

How is teacher need related to district poverty rate? As mentioned previously, the literature indicates that highly disadvantaged schools and districts (i.e. more poor, more minorities) have greater difficulty attracting and retaining teachers, have the highest rates of turnover, and thus the most teacher vacancies (Aragon, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Loeb & Reininger, 2004; Malatras et al., 2017; Murnane & Steele, 2007; Murphy et al., 2003). In Table 29, as expected, I show that districts with the highest percentage of FRL students, the most poor, have the greatest rates of teacher need (4th quintile with 0.14, 5th quintile with 0.13) while the least poor districts have the lowest rates of teacher need (1st quintile with 0.05). This means that the poorest districts have 12-13 vacancies per 100 FTE positions while the wealthiest districts have less than 5 vacancies per 100 FTE positions. High poverty is often associated with very urban or very rural areas. Figure 21 illustrates the relationship between average district vacancies and FTE teaching positions by poverty quintile.

Table 29: Teacher Need by District Poverty Rate (FRL) Quintile[43]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
0-0.54	least poor	1	56	36	542	10,647	**0.05**
0.55-0.64		2	52	35	521	6,595	**0.08**
0.64-0.71		3	51	37	652	7,086	**0.09**
0.72-0.76		4	53	38	781	5,893	**0.13**
0.77-1	most poor	5	49	37	388	3,330	**0.12**
		Total	261	183	2,884	33,551	**0.09**

Note: Mean %FRL 2016-17 = 65%. Poverty rate for Northwest Classical Academy not reported.



Note: Quintile 1 = Least poor, Quintile 5 = Most poor

Figure 21: Average Teacher Need by District Poverty Rate (FRL) Quintile

How is teacher need related to district racial/ethnic diversity? As stated previously, it is likely that districts with greater racial/ethnic diversity would have greater teacher need than those with less racial/ethnic diversity (Aragon, 2016; Dee & Goldhaber, 2017; Loeb &

[43] More than 64% of districts in quintiles 1 and 2, and at least 72% of districts in the remaining quintiles provided information on the survey for this factor.

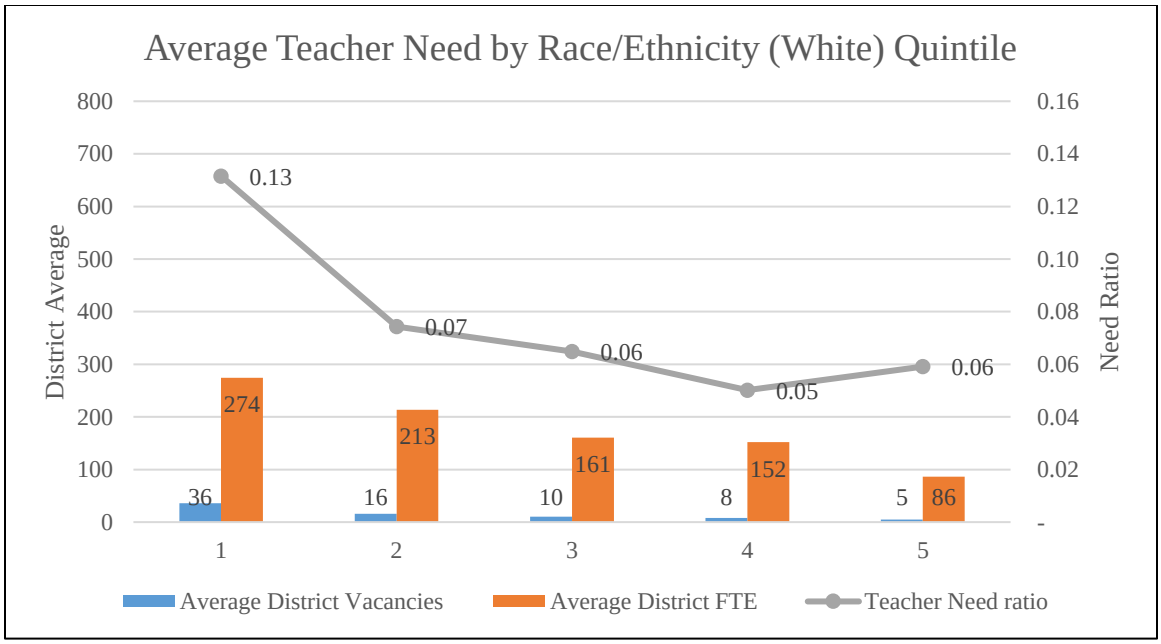
Reininger, 2004; Murnane & Steele, 2007; Murphy et al., 2003). However, remember that Arkansas also has some very poor rural areas with mostly white students. Using quintiles of the percent of white students in a district as a measure of diversity, in Table 30 I find that districts with the lowest percentage of white students (quintile 1) have the highest teacher need (0.13). Meanwhile, districts with the highest percentage of white students (quintiles 4 and 5) have far less teacher need. In fact, the rate of teacher need for quintile 3 (0.06), quintile 4 (0.05) and quintile 5 (0.06) is less than half the rate of quintile 1 (0.13). Poverty rates are often related to racial/ethnic diversity and urbanicity. Figure 22 illustrates the relationship between average district vacancies and classroom teaching positions by white quintile.

Table 30: Teacher Need by District Race/Ethnicity (White) Quintile[44]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
0-0.44	least white	1	54	41	1,479	11,241	**0.13**
0.47-0.71		2	53	36	571	7,682	**0.07**
0.72-0.87		3	51	35	365	5,624	**0.06**
0.88-0.93		4	60	43	328	6,536	**0.05**
0.94-0.98	most white	5	44	29	148	2,503	**0.06**
		Total	262	184	2,891	33,587	**0.09**

Note: Mean %White 2016-17 = 70%.

[44] More than 66% of districts in quintiles 2, 3, and 5, and more than 72% of districts in quintiles 1 and 4 provided information on the survey for this factor.



Note: Quintile 1 = Least White, Quintile 5 = Most White

Figure 22: Average Teacher Need by District Race/Ethnicity (White) Quintile

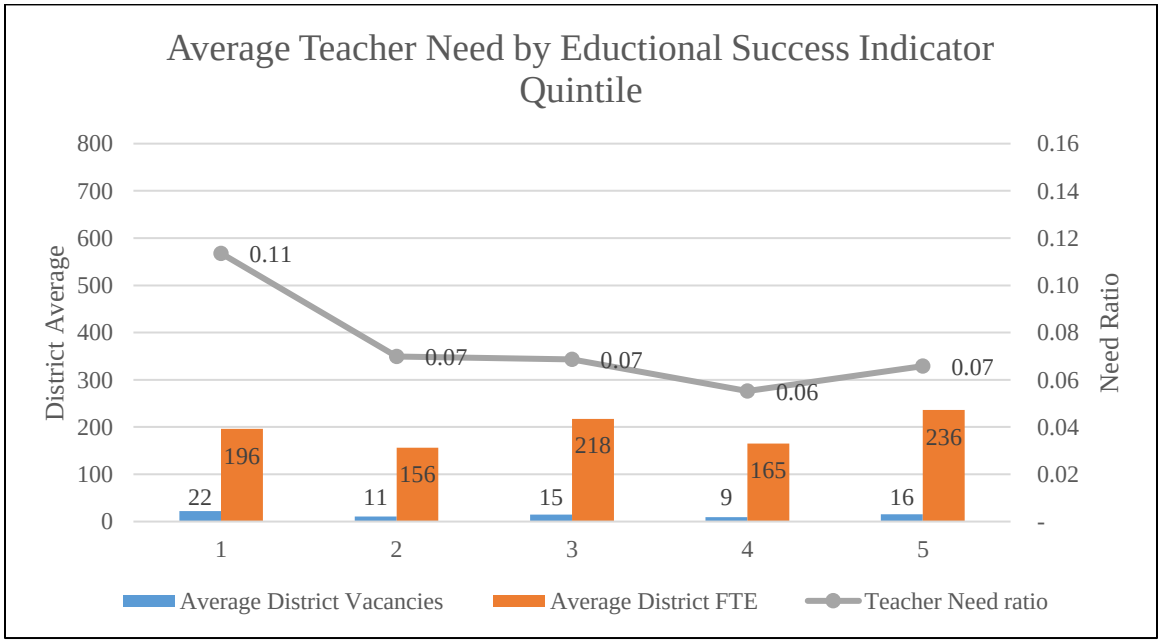
How is teacher need related to district educational success? Greater teacher turnover has been associated with schools and districts with lower academic achievement (Aragon, 2016; Hanushek et al., 2004; Loeb & Reininger, 2004). As such, one would expect that lower achieving districts would have greater teacher need than higher achieving districts. Employing the same district educational success indicator used earlier, in Table 31 I find some support for this hypothesis. Districts with the lowest educational success (quintile 1 at 0.11) have the highest rate of teacher need. However, the remaining four quintiles of educational success have similar lower rates of teacher need (0.06-0.07). Educational success only appears to be a factor related to teacher need for the lowest performing districts. For every 100 positions in the lowest achieving districts, there are 11 vacancies. Figure 23 illustrates the relationship between average district vacancies and full time teaching positions by educational success. While there appears to be a relationship between educational success and teacher need, poverty and urbanicity are often

related to educational success. Therefore, it is uncertain to what extent district educational success is independently associated with teacher need from this initial analysis.

Table 31: Teacher Need by District Educational Success Indicator Quintile[45]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
(-2.50) - (-0.47)	lowest	1	49	35	779	6,861	**0.11**
(-0.45) - (-0.07)		2	49	36	393	5,628	**0.07**
(-0.06) - 0.25		3	48	31	463	6,745	**0.07**
0.25 - 0.54		4	49	34	310	5,611	**0.06**
0.54 - 3.50	highest	5	48	36	560	8,511	**0.07**
		Total	243	172	2,505	33,356	**0.08**

Notes: Mean for 2016-17 = 0.05 SD. Educational Success = (0.25) ACT Aspire Math + (0.25) ACT Aspire Reading + (0.25) Grad rate + (0.25) Gr.11 ACT Math-Reading Composite. Total number of districts reflects those with the data required to create an Educational Success Indicator (composite). Districts missing graduation rate or assessments are not included.



Notes: Quintile 1 = Lowest, Quintile 5 = Highest

Figure 23: Average Teacher Need by District Educational Success Indicator Quintile

[45] More than 65% of districts in quintiles 3 and 4, and at least 71% of districts in the remaining quintiles provided information on the survey for this factor.

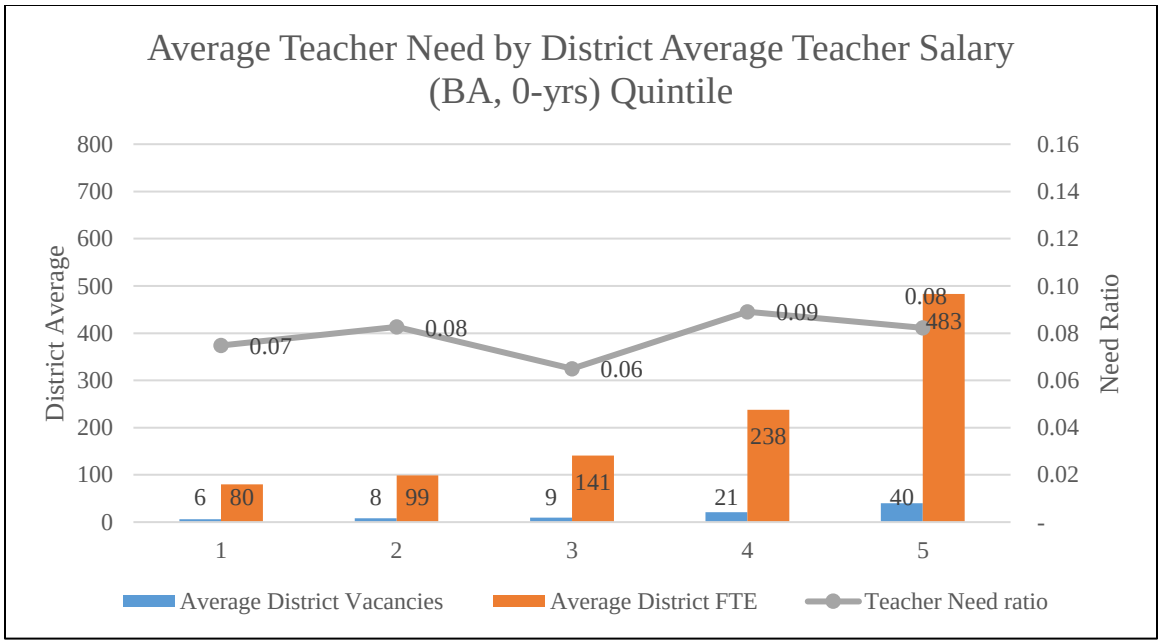
How is teacher need related to salary offered to new teachers? The variation in teacher salaries among districts may influence the ability of districts to retain and attract teachers (Hanushek et al., 2004; Loeb & Reininger, 2004). Teachers may leave positions for better paying jobs or districts, or they may stay if adequately compensated. Thus, I would hypothesize that districts with lower beginning teacher salaries would have greater teacher need. However, in Table 32, I do not find the expected relationship between teacher salary and teacher need, as the rate of teacher need does not differ greatly by quintile (0.06 – 0.09). That is, the lowest paying districts and highest paying districts have nearly the same rate of teacher need. As with district growth, this lack of variation suggests that teacher salary may not be a factor that contributes greatly to teacher need. However, it may also be that teacher pay is endogenous with districts paying as much as they must to reach an acceptable rate of need. Figure 24 illustrates the relationship between average district vacancies and FTE classroom positions by beginning teacher salary.

Table 32: Teacher Need by District Average Teacher Salary (BA, 0-years) Quintile[46]

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
$29,000 - 31,400	lowest	1	52	36	216	2,890	**0.07**
31,440 - 32,250		2	51	34	277	3,353	**0.08**
32,305 - 33,508		3	52	30	275	4,234	**0.06**
33,774 - 36,832		4	51	36	763	8,566	**0.09**
36,886 - 47,016	highest	5	51	30	1,191	14,481	**0.08**
		Total	257	166	2,722	33,525	**0.08**

Notes: Mean Teacher Salary BA0yrs 1617 = $34,020. Salary not reported for Arkansas School of the Blind, Arkansas School of the Deaf, Division of Youth Services Schools, Arkansas Virtual Academy, and Quest Middle School of Pine Bluff.

[46] More than 58% of districts in quintiles 3 and 5, and at least 67% of districts in the remaining quintiles provided information on the survey for this factor.



Note: Quintile 1 = Lowest salary, Quintile 5 = Highest salary

Figure 24: Average Teacher Need by District Average Teacher Salary (BA, 0-years) Quintile

To recap the descriptive relationships for teacher need thus far, I categorize districts into those with the greatest teacher need (need ratio greater than 0.13), average teacher need (ratio between 0.05 and 0.13), or least teacher need (ratio less than 0.05).[47] In Table 33 below, I find 29% of districts in the sample represented in the greatest teacher need category. Relative to the state, over-represented in the greatest need category are both small districts with student enrollments of less than 1,500 and large districts with enrollments greater than 3,500, urban districts, districts in the Northeast, Central, and Southeast regions, poorer districts, more racially diverse districts, the lowest achieving districts, and districts with the most growth. In the least teacher need category, I find 22% of districts in the sample represented. Relative to the state, it

Table 33: Summary of Teacher Need Indicators

[47] Categories determined by percentile ranking with 0.05 at the 25th percentile and 0.13 at the 75th percentile.

Indicators	Greatest Teacher Need (> 0.13)	Average Teacher Need	Least Teacher Need (< 0.05)	Sample Total	State Total
N of Districts	54	91	41	186	262
% of Sample	29%	49%	22%	100%	
Need Range	0.13 - 1.23	0.05 - 0.13	0 - 0.05	0 - 1.23	
Mean Need	0.24	0.09	0.03	0.09	
District Size					
% Small (< 1,500)	69%	67%	23%	68%	68%
% Midsize (1,500 - 3,500)	19%	19%	27%	20%	20%
% Large (> 3,500)	13%	14%	9%	12%	11%
Urbanicity					
% City	20%	9%	14%	12%	14%
% Suburb	6%	5%	20%	5%	8%
% Town	26%	22%	23%	24%	29%
% Rural	44%	64%	24%	58%	61%
Region					
% NW	19%	26%	35%	28%	30%
% NE	30%	26%	22%	27%	26%
% Central	22%	23%	3%	18%	21%
% SW	9%	13%	35%	14%	15%
% SE	20%	11%	9%	12%	9%
Mean Enrollment	2,060	1,989	1,891	1,988	1,822
Mean % FRL	72%	65%	61%	66%	65%
Mean % White	53%	75%	80%	69%	70%
Mean Educational Success (sd)	-0.29	0.13	0.25	0.05	0.05
Mean Beginning Teacher Salary (BA, 0-yrs)	$33,940	$34,017	$34,139	$34,022	$34,020
Mean % District Growth	2.15%	-0.38%	1.86%	0.82%	0.69%

Notes: Need categories determined by percentile ranking with 0.05 at the 25th percentile and 0.13 at the 75th percentile. Sample Total includes all districts with need ratios (with vacancy and FTE information). Educational Success Indicator is in standard deviation units.

appears midsize districts with enrollments between 1,500-3,500, suburban districts, districts in the Northwest and Southwest regions, wealthier districts, whiter districts, the highest achieving districts, and districts with high growth are over-represented in the least need category. Beginning teacher salary does not appear to be greatly associated with teacher need. In general, districts serving more disadvantaged students, defined in various ways, faced the greatest need

most likely due to teacher turnover. As many of these factors are related to each other I turn to multivariate analysis to ascertain these relationships.

Multivariate Analysis

What is driving teacher need? Looking at the correlations between the factors believed to be associated with teacher need in Table 34, I find that district growth and poverty level are significantly positively correlated with need, while educational success and percent white are significantly negatively correlated with need. District enrollment, new teacher starting salary, district size, and urbanicity do not appear to be directly correlated with need but are significantly correlated with the components of need (vacancies and FTE positions).[48] Based on the descriptive statistics and correlations presented, it is unclear which factors will predict teacher need when all variables are considered simultaneously.

To disentangle these relationships, multivariate analysis is needed to determine the drivers of teacher need. The same types of models used for supply will be used for need. As with supply, enrollment and region will be included in the same models, and region and urbanicity will be included in the same models, but enrollment and urbanicity will not be included in models together due to multicollinearity.

[48] Urbanicity is included in the correlation matrix due to its ordinal nature.

Table 34: Correlations: Variables Associated with Need

	Need	Total Vacancies	Total Applicants	Enrollment	District Growth	Achievement	Tsalary Ba0Yrs	FRL	White	District Size	Urbanicity
Need	1										
Total Vacancies	0.16**	1									
Total FTE	-0.07	0.68***	1								
Enrollment	-0.06	0.73***	0.99***	1							
District Growth	0.24***	0.03	-0.03	0.01	1						
Educational Success	-0.27***	-0.03	0.07	0.11*	0.28***	1					
Tsalary Ba0Yrs	-0.09	0.43***	0.55***	0.61***	0.23***	0.25***	1				
FRL	0.20***	-0.02	-0.16***	-0.19***	-0.23***	-0.66***	-0.44***	1			
White	-0.39***	-0.29***	-0.19***	-0.18***	0.01	0.62***	-0.19***	-0.39***	1		
District Size	0.02	0.63*	0.82*	0.83*	0.20*	0.14	0.57*	-0.34*	0.32*	1	
Urbanicity	-0.07	-0.55*	-0.68*	-0.63*	-0.03	0.11	-0.48*	0.07	-0.48*	0.48	1

Note: *** p<0.01, ** p<0.05, * p<0.1

Multivariate Regression Models

As with supply, the multivariate regression analysis models include three types: 1) separate models for district enrollment (using the categorical variable district size), urbanicity, and region, without variables controlling for demographics, educational success, teacher salary, or district growth; 2) models with both district enrollment (district size) and region, with and without control variables; and 3) models with both region and urbanicity, with and without control variables. Results for the nine regression models are presented in Table 35.

Results of Multivariate Regression

Here I examine whether the drivers of teacher supply are also driving teacher need. The descriptive data suggests the main drivers of teacher need are district enrollment (using the categorical variable district size)[49], urbanicity, and region. Additionally, it appears that poverty and race also influence teacher need.

In Table 35, I examine separately simple models for each (models 1-3). The first three individual models somewhat support the descriptive results.[50] Model 1 indicates that this measure of district size (using enrollment) is not associated with teacher need; there is no significant difference in need between large, midsize, or small districts. Model 2 looks at the association between teacher need and urbanicity. Results show that city districts have

[49] Multivariate regressions using enrollment as a continuous (linear) variable are included in Appendix I.

[50] The descriptive need (and supply) ratios are based on weighted averages for each group while the simple regressions are based on unweighted averages (treat districts in an unweighted way). Therefore, the descriptive ratios and simple regression coefficients show slightly different relationships.

Table 35: Predictors of Need

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region (no controls)	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity (no controls)	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.013			-0.011	-0.007	0.002			
	(0.022)			(0.019)	(0.024)	(0.018)			
Large districts (> 3,500)	-0.015			-0.049	-0.075*	0.014			
	(0.017)			(0.035)	(0.045)	(0.028)			
City (urbanicity 1)		0.093*					0.079*	0.041	-0.031
		(0.051)					(0.043)	(0.049)	(0.025)
Suburb (urbanicity 2)		0.021					0.017	0.031	0.028
		(0.037)					(0.034)	(0.033)	(0.031)
Town (urbanicity 3)		0.014					0.006	-0.004	-0.005
		(0.013)					(0.012)	(0.016)	(0.014)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			0.014	0.012	0.004	0.010	0.023*	0.014	0.009
			(0.011)	(0.012)	(0.012)	(0.011)	(0.013)	(0.011)	(0.011)
Central (Region 3)			0.114**	0.123**	0.082**	0.015	0.058**	0.055**	0.019
			(0.048)	(0.052)	(0.035)	(0.016)	(0.028)	(0.026)	(0.014)
SW (Region 4)			0.009	0.004	-0.034	-0.011	0.020	-0.005	-0.015
			(0.019)	(0.020)	(0.025)	(0.018)	(0.020)	(0.019)	(0.017)
SE (Region 5)			0.059***	0.053***	-0.022	0.028	0.068***	0.027	0.021
			(0.018)	(0.019)	(0.037)	(0.020)	(0.019)	(0.025)	(0.021)
District %FRL					0.071	0.067		0.136*	0.077
					(0.076)	(0.069)		(0.075)	(0.055)
District %White					-0.171**	-0.066*		-0.069	-0.092**
					(0.076)	(0.037)		(0.055)	(0.040)
Educational Success						0.001			0.005
						(0.012)			(0.012)
Teacher Salary BA, 0-yrs (in $1,000s)						-0.0002			-0.0002
						(0.002)			(0.002)
District Growth						0.002			0.002
						(0.002)			(0.002)
Constant	0.125***	0.099***	0.088***	0.096***	0.194**	0.195**	0.075***	0.051	0.188*
	(0.014)	(0.006)	(0.008)	(0.011)	(0.096)	(0.097)	(0.011)	(0.081)	(0.100)
Observations	186	184	186	186	185	178	184	183	178
R-squared	0.002	0.072	0.095	0.107	0.227	0.167	0.119	0.184	0.185

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Constant: Small districts, NW = Region 1, Rural. Mean unit of need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

significantly greater need than districts in rural, town, or suburban areas with 9 vacancies for every 100 classroom positions in city districts. Remember that the mean unit of overall teacher need is 9 vacancies for every 100 positions. Model 3 examines the relationship between teacher need and region and reveals that districts in the Central and Southeast regions have greater need relative to districts in the Northwest, Northeast, and Southwest. In fact, districts in the Central region have 11 vacancies per 100 full time equivalent positions relative to districts in the Northwest, Northeast, and Southwest, and 5 more vacancies than districts in the Southeast. Standing alone, the models using urbanicity as the measure of district size and region confirm what I find in the descriptive relationships.

Once again, as both enrollment and urbanicity are similar measures of district size, I do not include them in models together. The remaining six models presented combine region with each measure of district size; models 4-6 include enrollment and region, models 7-9 include region and urbanicity. When either measure of district size (enrollment or urbanicity) and region are included in models together, it appears the influence of region persists and district size diminishes. In models 4 and 7, the coefficients and relationships are similar to those seen in the simple models. In model 4, enrollment as a measure of district size does not seem to matter. In model 7, city districts have greater need than rural, town, or suburban districts. In both models, teacher need is greater in the Central and Southeast regions. However, need appears to matter more in the Northeast when using urbanicity and region together. As with the simple models, it appears that urbanicity is a stronger indicator of district size.

In models 5 and 8, I examine the extent to which including student characteristics such as race and poverty in the combined models influence the estimates. In these models, I find that

including race and poverty diminishes the association between teacher need and region, particularly in the Southeast. However, the relationship between district size and region appears stronger in model 5, with less teacher need found in large districts. I find the coefficients on race and poverty in the predicted direction in both models but not consistently significant. Race appears to matter more when using enrollment while poverty appears to matter more when using urbanicity. It may be that race displaces region as the racial compositions of regions differ a great deal (see Table 9).

Finally, in models 6 and 9, I examine whether including educational success, teacher salary, and district growth affect the estimates. Adding these new indicators reduces coefficients further as more variation is shared. District size does not matter using either measure (enrollment or urbanicity). Region only appears to matter in the model including enrollment, where teacher need persists in the Southeast. It appears that race (and poverty) displaces need in the Central region when these new indicators are added. Race is more strongly associated with teacher need in both models. Poverty points in the right direction but is only significant in the model including urbanicity and region.

The results of the regressions indicate that urbanicity and region matter, as do race and poverty. I consistently see the following relationships influencing teacher need:

- city districts have greater teacher need;
- districts in the Central and Southeast have greater need than districts in other regions; and
- higher racial/ethnic diversity and higher poverty are associated with greater need.

Other indicators included in the models appear to add more predictive power and reduce the magnitude and significance of the variables mentioned above. The key drivers of teacher need are urbanicity and region.

Research Question 4. Does need differ by school level or subject?

How does need vary by subject and grade level?[51] As with supply, I examine teacher need by elementary (K-4), middle school (5-8), and high school (9-12) levels as designated in the online survey. I expect to find greater teacher need at the high school level, as growing student enrollments age into secondary grades and class sizes increase further at the high school level, more teachers are needed (Behrstock-Sherratt, 2016; Cowan et al., 2016; Cross, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Murphy et al., 2003). I also look at teacher need by subject - middle school math and science[52]; middle school English/language arts (and social studies); high school math and science; and high school English/language arts. I expect to find greater teacher need in math and science than in language arts, as individuals with these degrees have more employment opportunities, which could increase turnover in these subjects (Behrstock-Sherratt, 2016; Cowan et al., 2016; Cross, 2016; Dee & Goldhaber, 2017; Ingersoll, 2001; 2003; Malatras et al., 2017; Murnane & Steele, 2007; Murphy et al., 2003).

As expected, I find greater teacher need associated with the high school level (Table 36 and Figure 25). However, it appears that teacher need is similar at the elementary level. At the

[51] FTE by grade and subject variables were created using de-identified teacher-level data that included grade/class assignments.
[52] Math and science does not include computer science or career technical education (CTE) courses.

high school level, there are 15 vacancies for every 100 full time teaching positions, while there are 13 vacancies for every 100 positions at the elementary level.

Table 36: Teacher Need by School Level (Raw Differences)

School Level	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
Elementary	185	1,406	10,499	**0.13**
Middle School	185	884	9,064	**0.10**
High School	185	1,226	8,440	**0.15**

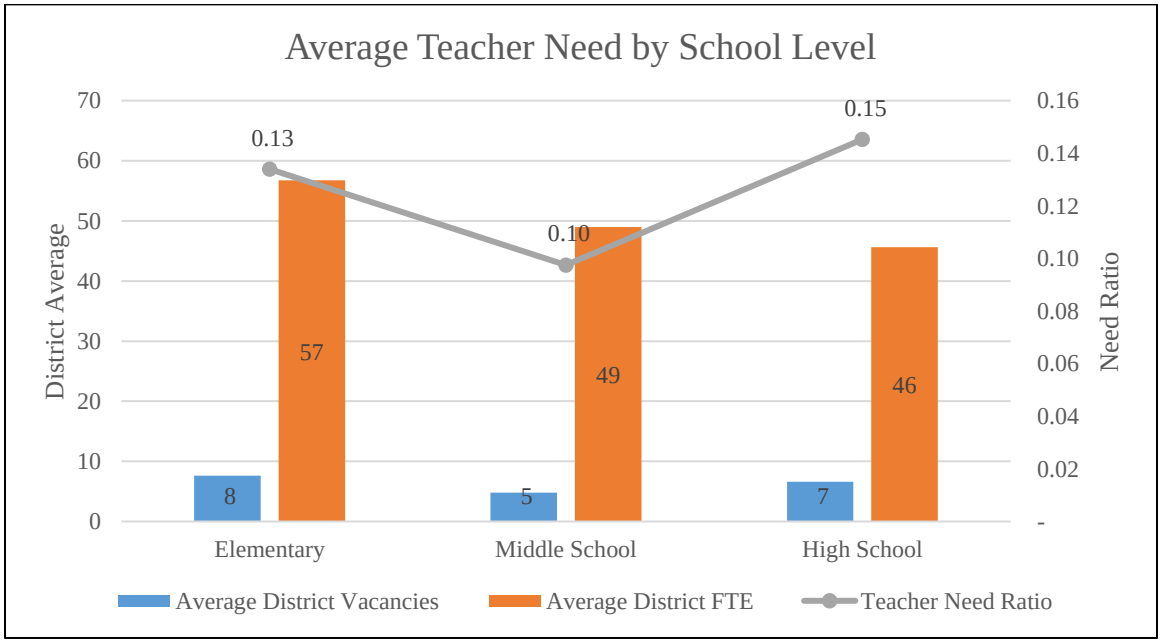


Figure 25: Average Teacher Need by School Level (Raw Differences)

Additional analyses included in Appendix J, examine the predictors of teacher need by school level as well. Results are somewhat similar to those in the overall analysis of teacher need presented above. There appears to be significantly less teacher need in large and midsize districts relative to small districts at all school levels (Appendix Tables J1-J3). Unlike the overall analysis, there appears to be significantly less need in suburban districts relative to rural

districts, particularly at the elementary and high school levels. Furthermore, teacher need does not appear to be associated with region, poverty level, ethnic/racial diversity, district educational success, beginning teacher salary, or district growth at any school level.

Turning to the relationship between subject area and teacher need, contrary to expectations, I find similar rates of teacher need associated with math and science and English/language arts (Table 37 and Figure 26). However, teacher need is greater at the high school level for both math and science and English/language arts than at the middle school level. I find there are 14 vacancies per 100 FTE positions for high school math and science, while there are 8 vacancies per 100 math and science positions at the middle school level. Similarly, it appears there are 12 vacancies per 100 classroom teaching positions for high school English/language arts, while there are 6 vacancies per 100 positions in middle school English/language arts (and social studies).

Table 37: Teacher Need by Subject Area (Raw Differences)

Subject	N of responses	Total Vacancies	Total FTE	Teacher Need ratio
MS Math & Science	151	174	2,168	**0.08**
HS Math & Science	150	270	1,889	**0.14**
MS ELA & SS	153	138	2,482	**0.06**
HS ELA	147	124	1,001	**0.12**

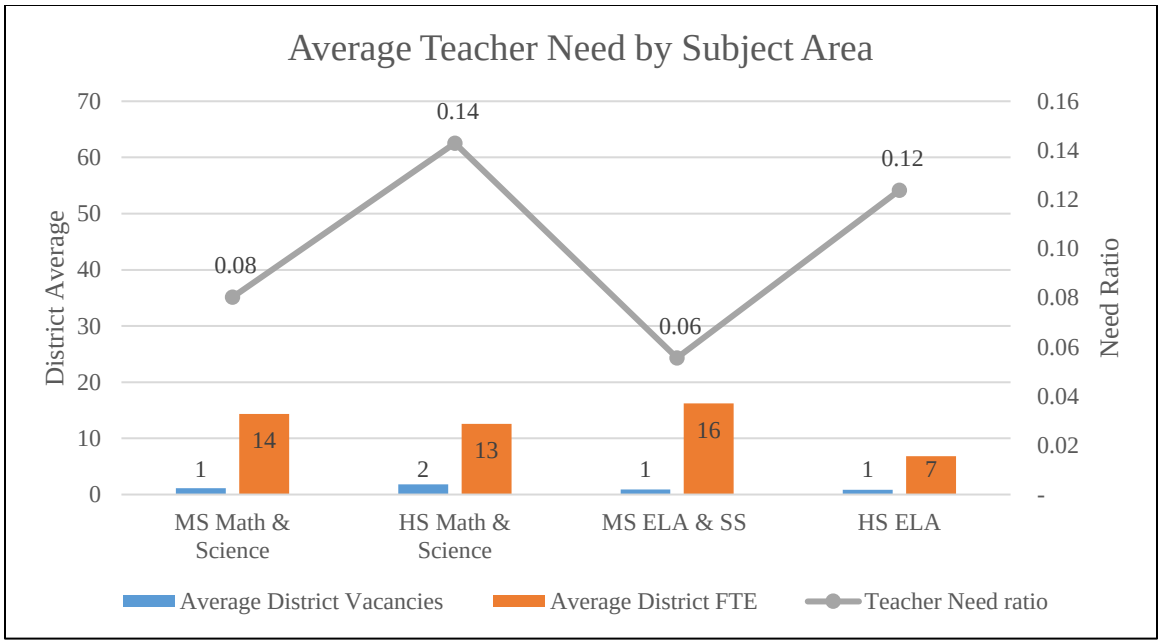


Figure 26: Average Teacher Need by Subject Area (Raw Differences)

Additional analyses included in Appendix J, further examine the predictors of teacher need by subject area. Similar to the findings by school level, I find significantly less teacher need in large and midsize districts relative to small districts, particularly for the high school subjects (Appendix Tables J4-J7). Additionally, there is significantly less teacher need in suburban districts relative to rural districts, with the least need in high school math and science. Region is associated with significantly greater teacher need for math and science. It appears there is greater teacher need for middle school math and science teachers in the Northeast and Southeast regions, and greater need for high school math and science teachers in the Central region. Teacher need also appears to be associated with poverty level and high school language arts. Teacher need does not appear to be related to ethnic/racial diversity, district educational success, beginning teacher salary, or district growth for these subjects at any school level.

In sum, these analyses indicate that teacher need is significantly associated with district size at all school levels and subjects with the greatest need in small districts. Furthermore, there

appears to be significantly less teacher need in suburban districts across school levels and subjects. The relationship between teacher need and region varies by subject and level, with the greatest need found in high school math and science and English/language arts in the Central region.

Need Summary

Examining the district characteristics believed to contribute to teacher need, I find that urbanicity and region have the most influence. In particular, districts that have the greatest teaching need are city districts and districts in the Central and Southeast regions. Teacher need does not appear to be as high in districts in the Northwest, Northeast, or Southwest; moreover, it is not greatly associated with district educational success, teacher salary, or district growth. District size and urbanicity become a factor when looking at teacher need by school level and subject. Here, I find the greatest teacher need in small districts and the least teacher need in suburban districts at all school levels. Teacher need by subject appears to vary by region but appears greatest for the high school subjects.

Teacher Supply and Teacher Need

What is the relationship between teacher supply and teacher need? One would assume there is a relationship between teacher supply and teacher need, however, theoretically the relationship is not clear. What kind of relationship should we find? I would expect that districts with the least need would have greater supply as these may be more desirable districts with fewer vacancies and more applicants. It is also possible that districts with greater need might also have greater supply as districts in desirable areas expand and attract more applicants.

On the other hand, districts with the least need may also have poor supply as these districts have little turnover and few vacancies available, so prospective teachers may not apply to districts that are "long shots". I would also suspect that districts with greater need might have poor supply as these districts may have difficulty in attracting applicants, or more turnover and vacancies. There may be a push toward both high teacher need and less teacher need. I examine the relationship between teacher supply and teacher need below.

Looking at the raw relationship between teacher need and teacher supply depicted in the scatterplot in Figure 27, greater teacher need appears to be associated with poor teacher supply. However, lower teacher need also appears to be distributed across the range of supply. Examining the correlation between teacher supply and teacher need, I find them to be modestly (but statistically significantly) negatively associated ($r(178) = -0.18$, $p = 0.018$).

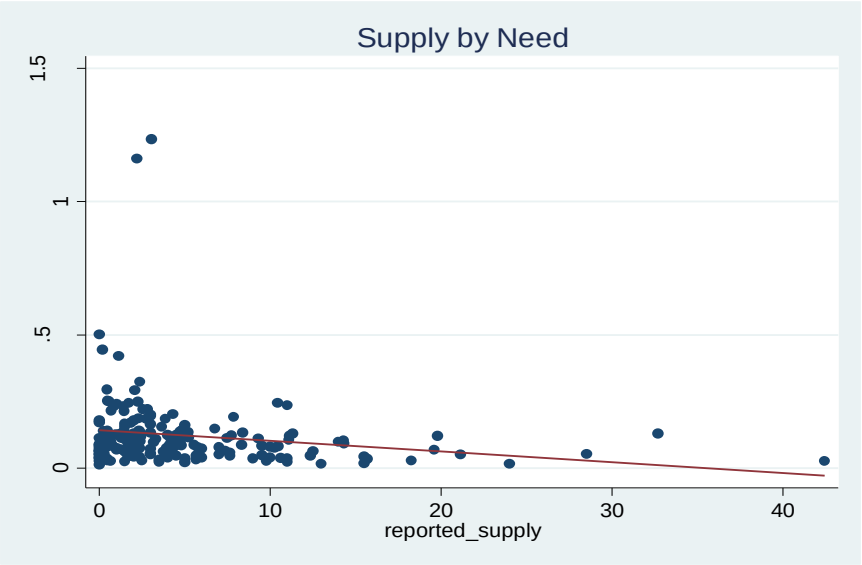


Figure 27: Supply by Need[53]

[53] The outliers for reported need (>1.0) include two charter school districts, Capitol City Lighthouse Academy and Little Rock Preparatory Academy. The outliers for reported supply (>30) include Bentonville and Jonesboro School Districts.

Examining the cross-tabulation of teacher supply by teacher need in Table 38, I find districts with the greatest need also have the least favorable supply (34%) and districts with the least need have some of the most favorable supply (40%). Chi-squared from one-way ANOVA indicates that teacher supply and teacher need are not independent and observed differences are significant. While there does not appear to be much of a relationship between supply and need based on Figure 27, the chi-squared test indicates a relationship at the tails.

Table 38: Supply by Need

	Supply			
Need	**Least Favorable Teacher Supply**	**Average Teacher Supply**	**Most Favorable Teacher Supply**	**Total**
Least Teacher Need	**9**	**18**	**17**	44
	20%	20%	40%	25%
Average Teacher Need	**20**	**47**	**22**	89
	45%	51%	52%	50%
Greatest Teacher Need	**15**	**27**	**3**	45
	34%	29%	7%	25%
Total	44	92	42	178
	100%	100%	100%	100%
Pearson chi2(4) = 13.2005		Pr = 0.010		

Note: 'Least' categories include the bottom quartile, 'Average' categories include middle two quartiles, 'Most/Greatest' categories include top quartile.

Returning to the overall results of the multivariate regressions for teacher supply and teacher need seen previously in Tables 21 and 35, there appears to be at least three very clear relationships. First, I find both lower teacher supply and greater teacher need for the Central and Southeast regions. Second, there is both more teacher supply and more teacher need in urban districts. Third, greater district poverty appears to be associated with significantly less teacher

supply and more teacher need. In addition to these supply and need relationships, there are also clear trends seen separately for each. With regard to supply, I find large districts and suburban districts have significantly more teacher supply while there is less teacher supply in the Southeast region. With regard to need, it appears greater district racial/ethnic diversity is associated with greater teacher need.

Chapter 5: Conclusion

The purpose of this study was to test whether a uniform teacher shortage exists across the state of Arkansas. The literature is muddled on whether a national teacher shortage exists depending on the information used and how it is assessed. Additionally, I examine whether there is a surplus of elementary and English/language arts teachers as indicated by the literature. I hypothesized that rather than a global shortage, teacher shortages are more likely to occur in certain regions and subjects. However, I expected to find more elementary teachers than middle or high school teachers, and more English/language arts teachers than math and science teachers.

To address these issues, I examined the characteristics of districts with the most favorable teaching supply and those with the greatest teaching need using descriptive and multivariate analysis. To do so, I used data on the number of vacancies and applications for positions by grade and subjects collected from surveys of districts along with administrative data. This is the third study to use applicant information to assess teacher shortages and the first to identify teacher supply and need in this way. In this study, "supply" is defined as the ratio of applications to vacancies and "need" is defined as the ratio of vacancies to full-time equivalent certified classroom teachers.

Discussion of Findings

With regard to teacher supply, I find district size, region, and urbanicity appear to drive supply. There does not appear to be a uniform shortage of teachers statewide. Teacher supply is most favorable for large districts with student enrollments greater than 3,500, districts in the Northwest, and suburban and city districts. Examining teacher supply by school level and subject, it appears that the middle school level, not the elementary level, has the greatest supply

of teachers. Moreover, English/language arts positions have a significant advantage attracting teachers, as expected.

Regarding teacher need, I find that urbanicity and region contribute most to need. Teacher need appears greatest for districts in cities, and districts in the Central and Southeast regions. Teacher need does not appear to be significantly influenced by district educational success, teacher salary, or district growth. When looking at teacher need by school level and subject, district size becomes a factor with the greatest need found in small districts and the least teacher need found in suburban districts. The greatest need for teachers is found at the high school level in math and science.

One expects the relationship between supply and need to be complementary. The findings suggest teacher supply is associated with district size, region, and urbanicity, while teacher need is related to urbanicity and region. These district characteristics will influence the relationship between supply and need. I find three clear relationships between teacher supply and need. In the Central region, there is lower teacher supply and greater teacher need. In urban districts, it appears there is both greater teacher supply and need. In higher poverty districts, there seems to be significantly less teacher supply and more teacher need.

Policy Implications/Recommendations

To address issues of teacher shortage, supply and need must first be identified. The steps taken to address the issues will vary based on what information is being used. The remedies may either address overall supply, overall need, a combination of both, or look at localized supply and need and how the issues related to particular types of districts might be addressed.

In Arkansas, the Department of Education has identified teacher supply as the number of students enrolled in educator preparation programs and the number of first time licenses issued (Pfeffer & Servedio, 2015). Arkansas' response to a trend in decreasing enrollment in educator preparation programs, even though program completers do not appear to be decreasing, has been to continue to recruit and offer incentives such as bonuses and student loan forgiveness. The strategy to address overall supply focuses on only one component of teacher supply. Overall teacher supply includes education preparation programs enrollees, completers, and the reserve pool of teachers who are licensed but not currently teaching. A comprehensive strategy would also consider increasing the number of education program completers and ways to attract those in the reserve pool back into teaching.

This way of identifying supply focuses more on the overall intended (future) supply, not on the current supply districts experience with the number of applications they receive. Issues related to district level teacher supply may be different and must also be considered. It is one thing to have a large supply of teachers overall, it is another thing to get them to where they are needed most. In this study, I identify the distribution of teacher supply and need at the district level looking at the characteristics of districts in an effort to understand how the issue of teacher shortages might differ in different types of districts. Findings indicate that there is an unequal distribution with regard to the supply of teachers to districts statewide. To better understand how teacher supply is distributed across districts, the state should consider collecting application information.

In addition to supply, how need is identified will also influence the strategies implemented to address it. The ADE uses the number of classes taught by long-term substitutes or teachers out of their area of licensure in a year, and the number of teachers who retired in the

previous year or who have the potential to retire in the near future (Pfeffer & Servedio, 2015). This method does not account for non-retirement attrition and turnover or changes in student enrollment. Using the current year's information of whether need is greater than supply, shortage areas are predicted for the following year (Pfeffer & Servedio, 2015). Arkansas does not currently implement strategies to address need directly. The state's primary strategy to address demand and shortages has been to increase supply.

A more comprehensive strategy would include looking at ways to promote adding multiple licensure areas so that teachers would not need to be teaching out of their field, identifying the amount of and reasons for non-retirement attrition and turnover, and implementing strategies to increase retention. Based on Arkansas' Every Student Succeeds Act Plan, it appears the state is beginning to consider strategies related to increasing retention which include providing advanced licensure levels to retain effective teachers and personalized mentoring support related to the teacher evaluation system (ADE, 2017b; Howell, 2017). Other retention strategies to consider include mentoring, induction, support, and/or residency models for new teachers, and opportunities to increase prestige and advancement for more experienced teachers through participation in mentoring and leadership teams.

While increasing compensation and workplace conditions are often suggested as means of ameliorating shortages, these may not be options available to all districts and will take time to change. Additionally, my analyses indicate that need does not vary based on average salary levels. To better match the existing supply of teachers to where they are needed most additional strategies may be needed. To make it easier for applicants to find district vacancies and districts to find applicants, a statewide online application process could be used. This approach would also allow for the collection of vacancy and application information at the district level.

Examining ways to purposefully place student teachers in districts and developing more district-university partnerships where they are limited or may not exist would also facilitate getting teachers to where they are needed. Starting the hiring process earlier, especially for high-needs districts, could increase both the quantity and quality of candidates as well.

Teacher supply and need are unequally distributed across the state and there are multiple factors that contribute to both. To continue to have persistent shortage areas identified by the state suggests that either the ways in which shortages are identified and/or the means by which they are being addressed may not be working. Rather than focus on overall supply and overall need (indicated by identified shortage areas), Arkansas should consider looking at the issue at a more localized level, address the factors related to both teacher supply and need, and examine ways to better match prospective teachers to positions.

Further Research

This study has focused on the teacher quantity shortage in Arkansas. The logical next step is to begin to examine the teacher quality shortage. Specifically, I am interested in looking at the quality of education preparation program graduates at different public institutions across the state, using college entrance exam scores and high school and college grade point averages as a proxy. Furthermore, I would like to examine which districts are served by each institution to better understand where gaps may exist and where initiatives might be targeted, using a measure of distance to higher education institutions, additional information collected in the district survey, and interviews conducted with education program placement coordinators. Other information collected from the district surveys yet to be examined includes which districts use incentives (and what kinds) to attract teachers and how superintendents' perceive the quality of teachers/applicants over the past five years. Additionally, it would be interesting to examine the

relationship between a district's value added and teacher supply and to look at the relationships between teacher supply and teacher retention. It may also be interesting to identify teacher supply and need outliers and study them qualitatively. While this study sheds more light on the issue of teacher shortages in Arkansas, there are many questions still to be answered. Hopefully, this study further informs the discussion and policies related to addressing the issue.

References

Aldeman, C. (2018). Educator supply and demand reports: Lessons for states, *Bellwether Education Partners*. Available at: https://bellwethereducation.org/sites/default/files/Bellwether_Lessons%20from%20state%20supply%20%26%20demand%20reports_final_18_0205_v2.pdf.

Angrist, J.D., & Pischke, J.S. (2009). *Mostly harmless econometrics: An empiricist's companion*, Princeton, NJ: Princeton University Press.

Aragon, S. (2016). Teacher Shortages: What we know, teacher shortage series, *Education Commission of the States.*

Arkansas Association of Educational Administrators. (2017). Map of Arkansas by educational region. Available at: https://arkansas.schoolspring.com/.

Arkansas Dept. of Education (ADE). (2017a). Arkansas educator preparation provider report. Available at: https://adedata.arkansas.gov/eppr/docs/State/StatewideReportApril2017.pdf.

Arkansas Dept. of Education (ADE). (2017b). Every Student Succeeds Act Arkansas state plan. Available at: http://www.arkansased.gov/public/userfiles/ESEA/Arkansas_ESSA_Plan_Final_rv_January_30_2018.pdf.

Arkansas Dept. of Education (ADE). (2017c). Teacher salary schedule analysis 2016-2017, March 21. Available at: http://www.arkansased.gov/public/userfiles/Fiscal_and_Admin_Services/Publication%20and%20reports/Salary%20Reports/Teacher_Salary_Schedule_Analysis_20162017_revised_3_20_17.pdf.

Arkansas Dept. of Education (ADE). (2016a). Critical academic licensure shortage areas for the 2016-2017 school year, Memo dated March 31. Available at: http://adecm.arkansas.gov/Attachments/LIC-16-037--16-17_Shortage_Areas_for_ADE_website.pdf.

Arkansas Dept. of Education (ADE). (2016b). Teacher recruitment & retention, research report prepared for the House Interim Committee on Education and the Senate Interim Committee on Education, April 12. Available at: http://www.arkleg.state.ar.us/assembly/2015/Meeting%20Attachments/410/I14363/Teacher%20Recruitment%20and%20Retention.pdf.

Barnett, J.H. & Blankenship, V. (2005). Superintendents speak out: A survey of superintendents' opinions regarding recent school reforms in Arkansas, *Journal of Educational Research & Policy Studies*, 5(1), 48-65.

Barnum, M. (2018). In many large school districts, hundreds of teaching positions were unfilled as school year began, *Chalkbeat*, January 9.

Behrstock-Sherratt, E. (2016). Creating coherence in the teacher shortage debate: What policy leaders should know and do, *Education Policy Center at American Institutes for Research.*

Belfield, C.R. (2005). The teacher labour market in the U.S.: Challenges and reforms, *Educational Review*, 57(2), 175-191.

Berg-Jacobson, A. & Levin, J. (2015). Oklahoma study of educator supply and demand: Trends and projections, American Institutes for Research. Available at: http://sde.ok.gov/sde/sites/ok.gov.sde/files/documents/files/15-3778_OK%20Study%20of%20Educator%20Supply%20and%20Demand%20Final%20Report%20Revised%2010_12_15.pdf

Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2005). The draw of home: How teachers' preferences for proximity disadvantage urban schools, *Journal of Policy Analysis and Management*, 24, 113–132.

Bruce, D.J., Fox, W.F., Douglas, B.M., Reynolds, M.O., & Yang, Z. (2009). Supply and demand for teachers in Tennessee, Center for Business and Economic Research, University of Tennessee. Available at: https://thec.ppr.tn.gov/THECSIS/CBERTHECReports/PDFS/Teacher%20Supply-Demand%2012-2009.pdf

Buddin, R.J., & Zamarro, G. (2009), "Teacher qualifications and student achievement in urban elementary schools", *Journal of Urban Economics*, 66(2), 103-115.

Bureau of Labor Statistics. (2018). Job openings and labor turnover – December 2017, *U.S. Department of Labor*, News Release – USDL-18-0204, February 6.

Cannata, M. (2010). Understanding the teacher job search process: Espoused preferences and preferences in use, *Teachers College Record*, 112(12), 2889-2934.

Chastain, R., Flores, M., Anderson, S., & Butts, R. (2017). The teacher shortage in Washington: Current status and actions to address it, Office of Superintendent of Public Instruction. Available at: https://app.leg.wa.gov/CMD/Handler.ashx?MethodName=getdocumentcontent&documentId=NRoW0T3q948&att=false

Connecticut State Department of Education. (2012). Data bulletin: Designation of teacher shortage areas for the 2012-13 school year (Fall hiring report), Division of Assessment, Research and Technology, Bureau of Data Collection, Research and Evaluation. Available at: http://sdeportal.ct.gov/Cedar/Files/Pdf/Reports/Fall_Hiring_Data_Bulletin11_12.pdf

Cook Smith, N. & Mackin, K.J. (2006). Report on New Hampshire educators: Credentialing and employment trends, New Hampshire Department of Education Division of Program Support. Available at: https://www.education.nh.gov/certification/documents/cred_employ_trends.pdf

Cowan, J., Goldhaber, D., Hayes, K., & Theobald, R. (2016). Missing elements in the discussion of teacher shortages, *Educational Researcher*, 45(8), 460-462.

Cross, F. (2016). Teacher shortage areas nationwide listing 1990-191 through 2016-2017, *United States Department of Education.*

Dee, T.S. & Goldhaber, D. (2017). Understanding and addressing teacher shortages in the United States, Hamilton Project Policy Brief 2017-05, *The Brookings Institution*.

Di Carlo, M. (2015). Update on teacher turnover in the U.S., *Albert Shanker Institute*, January 22.

Eide, E., Goldhaber, D., & Brewer, D. (2004). The teacher labour market and teacher quality, *Oxford Review of Economic Policy*, 20(2), 230-244.

Engage NY. (2013). Teacher supply and demand reports, Board of Regents Meeting. Available at: https://www.regents.nysed.gov/common/regents/files/TeacherSupplyDemandReports%5B1%5D.pdf

Engel, M. & Cannata, M. (2015). Localism and teacher labor markets: how geography and decision making may contribute to inequality, *Peabody Journal of Education*, 90(1), 84-92.

Engel, M., Jacob, B.A., & Curran, E.C. (2014). New evidence on teacher labor supply, *American Educational Research Journal*, 51(1), 36-72.

Ford Seiler, M., Nelson, D., Alexander, A., Clark, T., Landy, B., Olds, S., & Bailey, C. (2012). Tracking teacher shortages: Trends and continuing questions, Research Report No. 395, Office of Education Accountability, Legislative Research Commission. Available at: http://www.lrc.ky.gov/lrcpubs/rr395.pdf

Garrett, J. (2018). South Carolina annual educator supply and demand report, Center for Educator Recruitment, Retention, & Advancement. Available at: https://www.cerra.org/uploads/1/7/6/8/17684955/2017-18_supply_demand_report.pdf

Goff, P., Carl, B., & Yang, M. (2018). Supply and demand for public school teachers in Wisconsin, Working Paper No. 2018-2, Wisconsin Center for Education Research, University of Wisconsin-Madison. Available at: https://wcer.wisc.edu/docs/working-papers/Working_Paper_No_2018_02.pdf

Goldhaber, D. (2002), "The mystery of good teaching", *Education Next*, Spring 2002.

Goldhaber, D., Krieg, J., & Theobald, R. (2014). Knocking on the door to the teaching profession? Modeling the entry of prospective teachers into the workforce, *Economics of Education Review*, 43, 106-124.

Google. (2017). Arkansas teacher preparation programs in Arkansas, *Google Maps*.

Hanushek, E.A., Kain, J.F., & Rivkin, S.G. (2004). Why public schools lose teachers, *The Journal of Human Resources*, 39(2), 326-354.

Hanushek, E.A., & Rivkin, S.G. (2012). The distribution of teacher quality and implications for policy, *The Annual Review of Economics*, 4, 131-157.

Hicks, M.J. (2015). Indiana's demand & supply issues for K-12 educators, Center for Business and Economic Research, Ball State University. Available at: https://projects.cberdata.org/reports/TeacherSupply2015-1026.pdf

Hill, A. & Hirshberg, D. (2013). Alaska teacher turnover, supply, and demand: 2013 highlights, Center for Alaska Education Policy Research, University of Alaska Anchorage. Available at: http://www.alaskateacher.org/downloads/2013TeacherTurnover.pdf

Howell, C. (2017). 4-tiered teacher license in Arkansas proposed for '19 start, *Arkansas Online*, November 20.

Hussar, W.J., & Bailey, T.M. (2014). Projections of education statistics to 2022, Forty-first edition, NCES 2014-051, *National Center for Education Statistics*.

Ingersoll, R.M. & May, H. (2011). The minority teacher shortage: Fact or fable?, *Phi Delta Kappan*, 93(1), 62-65.

Ingersoll, R.M. (2003). Is there really a teacher shortage?, *CPRE* Research Reports, September 2003.

Ingersoll, R.M. (2002). The teacher shortage: A case of wrong diagnosis and wrong prescription, *NASSP Bulletin*, 86(631), 16-31.

Ingersoll, R.M. (2001). Teacher turnover and teacher shortages: An organizational analysis, *American Educational Research Journal*, 38(3), 499-534.

Katnik, P. (2017). Teacher workforce, Missouri Department of Elementary & Secondary Education. Available at: https://dese.mo.gov/sites/default/files/TeacherWorkforceFeb2017.pdf

Konoske-Graf, A., Partelow, L., & Benner, M. (2016). To attract great teachers, school districts must improve their human capital systems, *Center for American Progress*.

Krieg, J.M., Theobald, R., & Goldhaber, D. (2016). A foot in the door: Exploring the role of student teaching assignments in teachers' initial job placements, *Educational Evaluation and Policy Analysis*, 38(2), 364-388.

Ladd, H.F. (2007). Teacher labor markets in developed countries, *The Future of Children*, 17(1), 201-217.

Levin, J., Berg-Jacobson, A., Atchison, D., Lee, K., & Vontsolos, E. (2015). Massachusetts study of teacher supply and demand: Trends and projections, American Institutes for Research. Available at: https://www.air.org/sites/default/files/downloads/report/Massachusetts-Study-of-Teacher-Supply-and-Demand-December-2015_rev.pdf

Linder, C. & McHugh, C.M. (2017). Idaho State Board of Education 2017 teacher pipeline report. Available at: https://boardofed.idaho.gov/resources/2017-teacher-pipeline-report/

Lindsay, J., Wan, Y., Berg-Jacobson, A., Walston, J., & Redford, J. (2016). Strategies for estimating teacher supply and demand using student and teacher data, REL 2017-197, *Regional Educational Laboratory Midwest*.

Loeb, S. & Reininger, M. (2004). Public policy and teacher labor markets: What we know and why it matters, *The Education Policy Center at Michigan State University*.

Maier, A., & Youngs, P. (2009). Teacher preparation programs and teacher labor markets, *Journal of Teacher Education*, 60(4), 393-407.

Malatras, J., Gais, T., & Wagner, A. (2017). A background on potential teacher shortages in the United States, *SUNY Rockefeller Institute of Government*, July 2017.

Maranto, R., & McShane, M.Q. (2012). *President Obama and education reform: The personal and the political*, New York City: Palgrave Macmillan.

Maranto, R., & Shuls, J.V. (2012). How do we get them on the farm? Efforts to improve rural teacher recruitment and retention in Arkansas, *Rural Educator*, 34(1), n1.

Maryland State Department of Education. (2016). Maryland teacher staffing report 2016-2018. Available at: https://files.eric.ed.gov/fulltext/ED572300.pdf

Meeks, J.T. & Koch, C.A. (2014). Educator supply and demand in Illinois 2014 Annual Report, Illinois State Board of Education. Available at: https://www.isbe.net/Documents/ed-supply-demand-2014.pdf

Murnane, R.J., & Steele, J.L. (2007). What is the problem? The challenge of providing effective teachers for all children, *The Future of Children*, 17(1), 15-43.

Murphy, P., DeArmond, M., & Guin, K. (2003). A national crisis or localized problems? Getting perspective on the scope and scale of the teacher shortage, *Education Policy Analysis Archives*, 11(23).

National Center for Education Statistics (NCES). (2017a). Elementary/secondary information system, Arkansas school district urban-centric locale, 2014-15.

National Center for Education Statistics (NCES). (2017b). Locale classification and criteria. Available at: https://nces.ed.gov/programs/edge/docs/LOCALE_DEFINITIONS.pdf.

Nebraska Department of Education. (2018). Teacher vacancy survey report. Available at: https://2x9dwr1yq1he1dw6623gg411-wpengine.netdna-ssl.com/wp-content/uploads/2018/03/2017-Teacher-Shortage-Report.pdf

Nguyen, H., & Onstad, N. (2017). 2017 report of teacher supply and demand in Minnesota's public schools: Fiscal year 2017 report to the legislature, Minnesota Department of Education. Available at: https://education.mn.gov/mdeprod/groups/educ/documents/basic/bwrl/mdyw/~edisp/mde060019~1.pdf

OECD. (2017). Education at a glance 2017: OECD indicators, Paris: OECD Publishing.

OECD. (2005). Teachers matter: Attracting, developing and retaining effective teachers, Paris: OECD Publishing.

Office of Economic and Demographic Research. (2000). Teacher supply and demand forecasts, State of Florida. Available at: http://edr.state.fl.us/Content/special-research-projects/education/teachersupply.pdf

Office for Education Policy. (2005). Teacher shortages in Arkansas, Policy Brief, 2(3). *University of Arkansas*.

Oregon Department of Education. (2015). Understanding and identifying teacher shortage areas in Oregon. Available at: https://www.ode.state.or.us/wma/researchteacher-shortage-final-report.pdf

Papay, J. (n.d.). Aspen Institute Datasheet: The teaching workforce, *The Aspen Institute*. Available at: https://assets.aspeninstitute.org/content/uploads/files/content/docs/education/Ed_AspenTeacherWorkforceDatasheet.pdf.

Pfeffer, I. & Servedio, F. (2015). Academic shortage areas for 2016-17, Arkansas Dept. of Education, December 2015. Available at: http://www.arkansased.gov/public/userfiles/HR_and_Educator_Effectiveness/HR_Educator_Licensure/CSA_PPT_from_Dec_2015_FINAL_with_Notes-11266.pdf.

Podgursky, M. (2006). Is there a "qualified" teacher shortage?, *Education Next*, 6(2).

Raue, K., & Gray, L. (2015). Results from the first through fifth waves of the 2007-08 beginning teacher longitudinal study, *U.S. Department of Education*, NCES 2015-196.

Reichardt, R., Van Buhler, B., & Akiba, M. (2003). Teacher supply and demand in the State of Colorado, Mid-continent Research for Education and Learning.

Reininger, M. (2012). Hometown disadvantage? It depends on where you're from: Teachers' location preferences and the implications for staffing schools, *Educational Evaluation and Policy Analysis*, 34(2), 127-145.

Russell, A. (2005). The facts- and fictions- about teacher shortages, *American Association of State Colleges and Universities*, 2(5), 2-5.

Schug, M.C. & Holahan, W.L. (2004). The case of the simultaneous teacher shortages and surpluses: A new example for teaching about labor markets, *Journal of Private Enterprise*, 19(2), 108-119.

Sherretz, K.L., Kelly, C.G., & Matos, R.A. (2013). Delaware teacher and administrator supply and demand survey analysis report, Institute for Public Administration, University of Delaware. Available at: http://www.ipa.udel.edu/publications/teacher_supply13.pdf

Stephens, C., Hall, T., McCampbell, C. (2015). The 2015 Georgia public P-12 teacher workforce: A Status Report. Available at: https://www.gapsc.com/Commission/Research_Publication/downloads/2015%20Status%20Report.pdf

Stotsky, S. (2015). *An empty curriculum: The need to reform teacher licensing regulations and tests*, Lanham, MD: Rowman & Littlefield.

Stronge, J.H., Ward, T.J., & Grant, L.W. (2011), "What makes good teachers good? A cross-case analysis of the connection between teacher effectiveness and student achievement", *Journal of Teacher Education*, 62(4), 339-355.

Suckow, M.A. & Lau, P.P. (2017). Teacher supply in California: A report to the legislature annual report 2015-16, Professional Services Division of the Commission on Teacher Credentialing. Available at: https://www.ctc.ca.gov/docs/default-source/commission/reports/ts-2015-2016-annualrpt.pdf?sfvrsn=84d346b1_4

Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2016). A coming crisis in teaching? Teacher supply, demand, and shortages in the U.S., Research Brief, *Learning Policy Institute*.

U.S. Census Bureau. (2016). 0.Cartographic boundary shapefiles - school districts, Arkansas. Available at: https://www.census.gov/geo/maps-data/data/cbf/cbf_sd.html

U.S. Department of Education (USDOE). (2015). Enrollment in teacher preparation programs, Office of Postsecondary Education, Higher Education Act Title II Reporting. Available at: https://title2.ed.gov/Public/44077_Title_II_Issue_Brief_Enrollment.pdf/

Watson, A., Wagner, B., Lacy, K., Rose, E. (2017). Meeting state worker demand: Report on the labor market outcomes for Montana colleges, Montana Department of Labor & Industry. Available at: https://www.gfcmsu.edu/about/documents/StateCollegeReport.pdf

Wayne, A.J., & Youngs, P. (2003). Teacher characteristics and student achievement gains: A review, *Review of Educational Research*, 73(1), 89-122.

Weisberg, D., Sexton, S., Mulhern, J. & D. Keeling (2009), "The widget effect", Brooklyn, NY: *The New Teacher Project*.

Weiss, S. (2018). No substitute for trained teachers, *National Conference of State Legislatures*, January 1.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity, *Econometrica*, 48, 817-838.

Will, M. (2016). Help wanted: Teacher-shortage hot spots, *Education Week*, August 22.

Yaffe, D. (2016). Tackling the teacher shortage, *Education Digest*, 81(8), 11-15.

Zagorsky, J., Olsen, R., Hawley, J., & Gnagey, J. (2013). 2013 teacher supply and demand in Ohio, Ohio Department of Education. Available at: http://glennweb.glenn.it.osu.edu/wp-content/uploads/2017/07/2013-Teacher-Supply-and-Demand-in-Ohio.pdf

Appendices

Appendix A: Supply Using Log Enrollment

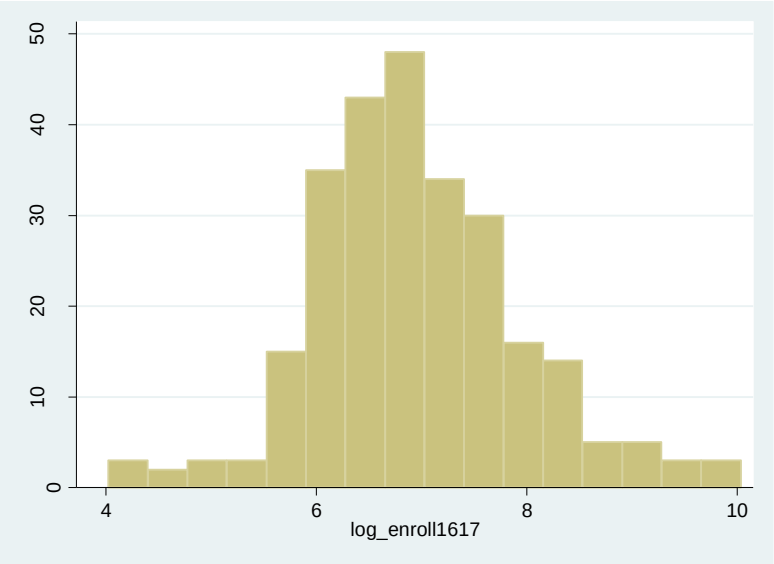


Figure A1: Distribution of Log Enrollment, 2016-17

Table A1: Predictors of Supply: Log Enrollment and Categorical Enrollment

	Using Log Enrollment				Using Categorical Enrollment			
VARIABLES	(1) Enrollment (Log)	(2) Enrollment & Region (no controls)	(3) Enrollment & Region (w/demo controls)	(4) Enrollment & Region (w/all controls)	(1) Enrollment (Categorical)	(2) Enrollment & Region (no controls)	(3) Enrollment & Region (w/demo controls)	(4) Enrollment & Region (w/all controls)
Small districts (< 1,500)					-	-	-	-
Midsize districts (1,500-3,500)					0.900	0.921	-0.294	-0.367
					(1.119)	(1.056)	(1.043)	(1.263)
Large districts (> 3,500)					5.674**	6.574***	5.505***	4.631*
					(2.319)	(2.366)	(2.054)	(2.368)
Enrollment (log)	1.571**	1.480**	0.985*	0.473				
	(0.708)	(0.658)	(0.526)	(0.644)				
NW (Region 1)	-	-	-	-	-	-	-	-
NE (Region 2)		-2.214	-1.813	-1.048		-1.946	-1.435	-0.843
		(1.357)	(1.276)	(1.326)		(1.327)	(1.262)	(1.297)
Central (Region 3)		-4.707***	-5.555***	-4.784***		-5.863***	-6.313***	-5.388***
		(1.152)	(1.392)	(1.460)		(1.261)	(1.448)	(1.610)
SW (Region 4)		-3.567***	-3.293***	-2.201*		-3.440***	-2.905**	-2.179*
		(1.180)	(1.147)	(1.192)		(1.195)	(1.162)	(1.259)
SE (Region 5)		-5.443***	-5.211***	-3.685***		-5.086***	-4.408***	-3.738***
		(1.106)	(1.127)	(1.143)		(1.091)	(1.065)	(1.023)
District %FRL			-11.02***	-5.091			-10.99***	-7.440
			(4.101)	(5.641)			(4.200)	(6.765)
District %White			-2.803	-2.562			-1.866	-1.994
			(1.773)	(2.187)			(1.655)	(2.519)
Educational Success				1.626				1.226
				(1.045)				(0.997)
Teacher Salary BA, 0-yrs (in $1,000s				0.000**				0.166
				(0.000)				(0.202)
District Growth				-0.0200				0.169
				(0.0639)				(0.203)
Constant	-5.842	-2.568	10.14**	-4.619	4.277***	6.908***	15.65***	7.203
	(4.753)	(4.324)	(4.391)	(8.887)	(0.393)	(0.803)	(4.021)	(8.750)
Observations	183	183	182	170	183	183	182	165
R-squared	0.065	0.172	0.221	0.246	0.089	0.222	0.271	0.295

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Constant: Small districts, NW = Region 1, Rural. Mean unit of supply = 5.12 (equivalent to ~5 applicants per vacancy).

Appendix B: Supply by District Percent Hispanic, Black Students

Supply by District Percent Hispanic

Table B1: Teacher Supply by District Race/Ethnicity - Hispanic (Quintile)

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
0-0.02	lowest%	1	59	41	316	1,085	**3.4**
0.03-0.04		2	71	50	404	1,392	**3.4**
0.05-0.06		3	41	29	322	1,262	**3.9**
0.07-0.10		4	40	27	764	3,295	**4.3**
0.11-0.61	highest%	5	51	37	1,085	9,912	**9.1**
		Overall	262	184	2,891	16,946	**5.9**

Note: Mean %Hispanic 2016-17 = 8.1%

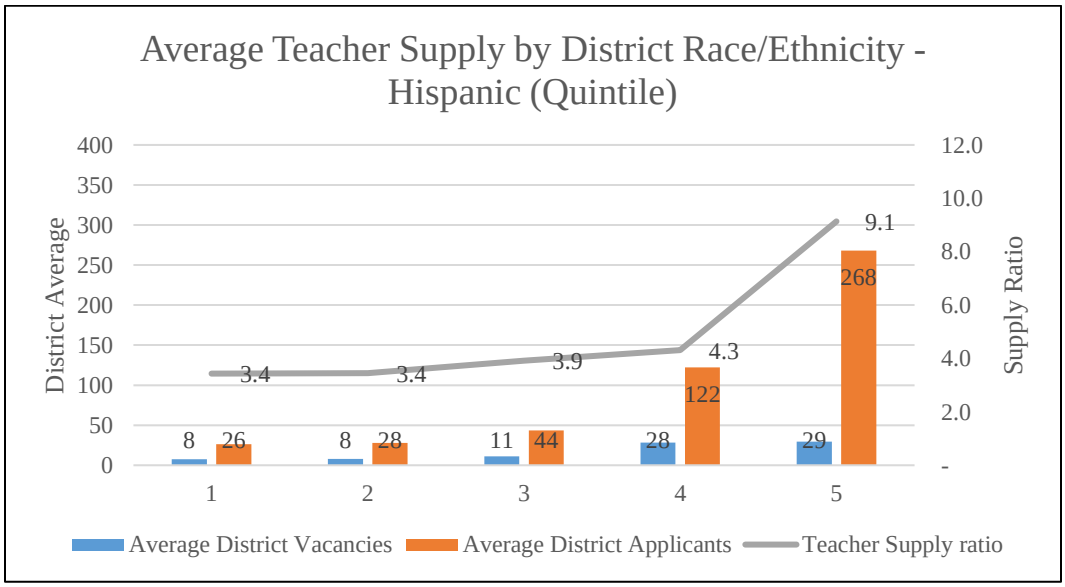


Figure B1: Average Teacher Supply by District Race/Ethnicity - Hispanic (Quintile)

Table B2: Teacher Supply by District Race/Ethnicity - Hispanic (Quintile), Excluding Northwest Region Districts

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
0-0.02	lowest%	1	59	29	264	688	**2.6**
0.03-0.04		2	71	36	328	1,085	**3.3**
0.05-0.06		3	41	25	300	976	**3.3**
0.07-0.10		4	40	16	664	2,628	**4.0**
0.11-0.61	highest%	5	51	23	539	3,490	**6.5**
		Overall	262	129	2,095	8,867	**4.2**

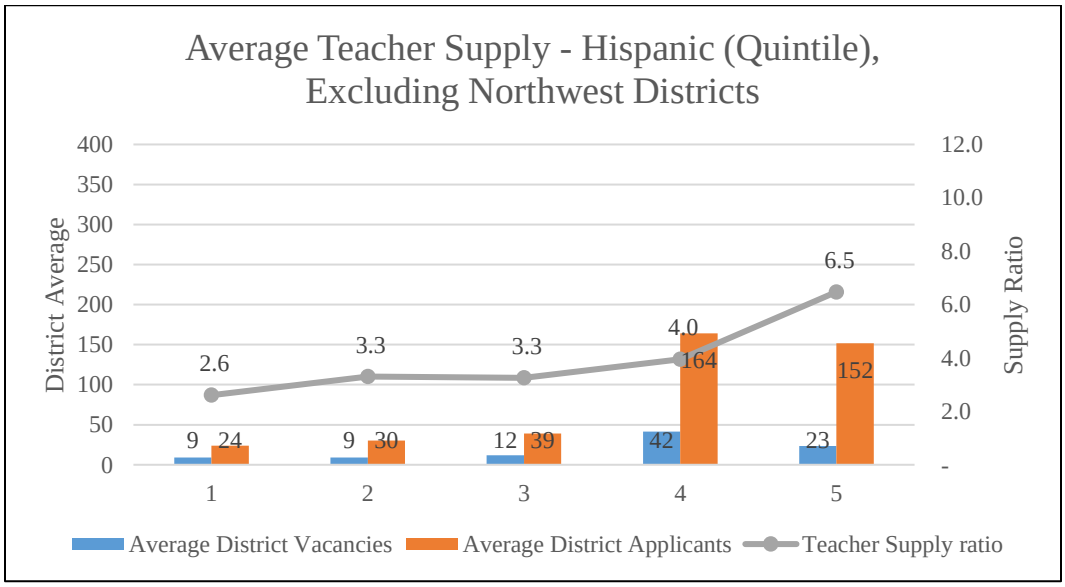


Figure B2: Average Teacher Supply by District Race/Ethnicity - Hispanic (Quintile), Excluding Northwest Region Districts

Supply by District Percent Black

Table B3: Teacher Supply by District Race/Ethnicity - Black (Quintile)

Quintile range		Quintile	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
0	lowest%	1	56	32	176	917	**5.2**
0.01		2	53	41	259	2,044	**7.9**
0.02-0.09		3	49	33	702	6,130	**8.7**
0.10-0.38		4	53	39	520	2,464	**4.7**
0.39-0.98	highest%	5	51	39	1,234	5,391	**4.4**
		Overall	262	184	2,891	16,946	**5.9**

Note: Mean %Black 2016-17 = 18.5%

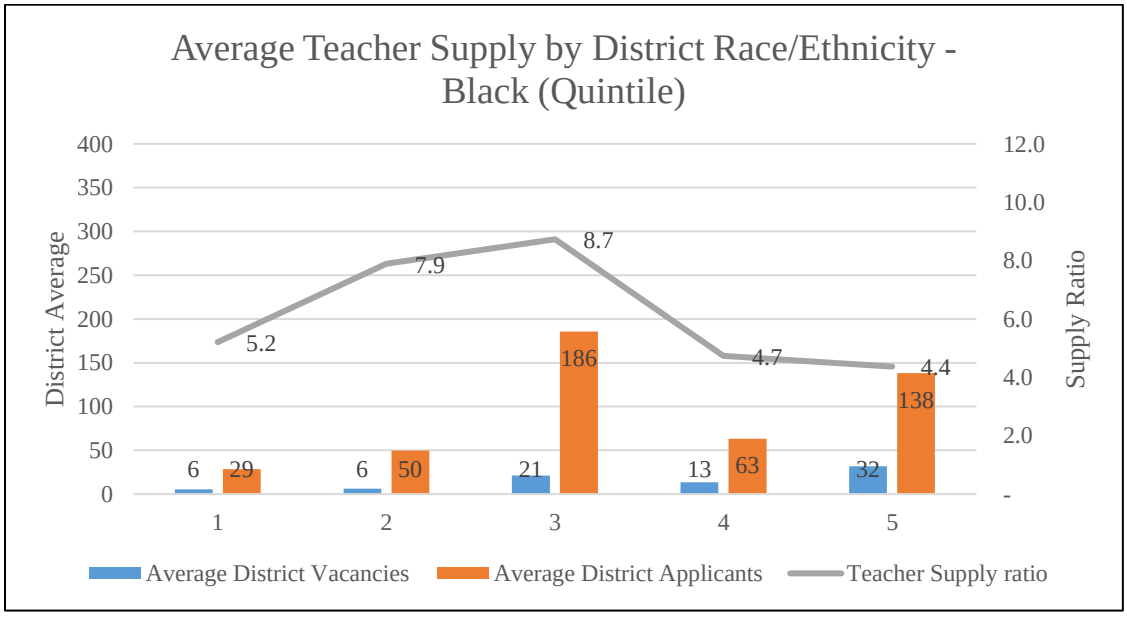


Figure B3: Average Teacher Supply by District Race/Ethnicity - Black (Quintile)

Table B4: Teacher Supply by District Race/Ethnicity - Black (Category)

Category range		Category	N of districts	N of responses	Total Vacancies	Total Applicants	Teacher Supply ratio
0	lowest%	1	56	32	176	917	**5.2**
0.01-0.10		2	108	77	1,070	9,137	**8.5**
0.10-0.50		3	62	46	706	3,496	**5.0**
0.51-0.98	highest%	4	36	27	939	3,396	**3.6**
		Overall	262	182	2,891	16,946	**5.9**

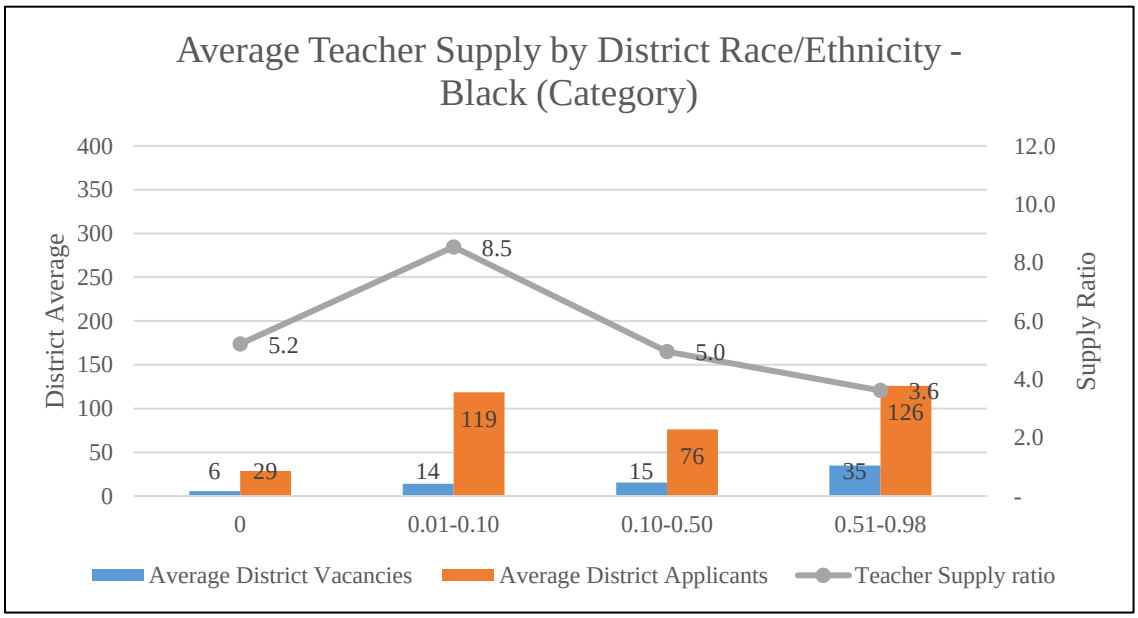


Figure B4: Average Teacher Supply by District Race/Ethnicity - Black (Quintile)

Appendix C: Race/Ethnic Diversity (%White) of Small Districts

Table C1: District Race/Ethnicity (White) Quintile for Small Districts Relative to All Districts

		All Districts					Small Districts				
Quintile range		**Quintile**	**N of districts**	**Mean % White**	**Min**	**Max**	**N of Small Districts**	**Mean % White**	**Min**	**Max**	**% of Small Districts in Quintile**
0-0.44	least white	1	54	0.23	108	22,759	30	0.16	108	1,462	0.56
0.47-0.71		2	53	0.61	62	15,399	32	0.60	62	1,419	0.60
0.72-0.87		3	51	0.81	336	16,609	39	0.81	336	1,454	0.76
0.88-0.93		4	60	0.91	325	10,290	38	0.91	325	1,314	0.63
0.94-0.98	most white	5	44	0.96	56	1,661	42	0.96	56	1,383	0.95
		Total	262	0.70	56	22,759	181	0.69			

Appendix D: Comparison of Descriptive Ratios and Simple Regression

Table D1: Example Comparison of Descriptive Supply Ratios and Simple Regression Coefficients - District Size

Size range	District Size	N of responses	Teacher Supply Ratio (weighted)	N of responses	Mean Teacher Supply (unweighted)	Simple Regression Coefficients	Sum of Coefficients and Reference Group
< 1,500	Small	128	**4.0**	128	**4.28**	4.28	(reference group)
1,500-3,500	Midsize	36	**2.8**	33	**5.18**	0.90	**5.18**
> 3,500	Large	20	**7.9**	22	**9.95**	5.67	**10.85**
	Total	184	**5.9**	183	**5.12**		

Note: Simple regression coefficients added to the reference group coefficient are approximately equivalent to the unweighted mean teacher supply.

Appendix E: Variation in Supply by Region

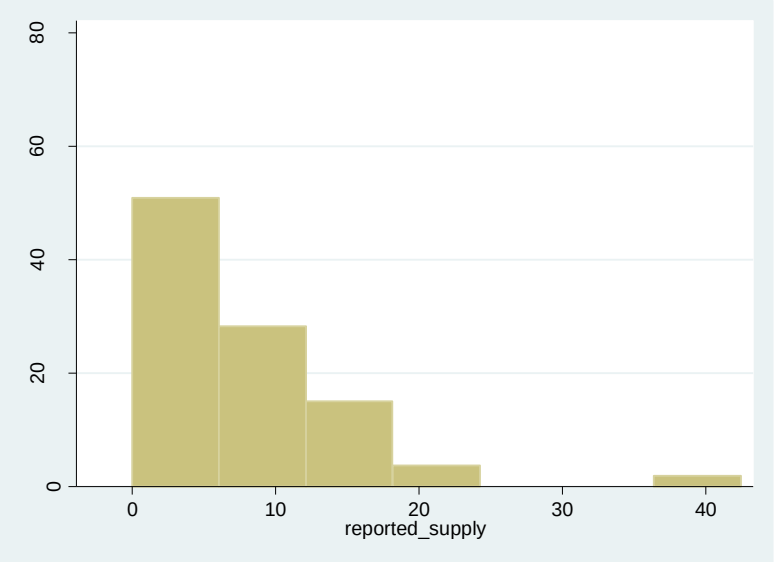


Figure E1: Distribution of Teacher Supply – Northwest Region

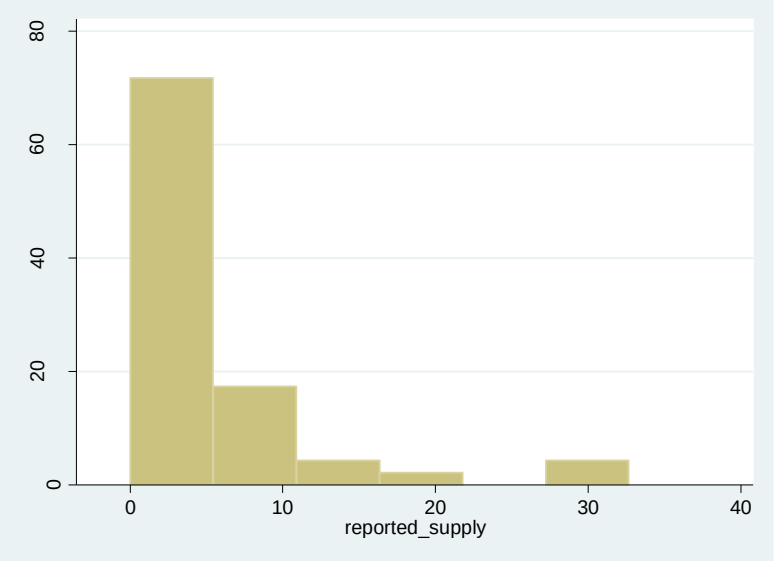


Figure E2: Distribution of Teacher Supply – Northeast Region

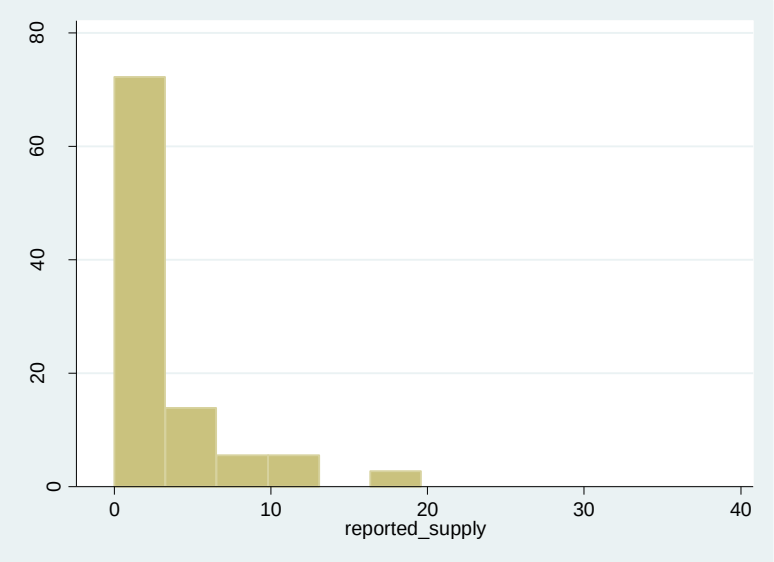


Figure E3: Distribution of Teacher Supply – Central Region

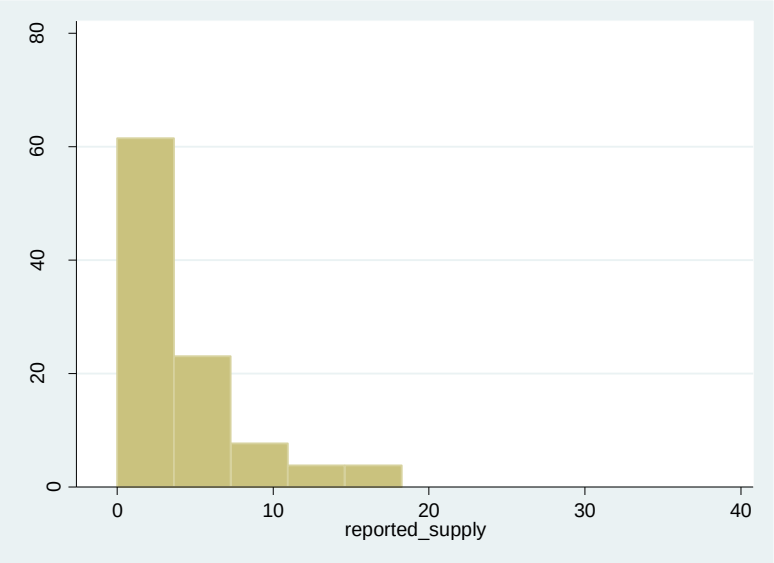


Figure E4: Distribution of Teacher Supply – Southwest Region

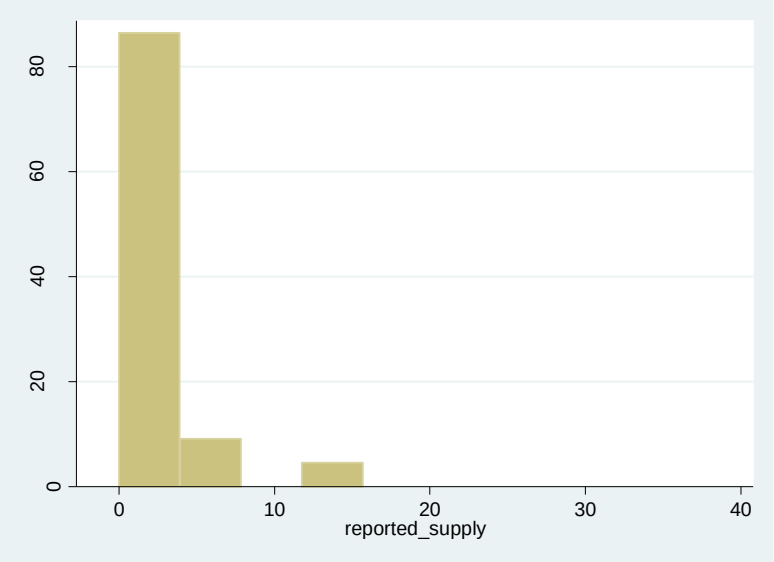


Figure E5: Distribution of Teacher Supply – Southeast Region

Table E1: Mean Teacher Supply by Region (Unweighted)

Region	Mean Teacher Supply (unweighted)	25th %ile	75th %ile	SD
NW	7.92	4.00	11.00	7.15
NE	5.47	1.45	5.66	6.87
Central	3.34	1.10	4.25	4.01
SW	3.90	1.50	5.00	4.02
SE	2.03	0.50	5.00	3.29

Appendix F: Supply Using Teacher Salary (Categorical)

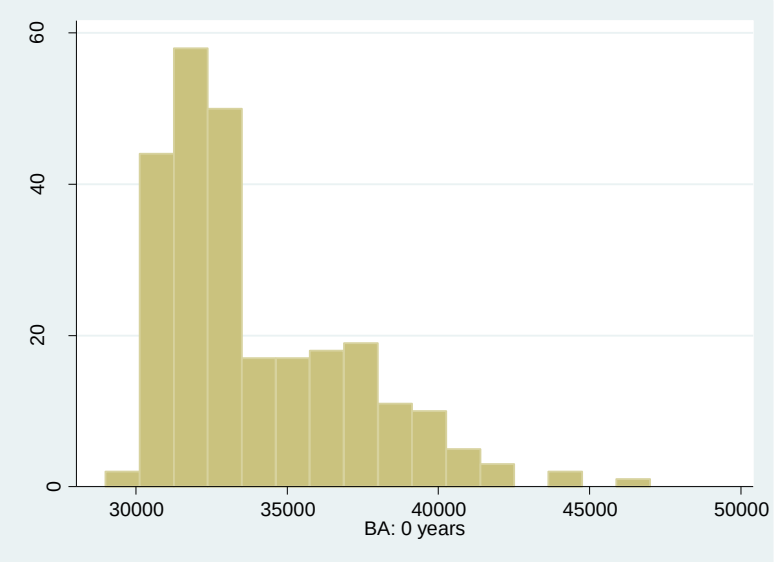


Figure F1: Distribution of Teacher Salary, 2016-17

Table F1: Teacher Supply by Teacher Salary – BA, 0 years (Categorical)

Salary Range	Salary Category	N of districts	N of responses	Total Vacancies	Total Applicants	Average District Vacancies	Average District Applicants	Teacher Supply ratio
< $31,610	Low	64	45	302	1,026	7	23	**3.4**
$ 31,610-36,000	Mid	126	88	1,183	3,634	13	41	**3.1**
> $36,000	High	67	47	1,367	12,277	29	261	**9.0**
	Total	257	180	2,852	16,937	16	94	**5.9**

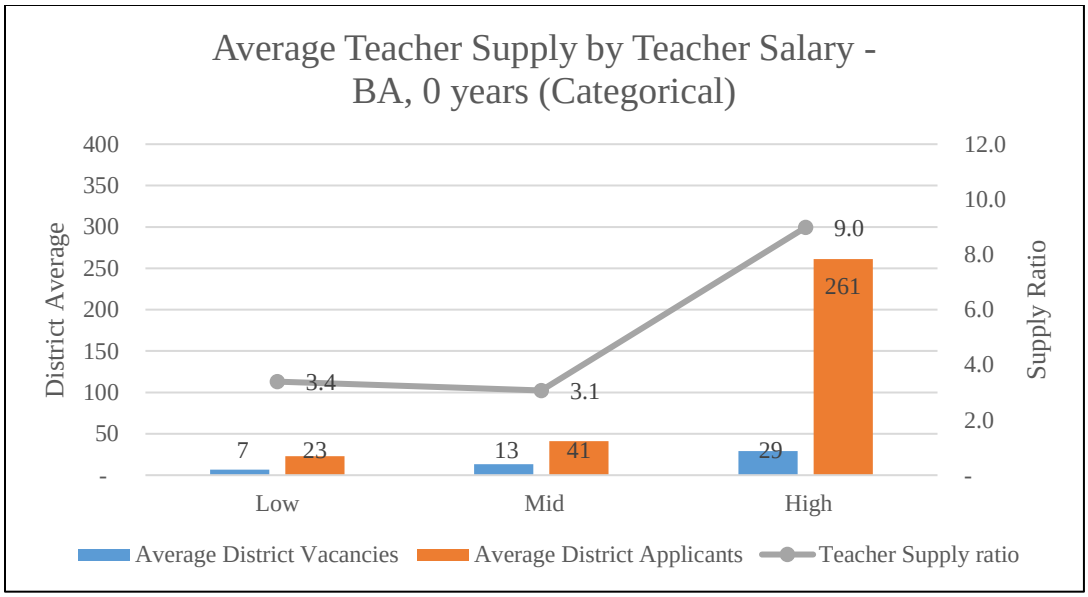


Figure F2: Average Teacher Supply by Teacher Salary – BA, 0 years (Categorical)

Table F2: Predictors of Supply: Continuous vs Categorical Teacher Salary

Teacher Salary Continuous			Teacher Salary Categorical		
	(6)	(9)		(1)	(2)
	Enrollment & Region (w/all	Region & Urbanicity (w/all		Enrollment & Region (w/all	Region & Urbanicity (w/all
VARIABLES	controls)	controls)	VARIABLES	controls)	controls)
Midsize districts (1,500-3,500)	-0.367		Midsize districts (1,500-3,500)	-0.667	
	(1.263)			(1.086)	
Large districts (> 3,500)	4.631*		Large districts (> 3,500)	4.725**	
	(2.368)			(2.297)	
City (urbanicity 1)		8.188**	City (urbanicity 1)		7.845**
		(3.534)			(3.192)
Suburb (urbanicity 2)		5.736**	Suburb (urbanicity 2)		4.766*
		(2.881)			(2.767)
Town (urbanicity 3)		2.026	Town (urbanicity 3)		2.020
		(1.351)			(1.315)
NE (Region 2)	-0.843	-0.672	NE (Region 2)	-0.762	-0.579
	(1.297)	(1.273)		(1.321)	(1.302)
Central (Region 3)	-5.388***	-4.780***	Central (Region 3)	-5.962***	-5.181***
	(1.610)	(1.726)		(1.717)	(1.703)
SW (Region 4)	-2.179*	-1.321	SW (Region 4)	-2.195*	-1.228
	(1.259)	(1.291)		(1.176)	(1.216)
SE (Region 5)	-3.738***	-2.755**	SE (Region 5)	-3.662***	-2.640**
	(1.023)	(1.211)		(1.123)	(1.266)
District %FRL	-7.440	-3.234	District %FRL	-7.166	-2.077
	(6.765)	(6.364)		(6.400)	(6.351)
District %White	-1.994	0.967	District %White	-1.885	1.894
	(2.519)	(2.667)		(2.480)	(2.627)
Educational Success	1.226	1.928*	Educational Success	1.054	1.574
	(0.997)	(0.990)		(1.036)	(0.997)
Teacher Salary BA, 0-yrs (rescaled)	0.166	0.102			
	(0.202)	(0.201)			
			Mid-salary ($31,610-36,000)	-1.353	-1.371
				(0.919)	(0.927)
			High-salary (> $36,000)	1.399	1.416
				(1.453)	(1.478)
District Growth	0.169	0.131	District Growth	0.039	-0.062
	(0.203)	(0.179)		(0.068)	(0.078)
Constant	7.203	3.088	Constant	12.983**	5.447
	(8.750)	(8.672)		(5.977)	(5.931)
Observations	165	165	Observations	170	170
R-squared	0.295	0.328	R-squared	0.298	0.318

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses**.**

Appendix G: Supply Using Log District Growth

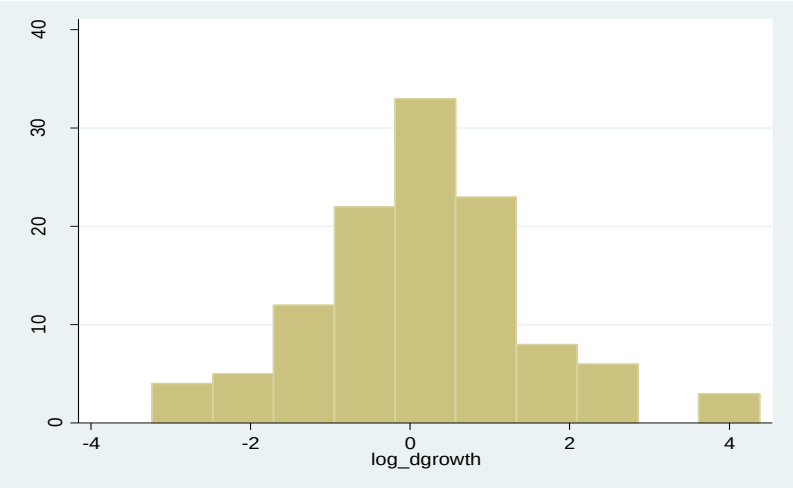


Figure G1: Distribution of Log District Growth, 2016-17

Table G1: Predictors of Supply: District Growth Percentage vs. Log District Growth Percentage

District Growth Percentage			Log District Growth Percentage		
VARIABLES	(6) Enrollment & Region (w/all controls)	(9) Region & Urbanicity (w/all controls)	VARIABLES	(1) Enrollment & Region (w/all controls)	(2) Region & Urbanicity (w/all controls)
Midsize districts (1,500-3,500)	-0.367		Midsize districts (1,500-3,500)	-0.557	
	(1.263)			(2.007)	
Large districts (> 3,500)	4.631*		Large districts (> 3,500)	8.566**	
	(2.368)			(4.110)	
City (urbanicity 1)		8.188**	City (urbanicity 1)		4.643
		(3.534)			(4.391)
Suburb (urbanicity 2)		5.736**	Suburb (urbanicity 2)		6.690*
		(2.881)			(3.715)
Town (urbanicity 3)		2.026	Town (urbanicity 3)		2.243
		(1.351)			(2.003)
NE (Region 2)	-0.843	-0.672	NE (Region 2)	-0.405	0.061
	(1.297)	(1.273)		(2.283)	(2.320)
Central (Region 3)	-5.388***	-4.780***	Central (Region 3)	-8.216***	-6.413**
	(1.610)	(1.726)		(2.605)	(2.517)
SW (Region 4)	-2.179*	-1.321	SW (Region 4)	-4.110***	-2.703*
	(1.259)	(1.291)		(1.213)	(1.524)
SE (Region 5)	-3.738***	-2.755**	SE (Region 5)	-3.726	-3.567
	(1.023)	(1.211)		(2.863)	(2.807)
District %FRL	-7.440	-3.234	District %FRL	-15.787*	-6.745
	(6.765)	(6.364)		(8.785)	(8.188)
District %White	-1.994	0.967	District %White	-6.413	-5.588
	(2.519)	(2.667)		(5.097)	(7.067)
Educational Success	1.226	1.928*	Educational Success	0.066	0.663
	(0.997)	(0.990)		(1.731)	(1.628)
Teacher Salary BA, 0-yrs (in $1,000	0.166	0.102	Teacher Salary BA, 0-yrs (in $1,000	0.0111	0.457
	(0.202)	(0.201)		(0.430)	(0.351)
District Growth	0.169	0.131	District Growth	0.184	-0.389
	(0.203)	(0.179)		(0.514)	(0.455)
Constant	7.203	3.088	Constant	21.573	-1.017
	(8.750)	(8.672)		(16.412)	(15.624)
Observations	165	165	Observations	74	74
R-squared	0.295	0.328	R-squared	0.426	0.393

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses. A 1% increase in district growth is not significantly associated with teacher supply.

Including district growth controls for districts that may be flourishing while others may be dying. As the distribution of district growth is positively skewed, I run models using the natural log of district growth. Regardless of which district growth variable is used, it appears that the teacher supply advantage for large districts and suburban districts persists as does the disadvantage for Central and SW districts, and high poverty districts.

Appendix H: Supply by Subgroups Analyses

Supply by School Level

Table H1: Predictors of Elementary Teacher Supply

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.589			-0.390	-0.803	0.493			
	(0.974)			(0.909)	(0.923)	(0.920)			
Large districts (> 3,500)	5.072**			5.882***	5.489**	7.279***			
	(2.117)			(2.105)	(2.259)	(2.624)			
City (urbanicity 1)		1.601					2.271	2.521	3.802
		(1.804)					(2.457)	(2.997)	(3.213)
Suburb (urbanicity 2)		5.443					5.548	5.143	4.984
		(4.240)					(4.498)	(4.518)	(4.268)
Town (urbanicity 3)		0.116					0.672	0.591	0.302
		(1.278)					(1.096)	(1.034)	(0.938)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-1.805	-1.195	-1.087	-0.753	-1.019	-1.006	-0.518
			(1.403)	(1.424)	(1.479)	(1.515)	(1.523)	(1.528)	(1.547)
Central (Region 3)			-3.324**	-4.844***	-4.874***	-3.446**	-3.846*	-4.111**	-2.214
			(1.608)	(1.276)	(1.604)	(1.722)	(1.957)	(2.037)	(2.185)
SW (Region 4)			-4.773***	-4.103***	-3.952***	-3.344***	-3.836***	-3.778***	-3.210**
			(1.013)	(1.075)	(1.274)	(1.263)	(1.113)	(1.353)	(1.368)
SE (Region 5)			-4.071**	-3.146	-2.899	-3.122**	-3.248*	-3.111*	-3.107**
			(2.013)	(2.076)	(1.819)	(1.422)	(1.898)	(1.675)	(1.552)
District %FRL					-3.340	2.399		-2.487	3.896
					(3.742)	(5.056)		(3.886)	(5.055)
District %White					-0.285	1.863		-0.282	-0.422
					(2.635)	(2.508)		(2.983)	(3.197)
Educational Success						0.549			1.772
						(1.052)			(1.281)
Teacher Salary BA, 0-yrs (in $1,000s						-0.126			-0.276
						(0.239)			(0.223)
District Growth						0.349*			0.350
						(0.211)			(0.216)
Constant	4.670***	4.646***	7.524***	6.707***	9.218**	7.055	6.335***	8.244*	2.601
	(0.601)	(0.513)	(0.909)	(0.997)	(3.918)	(10.69)	(1.038)	(4.533)	(10.46)
Observations	156	152	156	156	155	144	152	151	144
R-squared	0.077	0.036	0.076	0.160	0.165	0.268	0.101	0.109	0.221

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of supply for elementary teachers = 4.37 (equivalent to 4 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Table H2: Predictors of Middle School Teacher Supply

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.196			0.557	-0.688	-0.808			
	(1.327)			(1.296)	(1.236)	(1.311)			
Large districts (> 3,500)	7.862***			8.907**	7.836**	6.369			
	(2.967)			(3.438)	(3.419)	(3.896)			
City (urbanicity 1)		4.624					5.859	7.675	8.109
		(2.848)					(4.345)	(5.280)	(6.230)
Suburb (urbanicity 2)		9.201***					9.263**	8.453**	8.089*
		(3.331)					(3.822)	(4.217)	(4.266)
Town (urbanicity 3)		1.990					3.026	3.323	3.376
		(1.973)					(2.101)	(2.814)	(3.169)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-2.291	-1.342	-0.799	-0.344	-1.187	-0.897	-0.228
			(2.315)	(2.310)	(2.333)	(2.380)	(2.414)	(2.359)	(2.327)
Central (Region 3)			-3.075	-5.868***	-5.555**	-4.487	-5.610*	-5.540*	-3.016
			(1.879)	(2.022)	(2.334)	(2.752)	(3.147)	(3.327)	(3.234)
SW (Region 4)			-5.522***	-4.689***	-3.934**	-3.204*	-4.468**	-3.510*	-2.707
			(1.476)	(1.517)	(1.598)	(1.624)	(1.741)	(1.818)	(1.796)
SE (Region 5)			-7.506***	-6.128***	-5.012***	-3.763**	-6.641***	-4.967**	-3.187
			(1.298)	(1.190)	(1.493)	(1.541)	(1.691)	(2.003)	(1.951)
District %FRL					-9.934**	-2.966		-4.981	6.707
					(4.496)	(7.288)		(6.744)	(8.726)
District %White					-0.500	-1.810		3.128	0.249
					(2.704)	(3.034)		(5.313)	(4.637)
Educational Success						1.363			3.371*
						(1.465)			(1.750)
Teacher Salary BA, 0-yrs (in $1,000s						0.146			0.127
						(0.278)			(0.362)
District Growth						0.677			0.578
						(0.409)			(0.374)
Constant	4.764***	4.140***	8.708***	7.144***	14.09***	5.223	6.330***	6.819	-3.874
	(0.779)	(0.516)	(1.232)	(1.104)	(4.581)	(12.81)	(1.296)	(9.289)	(13.26)
Observations	137	134	137	137	136	127	134	133	127
R-squared	0.111	0.084	0.086	0.197	0.218	0.241	0.169	0.194	0.254

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of supply for middle school teachers = 6.6 (equivalent to ~7 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Table H3: Predictors of High School Teacher Supply

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.0863			-0.0623	-0.772	-0.675			
	(0.804)			(0.779)	(0.700)	(0.774)			
Large districts (> 3,500)	5.795**			6.463**	5.770**	4.900			
	(2.598)			(2.882)	(2.846)	(3.341)			
City (urbanicity 1)		3.643					5.405	7.075*	7.419*
		(2.676)					(3.543)	(4.123)	(4.316)
Suburb (urbanicity 2)		4.678**					5.485**	5.304*	4.760*
		(2.295)					(2.670)	(2.903)	(2.697)
Town (urbanicity 3)		0.123					0.492	0.951	0.785
		(0.836)					(1.089)	(1.244)	(1.121)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-1.390	-0.741	-0.523	-0.109	-0.295	-0.240	0.226
			(1.514)	(1.559)	(1.560)	(1.591)	(1.743)	(1.686)	(1.712)
Central (Region 3)			-2.888**	-4.242***	-4.666***	-3.528**	-4.734**	-4.838**	-3.152
			(1.136)	(1.171)	(1.409)	(1.662)	(1.965)	(2.044)	(1.945)
SW (Region 4)			-3.337***	-2.716***	-2.549**	-1.893*	-2.024*	-1.559	-0.983
			(0.912)	(0.968)	(1.038)	(1.137)	(1.092)	(1.120)	(1.216)
SE (Region 5)			-4.901***	-3.951***	-3.830***	-2.847**	-3.673***	-2.841**	-2.018
			(0.818)	(0.811)	(0.946)	(1.098)	(1.111)	(1.183)	(1.278)
District %FRL					-6.179**	-0.0551		-1.790	3.362
					(2.642)	(5.301)		(3.424)	(4.938)
District %White					-1.338	-1.486		2.461	-0.0470
					(1.665)	(2.221)		(2.173)	(2.180)
Educational Success						0.785			1.804*
						(0.817)			(0.978)
Teacher Salary BA, 0-yrs (in $1,000s)						0.151			0.120
						(0.161)			(0.174)
District Growth						0.463			0.362
						(0.292)			(0.232)
Constant	3.478***	3.349***	6.164***	5.232***	10.47***	0.961	4.679***	3.717	-2.337
	(0.360)	(0.372)	(0.787)	(0.797)	(2.370)	(8.480)	(0.860)	(3.961)	(8.808)
Observations	163	159	163	163	162	149	159	158	149
R-squared	0.111	0.069	0.080	0.200	0.218	0.235	0.164	0.187	0.250

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of supply for high school teachers = 4.38 (equivalent to 4 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Supply by Subject Area

Table H4: Predictors of Math & Science Teacher Supply (Middle School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	0.193			1.730	-3.332	-4.351			
	(2.096)			(1.594)	(4.837)	(5.154)			
Large districts (> 3,500)	12.04			12.07	7.916	2.539			
	(7.597)			(9.558)	(5.851)	(5.828)			
City (urbanicity 1)		9.277					8.448	7.663	4.545
		(9.482)					(12.66)	(12.34)	(15.57)
Suburb (urbanicity 2)		6.348					4.011	-3.224	-4.375
		(7.163)					(4.939)	(5.670)	(6.418)
Town (urbanicity 3)		0.0577					0.0659	-2.048	-3.386
		(2.041)					(1.964)	(3.115)	(3.203)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-14.44*	-11.16**	-8.826**	-7.322**	-12.25**	-9.840**	-8.027**
			(7.207)	(4.773)	(3.708)	(3.612)	(4.776)	(3.832)	(3.967)
Central (Region 3)			-10.68	-14.55	-11.93	-9.474	-14.72	-12.95	-9.990
			(7.562)	(10.03)	(9.191)	(9.696)	(11.99)	(10.20)	(11.84)
SW (Region 4)			-14.69**	-12.98**	-9.947*	-8.209*	-11.98***	-8.622***	-7.624**
			(7.212)	(6.449)	(5.228)	(4.763)	(4.259)	(3.123)	(3.252)
SE (Region 5)			-16.24**	-12.25***	-7.415**	-6.886*	-13.53***	-7.075*	-6.240
			(7.166)	(4.332)	(3.622)	(3.684)	(4.141)	(3.725)	(3.976)
District %FRL					-34.23	-30.18		-37.21	-30.65
					(31.12)	(34.11)		(25.83)	(33.22)
District %White					-1.803	-5.737		0.295	-5.529
					(9.119)	(9.409)		(6.257)	(5.684)
Educational Success						2.216			3.330
						(2.055)			(3.031)
Teacher Salary BA, 0-yrs (in 1,000s						0.434			0.358
						(0.632)			(0.701)
District Growth						0.218			-0.0537
						(0.642)			(1.139)
Constant	4.273***	5.052***	17.49**	13.02***	37.25	22.55	14.75***	38.39*	25.45
	(1.093)	(1.392)	(7.160)	(4.173)	(30.19)	(36.67)	(4.503)	(20.97)	(39.45)
Observations	61	60	61	61	61	59	60	60	59
R-squared	0.099	0.053	0.149	0.215	0.268	0.278	0.179	0.262	0.284

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of middle school math & science teacher supply = 5.7 (equivalent to ~6 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Table H5: Predictors of Math & Science Teacher Supply (High School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	0.198			0.362	-0.170	-0.00943			
	(0.638)			(0.834)	(0.779)	(0.726)			
Large districts (> 3,500)	4.493**			4.735**	4.330**	3.749			
	(1.722)			(2.057)	(1.942)	(2.349)			
City (urbanicity 1)		2.891					3.813	5.528	3.974
		(1.807)					(2.664)	(3.342)	(3.036)
Suburb (urbanicity 2)		5.459**					7.271***	7.221**	8.105***
		(2.491)					(2.608)	(2.867)	(2.308)
Town (urbanicity 3)		0.553					1.081	1.573	1.467*
		(0.721)					(0.928)	(0.965)	(0.805)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-1.435	-0.548	-0.305	-0.288	-0.451	-0.467	-0.262
			(1.389)	(1.668)	(1.701)	(1.610)	(1.721)	(1.686)	(1.624)
Central (Region 3)			-1.445	-2.437**	-2.725**	-2.104*	-3.686**	-3.757**	-2.487*
			(1.148)	(1.146)	(1.319)	(1.254)	(1.615)	(1.670)	(1.328)
SW (Region 4)			-2.678***	-2.030	-1.652	-1.463	-1.767	-1.221	-1.310
			(0.902)	(1.226)	(1.246)	(1.192)	(1.248)	(1.339)	(1.302)
SE (Region 5)			-3.299***	-2.153**	-1.816*	-1.468	-2.478*	-1.679	-1.417
			(0.859)	(1.041)	(1.036)	(1.029)	(1.252)	(1.449)	(1.271)
District %FRL					-5.397***	-0.811		-1.830	2.936
					(1.963)	(4.684)		(2.778)	(4.558)
District %White					-0.454	-0.716		2.413	-1.304
					(1.485)	(2.624)		(1.873)	(2.193)
Educational Success						0.555			1.759**
						(0.793)			(0.803)
Teacher Salary BA, 0-yrs (in 1,000s						0.082			0.022
						(0.218)			(0.204)
District Growth						0.423**			0.479***
						(0.199)			(0.177)
Constant	2.444***	2.374***	4.778***	3.512***	7.487***	1.758	3.326***	2.412	1.108
	(0.274)	(0.227)	(0.819)	(0.834)	(2.028)	(10.49)	(0.916)	(3.654)	(9.428)
Observations	82	81	82	82	81	76	81	80	76
R-squared	0.206	0.150	0.089	0.276	0.315	0.381	0.265	0.317	0.428

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of high school math & science teacher supply = 2.78 (equivalent to ~3 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Table H6: Predictors of English/Language Arts & Social Studies Teacher Supply (Middle School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	2.392			5.078	-0.936	1.097			
	(3.526)			(3.268)	(3.510)	(3.411)			
Large districts (> 3,500)	12.77*			13.69*	6.851	8.171			
	(6.535)			(6.946)	(5.467)	(6.180)			
City (urbanicity 1)		12.34*					16.37*	17.09	19.93
		(7.014)					(8.862)	(11.28)	(15.47)
Suburb (urbanicity 2)		18.38					24.01*	19.93	21.85***
		(15.96)					(13.35)	(12.41)	(4.842)
Town (urbanicity 3)		4.688					4.709*	4.012	4.943
		(2.965)					(2.781)	(2.760)	(3.145)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-6.784	-6.367	-3.436	-3.589	-7.274	-6.265	-5.300
			(6.792)	(5.072)	(4.828)	(4.198)	(4.479)	(4.130)	(3.758)
Central (Region 3)			-9.605*	-12.38*	-13.14**	-9.470	-17.20**	-15.46**	-10.73
			(5.440)	(6.167)	(5.788)	(6.482)	(8.312)	(6.865)	(6.820)
SW (Region 4)			-10.50*	-11.00*	-8.136	-5.746	-7.897**	-5.836	-2.448
			(5.440)	(5.476)	(5.127)	(5.117)	(3.793)	(3.553)	(3.540)
SE (Region 5)			-15.11***	-12.48***	-11.26***	-6.960	-11.72***	-7.187	-1.518
			(5.031)	(3.540)	(3.603)	(4.166)	(3.409)	(4.890)	(6.782)
District %FRL					-35.17	-24.22		-20.92	-12.13
					(23.64)	(24.88)		(17.42)	(27.59)
District %White					-14.45*	-18.80**		2.606	-6.677
					(8.197)	(9.161)		(10.39)	(9.853)
Educational Success						4.556			7.028*
						(3.451)			(3.680)
Teacher Salary BA, 0-yrs (in 1,000s						-0.685			-1.135
						(0.753)			(0.960)
District Growth						2.184**			2.244***
						(0.869)			(0.494)
Constant	6.108***	4.992***	16.56***	12.23***	46.68**	64.10*	11.60***	22.26	59.48
	(1.187)	(0.950)	(5.021)	(2.961)	(21.99)	(37.94)	(3.068)	(14.91)	(43.65)
Observations	52	51	52	52	52	49	51	51	49
R-squared	0.135	0.151	0.130	0.269	0.324	0.414	0.338	0.380	0.479

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of middle school English language arts & social studies teacher supply = 10.08 (equivalent to 10 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Table H7: Predictors of English/Language Arts Teacher Supply (High School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	0.449			-0.254	-1.758	-2.600			
	(1.706)			(1.448)	(1.385)	(2.026)			
Large districts (> 3,500)	11.29**			10.96**	9.658*	6.988			
	(4.961)			(4.744)	(4.892)	(7.955)			
City (urbanicity 1)		6.663					7.154	10.61	9.197
		(4.707)					(4.615)	(6.328)	(7.306)
Suburb (urbanicity 2)		7.938*					9.066**	8.658*	7.274*
		(4.062)					(4.066)	(4.558)	(4.306)
Town (urbanicity 3)		-1.083					-1.872*	-1.255	-0.466
		(1.263)					(1.111)	(1.318)	(1.875)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-3.102	-0.805	-0.168	-0.295	-1.338	-1.349	-1.029
			(4.113)	(2.898)	(3.376)	(3.939)	(2.901)	(3.347)	(3.570)
Central (Region 3)			-7.979**	-8.660**	-8.931**	-7.408*	-10.55**	-10.72**	-7.980*
			(3.564)	(3.452)	(3.993)	(4.239)	(4.109)	(4.352)	(4.241)
SW (Region 4)			-9.898***	-6.685***	-6.028**	-6.617*	-6.635***	-5.019*	-5.001
			(3.335)	(1.977)	(2.877)	(3.498)	(2.035)	(2.579)	(3.069)
SE (Region 5)			-10.42***	-7.175***	-5.941*	-5.484	-6.752***	-4.581*	-4.106
			(3.331)	(1.963)	(3.283)	(3.788)	(1.929)	(2.644)	(3.345)
District %FRL					-11.87	-13.43		-5.435	-6.432
					(8.397)	(16.41)		(10.42)	(15.27)
District %White					-0.711	-8.082		4.948	-4.209
					(3.005)	(6.993)		(5.152)	(7.699)
Educational Success						2.096			3.167
						(3.199)			(4.237)
Teacher Salary BA, 0-yrs (in 1,000s						-0.179			-0.142
						(0.532)			(0.534)
District Growth						0.642			0.440
						(0.391)			(0.286)
Constant	4.516***	4.833***	12.04***	8.864***	17.68***	30.55	9.313***	8.625	20.33
	(0.765)	(0.828)	(3.312)	(1.969)	(5.685)	(20.07)	(2.164)	(9.457)	(20.33)
Observations	57	56	57	57	56	53	56	55	53
R-squared	0.228	0.133	0.203	0.395	0.428	0.447	0.337	0.404	0.445

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of high school English language arts teacher supply = 6.78 (equivalent to ~7 applicants per vacancy). Overall mean unit of teacher supply = 5.12 (equivalent to ~5 applicants per vacancy).

Appendix I: Need Using Enrollment

Table I1: Predictors of Need: Log Enrollment and Categorical Enrollment

	Using Log Enrollment				Using Categorical Enrollment			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
VARIABLES	Enrollment (Log)	Enrollment & Region (no controls)	Enrollment & Region (w/demo controls)	Enrollment & Region (w/all controls)	Enrollment (Categorical)	Enrollment & Region (no controls)	Enrollment & Region (w/demo controls)	Enrollment & Region (w/all controls)
Small districts (< 1,500)					-	-	-	-
Midsize districts (1,500-3,500)					-0.013	-0.011	-0.007	0.002
					(0.022)	(0.019)	(0.024)	(0.018)
Large districts (> 3,500)					-0.015	-0.049	-0.075*	0.014
					(0.017)	(0.035)	(0.045)	(0.028)
Enrollment (log)	-0.023*	-0.027*	-0.032*	-0.004				
	(0.012)	(0.014)	(0.018)	(0.008)				
NW (Region 1)	-	-	-	-	-	-	-	-
NE (Region 2)		0.009	0.004	0.010		0.012	0.004	0.010
		(0.012)	(0.012)	(0.011)		(0.012)	(0.012)	(0.011)
Central (Region 3)		0.117**	0.068**	0.009		0.123**	0.082**	0.015
		(0.047)	(0.030)	(0.013)		(0.052)	(0.035)	(0.016)
SW (Region 4)		-0.001	-0.037	-0.010		0.004	-0.034	-0.011
		(0.019)	(0.025)	(0.018)		(0.020)	(0.025)	(0.018)
SE (Region 5)		0.050**	-0.022	0.034*		0.053***	-0.022	0.028
		(0.019)	(0.037)	(0.020)		(0.019)	(0.037)	(0.020)
District %FRL			0.030	0.110**			0.071	0.067
			(0.082)	(0.050)			(0.076)	(0.069)
District %White			-0.180**	-0.062*			-0.171**	-0.066*
			(0.078)	(0.033)			(0.076)	(0.037)
Educational Success				0.002				0.001
				(0.011)				(0.012)
Teacher Salary BA, 0-yrs				0.000				-0.000
				(0.000)				(0.000)
District Growth				0.001				0.002
				(0.002)				(0.002)
Constant	0.282***	0.279***	0.448**	0.094	0.125***	0.096***	0.194**	0.195**
	(0.094)	(0.101)	(0.217)	(0.097)	(0.014)	(0.011)	(0.096)	(0.097)
Observations	186	186	185	173	186	186	185	178
R-squared	0.025	0.128	0.244	0.211	0.002	0.107	0.227	0.167

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; Constant: Small districts, NW = Region 1, Rural. Mean unit of need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Appendix J: Need by Subgroups Analyses

Need by School Level

Table J1: Predictors of Elementary Teacher Need

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.210*			-0.204	-0.138	-0.116			
	(0.125)			(0.130)	(0.135)	(0.173)			
Large districts (> 3,500)	-0.290**			-0.331***	-0.287*	-0.005			
	(0.117)			(0.126)	(0.154)	(0.192)			
City (urbanicity 1)		0.023					0.044	0.211	-0.084
		(0.212)					(0.192)	(0.183)	(0.228)
Suburb (urbanicity 2)		-0.247*					-0.240	-0.020	-0.022
		(0.142)					(0.145)	(0.146)	(0.253)
Town (urbanicity 3)		-0.177					-0.169	-0.098	-0.060
		(0.139)					(0.133)	(0.141)	(0.162)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-0.021	-0.023	-0.062	-0.060	-0.003	-0.033	-0.073
			(0.272)	(0.277)	(0.297)	(0.284)	(0.283)	(0.289)	(0.267)
Central (Region 3)			-0.057	0.018	0.021	-0.139	-0.084	-0.046	-0.122
			(0.201)	(0.197)	(0.132)	(0.103)	(0.164)	(0.122)	(0.092)
SW (Region 4)			-0.082	-0.098	-0.159	-0.102	-0.063	-0.073	-0.120
			(0.190)	(0.193)	(0.207)	(0.212)	(0.201)	(0.194)	(0.201)
SE (Region 5)			-0.120	-0.140	-0.228	-0.055	-0.069	-0.076	-0.074
			(0.172)	(0.177)	(0.174)	(0.138)	(0.179)	(0.142)	(0.131)
District %FRL					0.661	0.995		1.024	1.105
					(0.850)	(1.358)		(0.859)	(1.298)
District %White					-0.003	0.504		0.299	0.462
					(0.405)	(0.487)		(0.427)	(0.409)
Educational Success						-0.128			-0.122
						(0.277)			(0.294)
Teacher Salary BA, 0-yrs (in 1,000s						-0.003			-0.001
						(0.027)			(0.029)
District Growth						0.049			0.050
						(0.037)			(0.038)
Constant	0.400***	0.376***	0.366**	0.439**	0.017	-0.542	0.403**	-0.528	-0.619
	(0.115)	(0.129)	(0.167)	(0.187)	(0.712)	(1.247)	(0.200)	(0.731)	(1.231)
Observations	185	184	185	185	184	176	184	183	176
R-squared	0.011	0.007	0.001	0.014	0.020	0.034	0.008	0.018	0.033

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of need for elementary teachers = 0.13 (equivalent to ~1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Table J2: Predictors of Middle School Teacher Need

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.068*			-0.067*	-0.050	-0.057			
	(0.035)			(0.036)	(0.047)	(0.056)			
Large districts (> 3,500)	-0.079**			-0.075**	-0.063	-0.012			
	(0.031)			(0.033)	(0.048)	(0.058)			
City (urbanicity 1)		0.018					0.039	0.072	0.037
		(0.047)					(0.047)	(0.051)	(0.070)
Suburb (urbanicity 2)		-0.089**					-0.077*	-0.021	0.000
		(0.039)					(0.042)	(0.047)	(0.065)
Town (urbanicity 3)		-0.038					-0.044	-0.026	-0.010
		(0.047)					(0.047)	(0.051)	(0.059)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-0.020	-0.018	-0.026	-0.027	-0.013	-0.020	-0.031
			(0.061)	(0.062)	(0.067)	(0.065)	(0.064)	(0.065)	(0.061)
Central (Region 3)			-0.047	-0.030	-0.029	-0.057	-0.057	-0.044	-0.056*
			(0.051)	(0.051)	(0.039)	(0.037)	(0.043)	(0.036)	(0.033)
SW (Region 4)			-0.038	-0.040	-0.053	-0.053	-0.030	-0.032	-0.051
			(0.073)	(0.073)	(0.083)	(0.076)	(0.072)	(0.084)	(0.075)
SE (Region 5)			0.002	0.000	-0.021	0.004	0.018	0.017	0.009
			(0.055)	(0.056)	(0.056)	(0.052)	(0.058)	(0.053)	(0.052)
District %FRL					0.163	0.227		0.264	0.297
					(0.280)	(0.429)		(0.238)	(0.369)
District %White					-0.006	0.046		0.075	0.080
					(0.106)	(0.135)		(0.111)	(0.103)
Educational Success						-0.020			-0.018
						(0.063)			(0.067)
Teacher Salary BA, 0-yrs (in 1,000s)						-0.003			-0.005
						(0.008)			(0.009)
District Growth						0.010			0.010
						(0.011)			(0.011)
Constant	0.170***	0.159***	0.165***	0.184***	0.082	0.113	0.172***	-0.067	0.078
	(0.029)	(0.030)	(0.043)	(0.047)	(0.236)	(0.486)	(0.051)	(0.190)	(0.450)
Observations	185	185	185	185	184	176	185	184	176
R-squared	0.015	0.009	0.005	0.018	0.024	0.042	0.015	0.025	0.037

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of need for middle school teachers = 0.1 (equivalent to 1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Table J3: Predictors of High School Teacher Need

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.151**			-0.143**	-0.096	-0.081			
	(0.062)			(0.058)	(0.074)	(0.086)			
Large districts (> 3,500)	-0.220***			-0.276***	-0.250***	-0.041			
	(0.052)			(0.073)	(0.086)	(0.103)			
City (urbanicity 1)		-0.001					-0.050	0.038	-0.076
		(0.119)					(0.116)	(0.152)	(0.122)
Suburb (urbanicity 2)		-0.174***					-0.204***	-0.069	0.008
		(0.059)					(0.075)	(0.077)	(0.097)
Town (urbanicity 3)		-0.081					-0.070	-0.033	0.009
		(0.080)					(0.074)	(0.087)	(0.091)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-0.056	-0.060	-0.088	-0.098	-0.060	-0.080	-0.114
			(0.096)	(0.096)	(0.107)	(0.107)	(0.101)	(0.104)	(0.104)
Central (Region 3)			0.029	0.092	0.106	-0.022	0.049	0.080	-0.006
			(0.121)	(0.119)	(0.100)	(0.087)	(0.104)	(0.093)	(0.081)
SW (Region 4)			-0.026	-0.041	-0.086	-0.122	-0.035	-0.051	-0.140
			(0.132)	(0.133)	(0.157)	(0.142)	(0.134)	(0.159)	(0.143)
SE (Region 5)			-0.041	-0.061	-0.125	-0.103	-0.036	-0.059	-0.123
			(0.103)	(0.106)	(0.114)	(0.097)	(0.106)	(0.108)	(0.100)
District %FRL					0.488	0.377		0.676	0.514
					(0.440)	(0.758)		(0.423)	(0.676)
District %White					-0.003	-0.086		0.142	-0.076
					(0.189)	(0.220)		(0.233)	(0.190)
Educational Success						0.021			0.024
						(0.080)			(0.087)
Teacher Salary BA, 0-yrs (in 1,000s						-0.032***			-0.033**
						(0.012)			(0.014)
District Growth						0.027			0.030
						(0.018)			(0.019)
Constant	0.331***	0.304***	0.294***	0.351***	0.040	1.247	0.326***	-0.240	1.174
	(0.049)	(0.048)	(0.088)	(0.098)	(0.349)	(0.794)	(0.105)	(0.364)	(0.751)
Observations	185	185	185	185	184	176	185	184	176
R-squared	0.033	0.011	0.004	0.044	0.063	0.084	0.016	0.043	0.082

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of need for high school teachers = 0.15 (equivalent to ~2 vacancies per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Need by Subject Area

Table J4: Predictors of Math & Science Teacher Need (Middle School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.006			-0.015	-0.002	-0.022			
	(0.043)			(0.043)	(0.040)	(0.043)			
Large districts (> 3,500)	-0.028			-0.005	-0.017	0.009			
	(0.027)			(0.034)	(0.045)	(0.049)			
City (urbanicity 1)		0.025					0.062	0.036	0.037
		(0.046)					(0.044)	(0.053)	(0.062)
Suburb (urbanicity 2)		-0.100***					-0.078**	-0.060	-0.049
		(0.028)					(0.033)	(0.047)	(0.046)
Town (urbanicity 3)		-0.013					-0.042	-0.053	-0.047
		(0.036)					(0.035)	(0.039)	(0.039)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			0.063	0.065*	0.053	0.053	0.075*	0.064*	0.057
			(0.038)	(0.039)	(0.038)	(0.039)	(0.039)	(0.038)	(0.038)
Central (Region 3)			0.030	0.031	0.026	0.001	0.014	0.009	-0.009
			(0.039)	(0.044)	(0.039)	(0.038)	(0.037)	(0.037)	(0.037)
SW (Region 4)			0.018	0.020	-0.018	-0.013	0.030	-0.004	-0.006
			(0.050)	(0.052)	(0.056)	(0.057)	(0.053)	(0.056)	(0.061)
SE (Region 5)			0.166***	0.167***	0.115*	0.130*	0.185***	0.139**	0.140*
			(0.058)	(0.057)	(0.065)	(0.067)	(0.059)	(0.066)	(0.072)
District %FRL					0.217*	0.233		0.187	0.194
					(0.123)	(0.165)		(0.134)	(0.160)
District %White					-0.060	-0.019		-0.060	-0.017
					(0.086)	(0.101)		(0.093)	(0.112)
Educational Success						-0.014			-0.018
						(0.034)			(0.035)
Teacher Salary BA, 0-yrs (in 1,000s						-0.001			0.000
						(0.006)			(0.005)
District Growth						-0.003			-0.005
						(0.005)			(0.006)
Constant	0.126***	0.126***	0.075***	0.077***	-0.009	-0.025	0.077***	0.016	-0.022
	(0.020)	(0.023)	(0.019)	(0.022)	(0.134)	(0.263)	(0.024)	(0.146)	(0.256)
Observations	151	151	151	151	150	143	151	150	143
R-squared	0.002	0.015	0.074	0.075	0.108	0.142	0.101	0.127	0.155

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of middle school math & science teacher need = 0.08 (equivalent to ~1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Table J5: Predictors of Math & Science Teacher Need (High School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.248***			-0.263***	-0.254***	-0.223**			
	(0.081)			(0.086)	(0.092)	(0.100)			
Large districts (> 3,500)	-0.292***			-0.375***	-0.446***	-0.238			
	(0.076)			(0.106)	(0.148)	(0.170)			
City (urbanicity 1)		-0.081					-0.149	-0.463	-0.465
		(0.150)					(0.145)	(0.281)	(0.297)
Suburb (urbanicity 2)		-0.322***					-0.376***	-0.444**	-0.402**
		(0.105)					(0.114)	(0.188)	(0.180)
Town (urbanicity 3)		-0.257***					-0.269***	-0.387***	-0.324**
		(0.087)					(0.087)	(0.148)	(0.145)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			0.141	0.146	0.122	0.104	0.149	0.115	0.082
			(0.149)	(0.154)	(0.143)	(0.148)	(0.151)	(0.133)	(0.138)
Central (Region 3)			0.247*	0.336**	0.290*	0.189	0.285**	0.240	0.150
			(0.145)	(0.148)	(0.153)	(0.179)	(0.141)	(0.155)	(0.174)
SW (Region 4)			0.051	0.061	-0.054	-0.104	0.055	-0.124	-0.191
			(0.125)	(0.126)	(0.157)	(0.179)	(0.132)	(0.187)	(0.209)
SE (Region 5)			0.146	0.129	-0.052	-0.048	0.195	-0.072	-0.117
			(0.110)	(0.116)	(0.196)	(0.212)	(0.119)	(0.224)	(0.243)
District %FRL					0.399	-0.051		0.295	-0.087
					(0.339)	(0.558)		(0.341)	(0.570)
District %White					-0.331	-0.558		-0.622	-0.792
					(0.304)	(0.466)		(0.457)	(0.577)
Educational Success						0.039			0.007
						(0.130)			(0.128)
Teacher Salary BA, 0-yrs (in 1,000s						-0.045**			-0.040**
						(0.018)			(0.016)
District Growth						0.019			0.019
						(0.021)			(0.022)
Constant	0.464***	0.465***	0.269***	0.352***	0.385	2.358**	0.354***	0.746	2.479**
	(0.072)	(0.078)	(0.071)	(0.080)	(0.347)	(1.086)	(0.088)	(0.535)	(1.105)
Observations	153	153	153	153	152	144	153	152	144
R-squared	0.041	0.037	0.021	0.075	0.106	0.105	0.064	0.115	0.132

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of high school math & science teacher need = 0.14 (equivalent to 1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Table J6: Predictors of English/Language Arts & Social Studies Teacher Need (Middle School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.001			0.003	0.020	0.012			
	(0.030)			(0.029)	(0.029)	(0.033)			
Large districts (> 3,500)	-0.026			-0.045	-0.036	0.006			
	(0.027)			(0.033)	(0.038)	(0.048)			
City (urbanicity 1)		0.037					0.025	0.039	0.022
		(0.040)					(0.043)	(0.048)	(0.060)
Suburb (urbanicity 2)		-0.070**					-0.073**	-0.043	-0.024
		(0.031)					(0.037)	(0.043)	(0.052)
Town (urbanicity 3)		-0.022					-0.024	-0.015	-0.007
		(0.029)					(0.030)	(0.029)	(0.031)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-0.036	-0.039	-0.046	-0.042	-0.030	-0.034	-0.038
			(0.038)	(0.038)	(0.041)	(0.040)	(0.039)	(0.040)	(0.039)
Central (Region 3)			0.014	0.025	0.032	0.004	0.010	0.019	-0.001
			(0.044)	(0.045)	(0.041)	(0.045)	(0.043)	(0.042)	(0.045)
SW (Region 4)			-0.015	-0.018	-0.033	-0.023	-0.011	-0.014	-0.017
			(0.054)	(0.055)	(0.061)	(0.066)	(0.057)	(0.064)	(0.069)
SE (Region 5)			0.007	0.002	-0.017	0.012	0.016	0.012	0.019
			(0.049)	(0.050)	(0.055)	(0.058)	(0.051)	(0.057)	(0.060)
District %FRL					0.176	0.194		0.153	0.149
					(0.117)	(0.193)		(0.122)	(0.191)
District %White					0.013	0.034		0.041	0.036
					(0.078)	(0.106)		(0.083)	(0.111)
Educational Success						0.016			0.013
						(0.056)			(0.059)
Teacher Salary BA, 0-yrs (in 1,000s						-0.003			-0.003
						(0.006)			(0.006)
District Growth						0.000			-0.000
						(0.006)			(0.006)
Constant	0.099***	0.100***	0.104***	0.109***	-0.017	0.044	0.108***	-0.027	0.066
	(0.020)	(0.022)	(0.032)	(0.034)	(0.114)	(0.263)	(0.037)	(0.125)	(0.260)
Observations	150	150	150	150	149	142	150	149	142
R-squared	0.002	0.017	0.012	0.018	0.031	0.024	0.025	0.033	0.026

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of middle school English language arts & social studies teacher need = 0.06 (equivalent to ~1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Table J7: Predictors of English/Language Arts Teacher Need (High School)

VARIABLES	(1) Enrollment (Categorical)	(2) Urbanicity	(3) Region	(4) Enrollment & Region	(5) Enrollment & Region (w/demo controls)	(6) Enrollment & Region (w/all controls)	(7) Region & Urbanicity	(8) Region & Urbanicity (w/demo controls)	(9) Region & Urbanicity (w/all controls)
Small districts (< 1,500)	-			-	-	-			
Midsize districts (1,500-3,500)	-0.175**			-0.171**	-0.072	-0.079			
	(0.082)			(0.081)	(0.075)	(0.083)			
Large districts (> 3,500)	-0.255***			-0.387***	-0.299**	-0.230			
	(0.072)			(0.134)	(0.122)	(0.166)			
City (urbanicity 1)		0.040					-0.073	0.034	-0.081
		(0.126)					(0.191)	(0.217)	(0.224)
Suburb (urbanicity 2)		0.152					0.129	0.340	0.379
		(0.366)					(0.395)	(0.400)	(0.418)
Town (urbanicity 3)		-0.141					-0.160*	-0.083	-0.056
		(0.086)					(0.092)	(0.100)	(0.104)
Rural (urbanicity 4)		-					-	-	-
NW (Region 1)			-	-	-	-	-	-	-
NE (Region 2)			-0.067	-0.069	-0.081	-0.076	-0.057	-0.066	-0.088
			(0.100)	(0.104)	(0.106)	(0.110)	(0.102)	(0.102)	(0.109)
Central (Region 3)			0.214	0.321	0.400*	0.321	0.220	0.348	0.277
			(0.177)	(0.195)	(0.213)	(0.229)	(0.221)	(0.224)	(0.218)
SW (Region 4)			-0.041	-0.038	-0.065	-0.034	-0.015	-0.009	-0.030
			(0.115)	(0.115)	(0.126)	(0.130)	(0.112)	(0.125)	(0.130)
SE (Region 5)			0.164	0.138	0.125	0.196	0.214	0.235	0.230
			(0.174)	(0.178)	(0.209)	(0.221)	(0.183)	(0.214)	(0.224)
District %FRL					0.961***	0.879**		1.258***	1.221**
					(0.332)	(0.437)		(0.389)	(0.471)
District %White					0.211	0.412		0.396	0.493
					(0.239)	(0.341)		(0.295)	(0.391)
Educational Success						-0.072			-0.055
						(0.098)			(0.095)
Teacher Salary BA, 0-yrs (in 1,000s						0.007			-0.005
						(0.016)			(0.017)
District Growth						0.003			0.003
						(0.020)			(0.019)
Constant	0.373***	0.329***	0.268***	0.336***	-0.490	-0.817	0.298***	-0.884**	-0.758
	(0.067)	(0.068)	(0.080)	(0.089)	(0.359)	(0.852)	(0.080)	(0.430)	(0.862)
Observations	147	147	147	147	146	140	147	146	140
R-squared	0.031	0.018	0.038	0.089	0.124	0.108	0.056	0.121	0.122

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Constant: Small districts, NW=Region 1, Rural. Mean unit of high school English language arts teacher need = 0.12 (equivalent to 1 vacancy per 10 classroom positions). Overall mean unit of teacher need = 0.09 (equivalent to ~1 vacancy per 10 classroom positions).

Appendix K: Approved IRB

K1: Institutional Review Board Approval

Office of Research Compliance
Institutional Review Board

February 20, 2017

MEMORANDUM

TO:	Leesa Foreman Evan Rhinesmith Gary Ritter
FROM:	Ro Windwalker IRB Coordinator
RE:	New Protocol Approval
IRB Protocol #:	17-02-434
Protocol Title:	*Localized Teacher Supply and Demand in Arkansas*
Review Type:	☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB
Approved Project Period:	Start Date: 02/17/2017 Expiration Date: 02/16/2018

Your protocol has been approved by the IRB, for phase one interviews and collection of existing data only. Future procedures that are not yet developed, such as surveys, will need to be submitted as modifications for review and approval before being implemented. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Research Compliance website (https://vpred.uark.edu/units/rscp/index.php). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

This protocol has been approved for 45,500 participants. If you wish to make *any* modifications in the approved protocol, including enrolling more than this number, you must seek approval *prior to* implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 109 MLKG Building, 5-2208, or irb@uark.edu.

109 MLKG • 1 University of Arkansas • Fayetteville, AR 72701-1201 • (479) 575-2208 • Fax (479) 575-6527 • Email irb@uark.edu

K2: IRB Protocol

UNIVERSITY OF ARKANSAS INSTITUTIONAL REVIEW BOARD PROTOCOL FORM

The University Institutional Review Board recommends policies and monitors their implementation, on the use of human beings as subjects for physical, mental, and social experimentation, in and out of class. . . . Protocols for the use of human subjects in research and in class experiments, whether funded internally or externally, must be approved by the (IRB) or in accordance with IRB policies and procedures prior to the implementation of the human subject protocol. . . Violation of procedures and approved protocols can result in the loss of funding from the sponsoring agency or the University of Arkansas and may be interpreted as scientific misconduct. *(see Faculty Handbook)*

Supply the information requested in items 1-14 as appropriate. **Type** entries in the spaces provided using additional pages as needed. In accordance with college/departmental policy, submit the original **and** one copy of this completed protocol form and all attached materials to the appropriate Human Subjects Committee. In the absence of an IRB-authorized Human Subjects Committee, submit the original of this completed protocol form and all attached materials to the IRB, Attn: Compliance Officer, MLKG 109, 575-2208. Completed form and additional materials may be emailed to irb@uark.edu. The fully signed signature page may be scanned and submitted with the protocol, by FAX (575-6527) or via campus mail.

1. Title of Project: **Localized Teacher Supply and Demand in Arkansas**

2. (Students **must** have a faculty member supervise the research. The faculty member must sign this form and all researchers and the faculty advisor should provide a campus phone number.)

	Name	Department	Email Address	Campus Phone
Principal Researcher	Leesa Foreman	EDRE	[redacted]	
Co-Researcher				
Co-Researcher				
Co-Researcher	Evan Rhinesmith	EDRE	[redacted]	
Faculty Advisor	Gary W. Ritter	EDRE	[redacted]	

3. Researcher(s) status. Check all that apply.

☒ Faculty ☐ Staff ☒ Graduate Student(s) ☐ Undergraduate Student(s)

4. Project type

☐ Faculty Research ☒ Thesis / Dissertation ☐ Class Project ☐ Independent Study / Educ. Spec. Project

☐ Staff Research ☐ M.A.T. Research ☐ Honors Project

5. Is the project receiving extramural funding? (Extramural funding is funding from an external research sponsor.)

☒ No ☐ Yes. Specify the source of funds

6. Brief description of the purpose of proposed research and all procedures involving people. Be specific. Use additional pages if needed. (**Do not** send thesis or dissertation proposals. Proposals for extramural funding must be submitted in full.)

Purpose of research: The purpose of this study is to determine the demand for teachers in Arkansas, and where shortages may be occurring. The Arkansas Department of Education (ADE) reports concerns of a teacher shortage in Arkansas and identifies statewide shortage areas for each school year. The ADE references the decline in the number of enrollees in education preparation programs as particular cause for concern.

We will descriptively present the characteristics associated with shortages in Arkansas and examine how districts and preparation institutions seek to meet the demand for teachers. We are particularly interested in subject areas and regions that chronically remain unfilled. We aim to identify feeder patterns of preparation institutions to districts in the state. We will build a database of district information connected to providers, and includes characteristics of districts, providers, and program graduates. We will conduct regression analyses to identify the characteristics as a function of the teacher shortage.

Procedures involving people: For the interview administration, structured phone (or in person) interviews will be conducted of an initial representative sample of districts to identify their needs, processes, and challenges to fill vacancies. An online survey will be developed based on the responses from these interviews to collect information from all districts. Additional structured phone (or in person) interviews will be conducted with educator preparation institutions to address the process for job placement. Interviews and surveys will be conducted with administrator/respondents who are 18 years of age or older that provide implied consent to participate by agreeing to be interviewed and by completing the survey. The lead researcher will conduct all interviews and surveys. No identifying information of respondents will be included or published.

Administrative data from the Arkansas Department of Higher Education will be based on applications and transcripts for students enrolling at each institution between 2003 and 2014. Each institution will strip the names of students from all records. The listed researcher(s) will comply with the data use and security policy outlined in the policy (1900.10 Academic Policy Series –http://provost.uark.edu/policies/1900(0-20040801.pdf). Moreover, the listed researcher will sign a statement affirming compliance with the requirements of Academic Policy Series 1900.10.

7. Estimated **number of participants** (complete all that apply)

____ Children under 14	____ Children 14-17	_45,000_ UA students (18yrs and older)	_500_ Adult non-students

8. Anticipated dates for contact with participants:

First Contact ___February 2017___ Last Contact ___August 2017___

9. Informed Consent procedures: The following information must be included in any procedure: identification of researcher, institutional affiliation and contact information; identification of Compliance Officer and contact information; purpose of the research, expected duration of the subject's participation; description of procedures; risks and/or benefits; how confidentiality will be ensured; that participation is voluntary and that refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled. See *Policies and Procedures Governing Research with Human Subjects*, section 5.0 Requirements for Consent.

☐ Signed informed consent will be obtained. **Attach copy of form.**
☐ Modified informed consent will be obtained **Attach copy of form.**
☒ Other method (e.g., implied consent). **Please explain on attached sheet.**
☐ Not applicable to this project. **Please explain on attached sheet.**

10. Confidentiality of Data: All data collected that can be associated with a subject/respondent must remain confidential. Describe the methods to be used to ensure the confidentiality of data obtained.

All respondent, student, or applicant level data will be kept confidential by researchers. Researchers will keep all information in a secure, supervised location at all times.

For the purposes of this study, researchers will have access to student and applicant level data. However, no identifying information will be used once the data is obtained. Data are provided with a unique, anonymous ID from the Arkansas Department of Higher Education, where it is kept and not shared with the researchers. All data will be kept in a secure location and discarded when it is no longer necessary, but no sooner than 3 years after completion of analyses. No identifying information will be used within the evaluation or in any published form.

All data and information collected will be kept in a private locked file to which only the primary researchers will have access. State and federal regulations require that all records of research with human subjects be maintained for a minimum of three years past the completion of the study. All data obtained for this project will be returned and/or purged from computer systems at that time, expected date December 31, 2019.

11. Risks and/or Benefits:

Risks: Will participants in the research be exposed to more than minimal risk? Yes ☒ No Minimal risk is defined as risks of harm not greater, considering probability and magnitude, than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. Describe any such risks or discomforts associated with the study and precautions that will be taken to minimize them.

Benefits: Other than the contribution of new knowledge, describe the benefits of this research, especially any benefits to those participating.

This study will provide meaningful information to the state by highlighting differences in outcomes for students in education programs at universities in the state. Teacher preparation institutions could inform recruiting and placement practices from knowing which districts hire their graduates and what the specific needs are in local districts. Districts could add efficiency to their hiring practices from knowing the types of teachers supplied by preparation institutions. Additionally, information provided to the Arkansas Department of Education and the State Board of Education will aid in identifying which districts/regions are in greatest need and in which subject areas.

12. Check all of the following that apply to the proposed research. Supply the requested information below or on attached sheets:

☐ A. Deception of or withholding information from participants. Justify the use of deception or the withholding of information. Describe the debriefing procedure: how and when will the subject be informed of the deception and/or the information withheld?

☐ B. Medical clearance necessary prior to participation. Describe the procedures and note the safety precautions to be taken.

☐ C. Samples (blood, tissue, etc.) from participants. Describe the procedures and note the safety precautions to be taken.

☐ D. Administration of substances (foods, drugs, etc.) to participants. Describe the procedures and note the safety precautions to be taken.

☐ E. Physical exercise or conditioning for subjects. Describe the procedures and note the safety precautions to be taken.

☐ F. Research involving children. How will informed consent from parents or legally authorized representatives as well as from subjects be obtained?

☐ G. Research involving pregnant women or fetuses. How will informed consent be obtained from both parents of the fetus?

☐ H. Research involving participants in institutions (cognitive impairments, prisoners, etc.). Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.

☐ I. Research approved by an IRB at another institution. Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.

☐ J. Research that must be approved by another institution or agency. Specify agencies or institutions involved. Attach letters of approval. Letters must be on letterhead with original signature; electronic transmission is acceptable.

13. Checklist for Attachments

The following are attached:

☒ Consent form (if applicable) or

☒ Letter to participants, written instructions, and/or script of oral protocols indicating clearly the information in item #9.

☐ Letter(s) of approval from cooperating institution(s) and/or other IRB approvals (if applicable)

☒ Data collection instruments

14. Signatures

I/we agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects/respondents are protected. I/we will report any adverse reactions to the committee. Additions to or changes in research procedures after the project has been approved will be submitted to the committee for review. I/we agree to request renewal of approval for any project when subject/respondent contact continues more than one year.

Principal Researcher [redacted] Date 2-3-17

Co-Researcher [redacted] Date 2-3-17

Co-Researcher _____ Date

Co-Researcher _____ Date

Faculty Advisor [redacted] Date 2-3-17

PROTOCOL APPROVAL FORM

(To be returned to IRB Program Manager with copy of completed protocol form and attachments)

Human Subjects Committee Use Only (In absence of IRB-authorized Human Subjects Committee, send protocol to IRB.)

Recommended Review Status

9 Human Subjects Committee can approve as exempt because this research fits in the following category of research as described in section 9.02 of the IRB policies and procedures **(Cite reasons for exempt status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

****

9 Expedited Review by a designated member of the IRB because this research fits in the following category of research as described in section 9.03 of the IRB policies and procedures **(Cite reasons for expedited status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

****

9 Requires Full Review by the IRB because this research fits in the following category of research as described in section 9.04 of the IRB policies and procedures **(Cite reasons for full status.)**:

Printed Name and
Signature of the HSC Chair _____ Date

IRB/RSCP Use Only

Project Number _____ Received RSCP

Sent to: _____ Date:

Final Status

9 Approved as **Exempt** under section 9.02 of the IRB Policies and Procedures **(Cite reasons for exemption.)**:

9 Approved as **Expedited** under Section 9.03 of the IRB Policies and Procedures because **(Cite reasons for expedited status.)**

Printed Name and
Signature: _____ Date _____
IRB (for the Committee)

9 Approved by **Full** review under Section 9.04 of the IRB as meeting requirements of the IRB Policies and Procedures.

Printed Name and
Signature: _____ Date
IRB Chairperson

Exhibit A

We, the undersigned, have read and initialed the attached 1900.10 Academic Policy Series, and understand the terms therein. We will comply with this and all other University of Arkansas policies concerning the use and security of student data.

[redacted] Date 2-3-17

Leesa Foreman, Principal Researcher

[redacted] Date 2-3-17

Evan Rhinesmith, Co-Researcher

[redacted] Date 2.3.17

Gary Ritter, PhD, Faculty Advisor

Academic Policy Series	1900.10

Employee and Student Data: Use and Security

The University of Arkansas (UA) houses and maintains student and employee data in many systems and locations. Such data are utilized to support University operations and to facilitate the ethical and scholarly conduct of research by members of the UA community. The University is committed to using student and employee data in a judicious and responsible manner while working to protect the privacy and confidentiality of all individuals represented in the data. Subject to all applicable UA policies, the University of Arkansas seeks to protect personal and private information in every location or format, including data in any warehouse or comparable site aggregated for access by campus users.

This policy describes the University's general approach to the use and security of employee and student data; other policies may apply to specific types of data or databases. Unless specifically limited, statements in this policy refer to both educational/research and administrative use of individually identifiable information.

In general, requests by UA officials for non-aggregated student or employee data for bona fide administrative or non-research educational purposes shall be considered by administrators for approval to the extent the requests are consistent with the Family Educational Rights and Privacy Act (FERPA), codified at 20 U.S.C. § 1232g, and other federal or state provisions designed to protect the privacy of personal information. Requests for non-aggregated student or employee data for bona fide research purposes shall be considered for approval by the UA Institutional Review Board (IRB) using appropriate protocols. IRB protocols take into account the requirements of (FERPA) and other federal or state provisions designed to protect the privacy of personal information.

Obtaining Access to University of Arkansas Student Data

University of Arkansas faculty and staff must be authorized by the Registrar or Director of Institutional Research, or other appropriate University officials as described below, in order to access UA student data. Any access to student education records must be in compliance with FERPA and Universitywide Administrative Memorandum 515.1, UA Policy Concerning Student Educational Records. Department or unit heads are responsible for monitoring use of information within the department and any failure to comply may result in immediate loss of access to UA student data and may be considered for purposes of job performance evaluation. To the extent applicable, the U of A will not release any "individually identifiable health information" as described in the Health Insurance Portability and Accountability Act of 1996 (HIPAA) except as expressly permitted by HIPAA and its implementing regulations. Likewise, student social security numbers will not be released except for IRB-approved research or for non-research purposes, to the extent permitted by federal law, as approved by the Registrar, the Director of Institutional Research, the Provost, or the Vice Chancellor for Finance and Administration [e.g., for student loan administration or pertaining to student

employment); otherwise the University Personal Identification number (UID) shall be used if needed.

Student data shall be released only to properly trained appointed employees with a job-related, educational or administrative need to know and consistent with a signed confidentiality agreement approved by the college dean or non-academic department director or director's agent. Student users, both graduate and undergraduate and administrative and research users, shall only be permitted to access information under the supervision of a full-time faculty or staff member who is responsible for monitoring use and consistent with a signed confidentiality agreement. Non-aggregated student information shall only be released with a signed confidentiality agreement that specifies data shall be handled as follows:

1. Data shall be destroyed at the completion of the intended research project or administrative use, rendered anonymous or, in the case of longitudinal data, personally identifiable information will be kept separate from the data in a secured area consistent with the written policy and procedures of the unit.
2. Data shall be used solely for the approved research project or administrative purpose.
3. Data shall be used solely in accordance with FERPA and its implementing regulations, located at 34 CFR § 99, and any other applicable federal or state law.
4. Data shall not be used in any way that permits the identification or contact of any student or his/her parents outside the scope of the approved research project or administrative purpose.
5. Data shall not be disclosed to any unauthorized party.

Obtaining Access to University of Arkansas Employee Data

Employee data shall be released only to properly trained employees with a job-related need to know, and solely to the extent permitted by applicable federal or state law. To the extent applicable, the UA shall not release any "individually identifiable health information" as described in Health Insurance Portability and Accountability Act of 1996 (HIPAA) except as expressly permitted by HIPAA and its implementing regulations. Employee social security numbers shall not be released except for IRB approved research or for non-research access approved by the Director of Institutional Research, the Vice Chancellor for Finance and Administration, or the Provost; otherwise, the University Personal Identification number (UID) shall be used if needed. Non-aggregated employee information shall only be released with a signed confidentiality agreement that specifies non-aggregated data shall be handled as follows:

1. Data shall be destroyed at the completion of the intended research project or administrative use, rendered anonymous or, in the case of longitudinal data, personally identifiable information shall be kept separate from other data in a secured area consistent with the written policy and procedures of the unit.

[redacted] 2-3-17

2-3-17

2-3-17

2. Data shall be used solely for the approved research project or administrative purpose.
3. Data shall be used solely in accordance with any applicable federal or state law.
4. Data shall not be used in any way that permits the identification or contact of any employee or his/her family outside of the scope of the approved research project or administrative purpose.
5. Data shall not be disclosed to any unauthorized party.

Resources
FERPA: www.ed.gov/offices/OII/fpco/ferpa/

HIPAA: www.uark.edu/depts/healinfo/AnnouncePage080.3a.shtml
www.hrsa.gov/website.htm

IRB: UA Research and Sponsored Programs – Research Compliance
www.uark.edu/admin/rsspinfo/compliance/human-subjects-irb/index.html

Universitywide Memorandum 515.1, UA Policy Concerning Student Educational Records

Provost's Office 8/1/04

Additional Information:

9. Informed Consent procedures:

Other method - Implied Consent (letter attached).
Implied consent to participate is provided by respondents who agree to be interviewed or complete the survey.

Exhibit B: Implied Consent Explanation

Office for Education Policy

Dear Human Resource Administrator,

Greetings from the Office for Education Policy at the University of Arkansas. This research is part of a dissertation designed to identify what the true level of teacher need is statewide, and where shortages may be occurring. Part of the evaluation is to interview an initial representative sample of districts to identify their needs, hiring processes, and challenges to fill vacancies. An online survey will be developed based on the responses from these interviews in hopes of collecting information from all districts statewide. The interviews and survey are meant to give a voice to the districts affected by teacher shortages. There is no risk to you in participating in the interview (or completing this survey), however, participation will be extremely helpful to research and gaining a better understanding of district needs and experiences.

At a time of your convenience, we would like to schedule a half hour interview. By participating, you certify that you are at least 18 years of age and are consenting to have your responses included in this research. Your privacy is important for this research and **your responses will remain anonymous.**

If you have any additional questions about this survey, please contact the principal researcher via email [redacted]. This project has been reviewed by the Institutional Review Board at the University of Arkansas which oversees research involving human subjects. Any questions or concerns can be directed to Ro Windwalker at [redacted]

Thank you for your cooperation and participation in this research. We hope it will be helpful to gaining a better understanding of the local teacher shortage need.

Leesa Foreman

Human Resource Administrator Interview (and Survey) Question Guide

Identifying Need

In the past year (2016-17), how many vacancies were available in your district?

In what subjects were positions available? How many vacancies for each and at what level (elementary, middle school/junior high, high school)?

Are there chronically vacant positions? In what areas? Can you give an example(s)?

How far in advance do you know about upcoming vacancies/need? When do you start to advertise vacancies?

What is the process for seeking applicants and filling positions for the following school year? (How do you plan for this?)

How many teachers leave each year? Is there an exit survey/do you know what the reasons for leaving are?

How much movement is there within the district? How many vacancies are filled by transferring teachers? by new hires?

How many teachers retire each year?

Hiring

Could you describe the hiring process?

How many teachers do you hire each year?

How do prospective teachers find out about available positions?

Where do new hires come from?

How do you seek/recruit applicants?

What challenges do districts face in finding applicants?

What incentives (if any) are offered/available for hard-to-staff positions or schools?

K3: Data Share Agreement - Arkansas Dept. of Higher Education and University of Arkansas

MEMORANDUM OF AGREEMENT BETWEEN THE ARKANSAS DEPARTMENT OF HIGHEREDUCATION AND UNIVERSITY OF ARKANSAS, FAYETTEVILLE CAMPUS

This Memorandum of Agreement ("the Agreement") is entered into this day _3 February 2017_ by and between the Arkansas Department of Higher Education ("the Department") and the Board of Trustees, University of Arkansas acting for and on behalf of the University of Arkansas, Fayetteville campus and the College of Education & Health Professions ("University of Arkansas").

I. PARTIES. The Arkansas Department of Higher Education is a state educational agency, authorized to collect and maintain student educational records and to receive information from institution of higher education consistent with applicable state and federal laws and subject to the federal Family Educational Rights and Privacy Act (FERPA), as authorized by 20 U.S.C. § 1232g(b) and 34 CFR Part 99. The Department is headquartered at 423 Main Street, Suite 400, Little Rock, Arkansas, 72201.

The University of Arkansas is an institution of higher education located in Fayetteville, Arkansas, 72701. The College of Education & Health Professions is a college of the University of Arkansas with address of Room 324, Graduate Education Building, Fayetteville, Arkansas, 72701.

II. PURPOSE. The purpose of the Agreement is to document the terms under which the Department is authorized to release de-identified student information for approved research projects, and to designate the University of Arkansas as the authorized representative of the Department consistent with applicable federal and state laws concerning access to and confidentiality of student record information including FERPA.

As described herein, the University of Arkansas, as the Department's authorized representative, may have temporary access to data in the custody of the Department for use in projects identified in addenda to the Agreement and under the terms and conditions described in the Agreement and any addenda to it.

III. AUTHORITY. Consistent with the federal Family Educational Rights and Privacy Act (FERPA) the Department may disclose information from students' education records to its authorized representative without written consent for use in studies initiated or approved by the Department in connection with an audit or evaluation of Federal or State supported education programs; or enforcement of, or compliance with, Federal legal requirements relating to such programs. 34 CFR § 99.31(a)(3), 20 U.S.C. § 1232g(b)(3). The Department may also disclose information to its authorized representative without written consent for the purpose of conducting studies for or on behalf of the Department in order to develop, validate or administer predictive tests; administer student aid programs; or improve instruction. 34 CFR § 99.31(a)(6) and §§ 99.35; 20 U.S.C. § 1232g(b)(1)(F).

The Department designates the University of Arkansas as its authorized representative for the purposes of disclosing student information for use in evaluation, enforcement, audit,

compliance, or study as described above.

All projects referred to above shall be described in addenda to this Agreement, which shall include project information including but not limited to the scope of the project, the data that will be disclosed to the University of Arkansas, the temporary custodian appointed by the Department, applicable timelines, additional terms and conditions specific to each project, and requirements for communication and reporting to the Department.

IV. TERMS AND CONDITIONS. To effect the transfer of data and information that is subject to State and Federal confidentiality laws and to ensure that the required confidentiality of information shall always be maintained, the University of Arkansas, agrees to:

1. In all respects comply with the provisions of FERPA. For the purposes of the Agreement and the specific projects conducted pursuant to the Agreement and described in addenda to it, FERPA includes any amendments or other relevant provisions of federal law, as well as all requirements of 34 CFR Part 99 and 20 U.S.C. § 1232g. Nothing in this Agreement may be construed to allow either party to maintain, use, disclose, or share student record information in a manner not allowed under Federal law or regulation.

2. Name a temporary custodian of the Department's data for each project. That custodian shall be able to request and receive data under the Agreement and applicable addenda to it and to ensure the University of Arkansas's compliance with the terms of the Agreement and applicable laws. The Department shall release data only to the named temporary custodian, who shall be responsible for transmitting all data requests and maintaining a log or other record of all data requested and received pursuant to the Agreement and addenda to it, including confirmation of the completion of the project and the return or destruction of data as required by the Agreement. The Department or its agents may upon request review the records required to be kept by the University of Arkansas under this section.

3. Use data shared under the Agreement for no purpose other than the research projects described in the attached addenda, and as authorized under 34 CFR §§ 99.31(a)(6) and 99.35; or 34 CFR § 99.31(a)(3). Nothing in the Agreement or the addenda shall be construed to authorize the University of Arkansas to have access to additional data from the Department that is not included in the scope of the Agreement or under the terms of the projects described in the addenda to it or to govern access to the data by entities other than the Parties. The University of Arkansas further agrees not to share data received under the Agreement and addenda with any other entity without prior written approval from the Department. The University of Arkansas understands that the Agreement does not convey ownership of data to the University of Arkansas.

4. Require all employees, contractors and agents of any kind to comply with the Agreement, and all applicable provisions of FERPA and other federal and state

laws with respect to the data and information shared under the Agreement. The University of Arkansas agrees to require of and maintain an appropriate confidentiality agreement from each employee, contractor, or agency with access to data pursuant to the Agreement and addenda to it. Nothing in this section authorizes the University of Arkansas to share data and information provided under the Agreement and addenda with any other individual or entity for any purpose other than completing the work as authorized by the Department consistent with this Agreement and addenda to it.

5. Provide the Department with periodic status reports during the project term as described in addenda to this Agreement. Progress reports shall include but not be limited to progress of the project relative to established deadlines. The University of Arkansas shall provide the Department with immediate written notice of any changes to project protocols except as consistent with the Agreement and any addenda to it.

6. Maintain all data received pursuant to the Agreement separate from all other data files and not copy, reproduce or transmit data obtained pursuant to the Agreement except to its own agents acting for or on behalf of the Department and as necessary to fulfill the purpose of the project described in the attached addenda. All copies of data of any type, including any modifications or additions to data from any source that contains information, are subject to the provisions of the Agreement and addenda to it in the same manner as the original data disclosed by the Department to the University of Arkansas. The ability to access or maintain data under the Agreement shall not under any circumstances transfer from the University of Arkansas to any other individual, institution or entity.

7. Not disclose data contained under the Agreement or addenda to it in any manner that could identify any individual student to any entity other than the Department, or authorized employees, contractors and agents of the University of Arkansas working as the Department's authorized representative on projects approved by the Department consistent with this Agreement and described in addenda to it. Persons participating in approved projects on behalf of the Parties under this Agreement shall neither disclose or otherwise release data and reports relating to an individual student, nor disclose information relating to a group or category of students without ensuring the confidentiality of students in that group. Publications and reports of this data and information related to it, including preliminary project descriptions and draft reports shall involve only aggregate data and no personally identifiable information or other information that could lead to the identification of any student. No report of these data containing a group of students less than the minimum determined by the Department shall be released to anyone other than the Department. The University of Arkansas shall require that all employees, contractors and agents working on this project abide by that statistical cell size.

8. Not provide any data obtained under this Agreement to any entity or person ineligible to receive data protected by FERPA, or prohibited from receiving data

from any entity by virtue of a finding under 34 CFR § 99.31(a)(6)(iii).

9. Destroy all data obtained under the Agreement and addenda to it when no longer needed for the purpose for which it was obtained, or after a period of five (5) years whichever comes first. Nothing in this Agreement authorizes the University of Arkansas to maintain data beyond the time period reasonably needed to complete the projects described in the addenda to this Agreement. Upon termination of the Agreement or publication of reports generated under this Agreement and addenda to it, as authorized by the Department, whichever occurs first, the University of Arkansas shall return all data files and hard copy records to the Department and purge any copies of data from its computer systems in compliance with 34 CFR §§ 99.31(a)(6)(ii)(b) and 99.35(b)(2). The University of Arkansas agrees to require all employees, contractors, or agents of any kind to comply with this provision. No other entity is authorized to continue research using the data obtained under the Agreement upon the termination of the Agreement and projects described in addenda to it.

10. Provide the Department with one electronic and, upon written request, at least one paper copy of the final versions of all approved, released reports and other documents associated with this project. The Department reserves the right to distribute and otherwise use the final approved, released report and associated documents as it wishes, in sum or in part.

V. RELATED PARTIES. The University of Arkansas represents that it is authorized to bind to the terms of the Agreement, including confidentiality, maintenance, publication, and destruction or return of data, all related or associated institutions, individuals, employees or contractors who may have access to the data or may own, lease or control equipment or facilities of any kind where the data is stored, maintained or use in any way.

VI. FEES. There shall be no cost or fees charged to or paid by any party participating in this Agreement unless agreed to in writing by an authorized representative of each organization.

VII. TERM. This Agreement takes effect upon signature by the authorized representative of each Party and shall remain in effect until completion of the projects described in the addenda or until canceled by either Party upon 30 days written notice, whichever occurs first. The Agreement is renewable upon written approval by the authorized representative of each Party.

VIII. This Agreement expresses the entire agreement of the parties and shall not be modified or altered except in writing executed by the authorized representatives of the Department and the University of Arkansas, and in a manner consistent with applicable Arkansas and Federal laws.

IX. EXECUTION

[redacted] Date: 3-31-17

Marla Strecker, Ed.D.
Senior Associate Director of Research & Technology
Arkansas Department Higher of Education

[redacted] Date: 2/20/17

Dr. Robert Beitle
Associate Vice Provost for Research and Economic Development
Interim Director of Research Compliance
University of Arkansas

Attachment(s): Addendum A

Addendum A: Localized Teacher Supply and Demand in Arkansas

Description/Scope of Work

The purpose of this study is to determine the demand for teachers in Arkansas, and where shortages may be occurring. The Arkansas Department of Education (ADE) reports concerns of a teacher shortage in Arkansas and identifies statewide shortage areas for each school year. The ADE references the decline in the number of enrollees in education preparation programs as particular cause for concern.

We will descriptively present the characteristics associated with shortages in Arkansas and examine how districts and preparation institutions seek to meet the demand for teachers. We are particularly interested in subject areas and regions that chronically remain unfilled.

Study Questions

1. Current need: What are the needs and shortage areas in each district? What challenges do districts face in finding applicants? Are some districts/regions in greater need? In what areas?
2. Exiting the system: How many teachers leave each year and why? How many are retiring? (How influenced is the shortage by turnover and attrition?)
3. Entering the system: How do districts seek/recruit applicants? How do Teacher Preparation Program graduates locate positions? Are they informed of incentives for hard-to-staff schools, and if so how?
4. **Pipeline to employment: What preparation programs serve which districts? What is the average quality of Teacher Preparation Program completers serving these districts?**

The data requested will be used to answer Question 4. We aim to identify feeder patterns of preparation institutions to districts in the state, and the characteristics of the graduates provided. We will build a database of districts connected to providers that includes characteristics of districts, providers, and program graduates. We will conduct regression analysis to identify the characteristics as a function of the teacher shortage.

This study will provide meaningful information to the state by highlighting differences in outcomes for students in education programs at universities in the state. Teacher preparation institutions could inform recruiting and placement practices from knowing which districts hire their graduates and what the specific needs are in local districts. Districts could add efficiency to their hiring practices from knowing the types of teachers supplied by preparation institutions. Additionally, information provided to the Arkansas Department of Education and the State Board of Education will aid in identifying which districts/regions are in greatest need and in which subject areas.

The final comprehensive report will include single and multi-year comparisons of program participants, student academic achievement and attainment. This will also include graphic representation of the results of the analyses. The primary researcher will be available for technical assistance and presentation.

Timeline of Work & Destruction Date

The work will be conducted between February 2017 and May 2017.

Data Sets for Study

This study aims to use student level data from the 10 four-year campuses and 22 two-year campuses in Arkansas. This includes enrollment year; ACT composite, English, reading, and math scores; high school GPA, high school name, and high school location including city and state; student race and gender; Pell Grant eligibility (where available); expected family contribution to tuition payments (where available); status as an English Language Learner (where available); if parent(s) graduated from college (where available); and thirteen semesters of enrollment status as whether they were enrolled, withdrawn, or graduated; credit hours earned per semester; college in which students were enrolled; major; and cumulative GPA. This covers all first-time enrollees from the fall of 2003 through the spring of 2015. This would provide observations for over 200,000 college enrollees in the state of Arkansas.

Additionally, this study will include interviews of district hiring personnel to identify their needs, processes, and challenges to fill vacancies that will be used to develop a survey to elicit input from all districts. Educator program personnel will also be interviewed to address the process for job placement for program completers.

Principal Investigator(s)
Leesa Foreman
211 Graduate Education Building
College of Education and Health Professions
Fayetteville, AR 72701
[redacted]

Evan Rhinesmith **(Temporary Custodian)**
211 Graduate Education Building
College of Education and Health Professions
Fayetteville, AR 72701
[redacted]

Academic Advisor to Research and Co-Principal Investigator
Gary W. Ritter, Ph.D.
207 Graduate Education Building
College of Education and Health Professions
Fayetteville, AR 72701
[redacted]

Appendix L: Approved Protocols

L1: Protocol for Initial District Interviews for Survey Development

Exhibit B: Implied Consent Explanation

Office for Education Policy

Dear Human Resource Administrator,

Greetings from the Office for Education Policy at the University of Arkansas. This research is part of a dissertation designed to identify what the true level of teacher need is statewide, and where shortages may be occurring. Part of the evaluation is to interview an initial representative sample of districts to identify their needs, hiring processes, and challenges to fill vacancies. An online survey will be developed based on the responses from these interviews in hopes of collecting information from all districts statewide. The interviews and survey are meant to give a voice to the districts affected by teacher shortages. There is no risk to you in participating in the interview (or completing this survey), however, participation will be extremely helpful to research and gaining a better understanding of district needs and experiences.

At a time of your convenience, we would like to schedule a half hour interview. By participating, you certify that you are at least 18 years of age and are consenting to have your responses included in this research. Your privacy is important for this research and **your responses will remain anonymous.**

If you have any additional questions about this survey, please contact the principal researcher via email [redacted] This project has been reviewed by the Institutional Review Board at the University of Arkansas which oversees research involving human subjects. Any questions or concerns can be directed to Ro Windwalker at i[redacted]

Thank you for your cooperation and participation in this research. We hope it will be helpful to gaining a better understanding of the local teacher shortage need.

Leesa Foreman

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

L2: Protocol for Survey Participation

Implied Consent Explanation (for Survey)

Office for Education Policy

Dear Superintendent/Human Resource Administrator,

Greetings from the Office for Education Policy at the University of Arkansas. We are working on a project to identify the level of teacher need statewide and where shortages (or surpluses) may be occurring. As part of the investigation, we have developed an online survey in hopes of collecting information from all districts statewide. The survey is meant to give a voice to the districts affected by teacher shortages. The survey will take approximately 15 minutes.

By participating, you certify that you are at least 18 years of age and are consenting to have your responses included in this research. Your privacy is important and **your responses will remain anonymous**. There is no risk to you in completing this survey. Your participation will be extremely helpful in gaining a better understanding of district needs and experiences.

If you have any additional questions about this survey, please contact the principal researcher via email [redacted] This project has been reviewed by the Institutional Review Board at the University of Arkansas which oversees research involving human subjects. Any questions or concerns can be directed to Ro Windwalker at [redacted]

Thank you for your cooperation and participation in this research. We hope it will be helpful to gaining a better understanding of the local teacher shortage need.

Leesa Foreman and Dr. Gary Ritter

Localized Teacher Supply and Demand in Arkansas – Survey Consent

IRB #17-02-434
Approved: 03/29/2017
Expires: 02/16/2018

L3: Protocol for Interviews with Teacher Preparation Programs

Implied Consent Explanation (for Interviews with TPP/EPPs)

Office for Education Policy

Dear Placement Coordinators,

Greetings from the Office for Education Policy at the University of Arkansas! Over the next few months, the OEP will be working to identify the demand for teachers throughout the state and where shortages (or surpluses) may be occurring. As part of this research, we are interested in speaking with representatives from Educator Preparation Programs regarding their relationships with districts and the hiring processes for program graduates. As such, we are looking to arrange 30-60 minute interviews to discuss this. There is no risk to you in participating in the interview, and participation will help us develop a better understanding of how districts' needs may be met.

By participating, you certify that you are at least 18 years of age and are consenting to have your responses included in this research. Your privacy is important to this research and **your responses will remain anonymous**.

If you have any additional questions about this interview or survey, please contact the principal researcher via email [redacted]. For more information about your rights, you can contact the Institutional Research Board Coordinator at the University of Arkansas, at [redacted] or [redacted].

Thank you for your cooperation and participation in this research. We hope it will lead to a better understanding of and solutions to teacher shortages throughout the state.

Leesa Foreman
Gary Ritter, PhD
Principal Investigators

IRB #17-02-434
Approved: 04/19/2017
Expires: 02/16/2018

Appendix M: Instruments

Interviews

M1: Districts' Interview Questions for Survey Development

Human Resource Administrator Interview (and Survey) Question Guide

Introduction:
Hello, my name is Leesa Foreman and I work for the Office for Education Policy at the University of Arkansas. Thank you for taking the time to speak with me (us). Currently, we are working on a project to identify the level of teacher need statewide and where shortages (or surpluses) may be occurring, and how that need is being met. The interviews and subsequent survey are meant to give a voice to the districts affected by teacher shortages.

Your privacy is important for this research and your responses will remain anonymous. We respect your time and will do our best to keep this interview to 30 minutes. This interview will be recorded to ensure completeness of your response.

Are there any questions before we get started?

What is your position?

Identifying Need

How many teaching position vacancies were available in your district for the 2016-17 school year?

Please list vacancies for all areas including Core, Electives, Special Education, ELL, Library/Media, and Counseling. Consider all vacancies, including those resulting from retirement, teacher turnover, and expanding enrollment. (Add additional lines or attach a separate spreadsheet as needed.)

Grade (or Grade Range)	Subject Area	Number of Vacancies
Example: 3rd	*All*	*2*
Example: Middle School	*Music*	*1*

On average, how many teachers leave your district each year?

Is there an exit survey or do you know why the teachers are leaving?

How many teachers retire each year?

How are upcoming vacancies/staffing needs for the next school year identified?

When do you start to advertise vacancies or anticipated vacancies? Where is this information available?

How have needs changed in the past few years?

What is the process for seeking/recruiting applicants and filling positions for the following school year? (How do you plan for this?)

Does your district face any challenges in finding applicants?

Hiring

On average, how many applicants do you receive for open positions?

What is the selection process when you have numerous applicants for a position(s)?

About how many teachers do you hire each year? (Are you able to fill all vacancies?)

Do you have positions that are always difficult to fill? In what areas? Can you give an example(s)?

How much movement is there within the district? How many transfers in? transfers out? new hires?

In general, where do new hires come from?

- Which teacher training programs generate the most new hires?

- Do you receive many applicants who are currently employed in nearby districts? Which ones?

- How many teachers transfer from out of state?

- How many are non-credentialed?

Does your district offer any incentives for hard-to-staff positions or schools?

How has hiring changed in the past few years?

Statewide Data

We plan to collect statewide data via a survey. What sorts of questions should we ask? Which people in districts should we contact?

Closing:

Thank you for taking the time to speak with me today. We really appreciate your input. If you have any follow-up questions or comments, feel free to reach out to our office.

M2: Teacher Preparation Programs' Interview Questions

TPP Placement Coordinators Interview - Question Guide

What districts do you partner with for student teaching/internship training?

- Do you work with any charter districts?

How are districts/schools selected for partnering? What is the process?

Which districts hire your graduates?

- Do you collect data/information on students after graduation? What kinds?

Are you aware of what the hiring needs of the districts surrounding your institution are? (Can you provide examples?)

Do you provide any counseling/advising for students to pursue additional licensure/endorsement areas (in particular for high need shortage areas)?

What types of assistance does the TPP provide graduates for job seeking/job placement?

How do graduates find job vacancies?

What information is provided to graduates regarding bonuses, incentives, or loan forgiveness for hard-to-staff subjects/schools?

Does your institution/program recruit for program enrollment? How, where, when?

- How is enrollment defined for reporting (to the state, feds)?
- Thoughts about why numbers vary over time for Title II reporting?
- Has enrollment changed over the past five years or so? How?

Surveys

M3: Initial Survey (Approved)

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

Vacancies

Please identify the areas for which you had vacancies and indicate the number for each:

- Elementary (K-4)
- Middle (5-8)
- Secondary (9-12)

(SLIDING SCALE ADJUSTED BASED ON DISTRICT SIZE)

For each level indicated, please identify how many **openings** you had for the following areas:	Please indicate how many **applicants** you had for each:
Elementary (K-4)	
• K-4 (core classroom teachers) 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• SPED 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• ELL 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Music/Art 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• PE 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Library/Media 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Other 1 2 3 4 5 more than 5/(How many?) _____	<Sliding scale 0-200>
Middle (5-8)	
• 5 (all core subjects) 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Math/Science 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• English/ Social Studies 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Computer Science 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• CTE 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Foreign Language 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• SPED 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• ELL 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Music/Art 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• PE 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Library/Media 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Other 1 2 3 4 5 more than 5/(How many?) _____	<Sliding scale 0-200>
Secondary (9-12) (Include AP within subject area)	

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

• Math 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Science 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• English 1 2 3 4 5 more than 5/(How many?)	
• Social Studies 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Computer Science 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
	<Sliding scale 0-200>
• CTE 1 2 3 4 5 more than 5/(How many?)	
• Foreign Language 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
	<Sliding scale 0-200>
• SPED 1 2 3 4 5 more than 5/(How many?)	
• ELL 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Music/Art 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• PE 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Library/Media 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
• Other 1 2 3 4 5 more than 5/(How many?)	<Sliding scale 0-200>
_____	

Mark any of the following positions that have been *consistently difficult* for your district to fill (K-12).

- Art
- Computer Science
- Family & Consumer Science
- Journalism
- Library
- Mathematics
- Music
- Physical Science (Physics, Chemistry)
- Social Studies
- Spanish
- Special Education

Mark any of the following positions that have been *easy* for your district to fill (K-12).

- Art
- Computer Science
- Family & Consumer Science
- Journalism
- Library
- Mathematics

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

- Music
- Physical Science (Physics, Chemistry)
- Social Studies
- Spanish
- Special Education

Was the district able to fill all vacancies in 2016-17 with credentialed teachers? Yes No

Applicants

Please indicate up to 5 places where you advertise vacant positions and/or seek applicants?

- District website
- Social media (e.g. Facebook, Twitter, Linkedin)
- Newspaper
- Radio/TV
- Teacher career fairs
- Teacher job board (e.g. AAEA, School Spring)
- Recruiting agency
- TFA
- ATC
- "Grow your own" (e.g. Paraprofessionals, Teacher cadets (high school students), Parents)
- Recruited from nearby districts
- Out of state
- Other _____

Of the ones you selected, which one(s) are the most effective at drawing applicants? (Choose up to 2)

Please indicate where applicants/new hires come from: (SCALE ADJUSTED BASED ON DISTRICT SIZE; Percent totals = 100)

- New teacher graduates <Indicate percentage/number>
- Nearby districts <Indicate percentage/number>
- Charter schools (districts) <Indicate percentage/number>
- Out of state <Indicate percentage/number>
- TFA/ ATC <Indicate percentage/number>
- Non-credentialed <Indicate percentage/number>
- Returning to teaching <Indicate percentage/number>
- Other _____ <Indicate percentage/number>

Does your district participate in internship/student teacher training? Yes No

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

(If yes) Please indicate your primary partner(s).

- Arkansas Professional Pathway to Educator Licensure APPEL
- Arkansas State University ASU
- Arkansas Tech University ATU
- Central Baptist College CBC
- Harding University HU
- Henderson State University HSU
- Hendrix College HC
- John Brown University JBU
- Lyon College LC
- Ouachita Baptist University OBU
- Philander Smith College PSC
- Southern Arkansas University SAU
- University Of Arkansas - Fayetteville UAF
- University Of Arkansas - Fort Smith UAFS
- University Of Arkansas - Little Rock UALR
- University Of Arkansas - Monticello UAM
- University Of Arkansas - Pine Bluff UAPB
- University Of Central Arkansas UCA
- University Of The Ozarks UO
- Williams Baptist College WBC
- Other/Alternative certification_____

(If no) Would your district like to participate in internship/student teacher training? Yes No

Of your teachers on staff now, where did most of them receive their education degree? Please rank the top 5 places (by dragging selections in order).

- Arkansas Professional Pathway to Educator Licensure APPEL
- Arkansas State University ASU
- Arkansas Tech University ATU
- Central Baptist College CBC
- Harding University HU
- Henderson State University HSU
- Hendrix College HC
- John Brown University JBU
- Lyon College LC
- Ouachita Baptist University OBU
- Philander Smith College PSC
- Southern Arkansas University SAU

IRB #17-02-434
Approved: 02/17/2017
Expires: 02/16/2018

- University Of Arkansas - Fayetteville UAF
- University Of Arkansas - Fort Smith UAFS
- University Of Arkansas - Little Rock UALR
- University Of Arkansas - Monticello UAM
- University Of Arkansas - Pine Bluff UAPB
- University Of Central Arkansas UCA
- University Of The Ozarks UO
- Williams Baptist College WBC
- Other/Alternative certification_____

Which of the following incentives does your district offer? (Mark all that apply)

- Signing bonus (one-time)
- Minority teacher bonus (one-time)
- Hard-to-staff position bonus (one-time)
- Pay differential (step or experience increase)
- Job sharing
- Student loan forgiveness
- Tuition reimbursement
- Paid licensure exams
- Merit pay
- Low-interest loans
- Moving expenses
- Non-monetary incentives
  - Explain _____
- Other _____
- None

- Do you advertise the availability of incentives to prospective applicants? Yes No

Your Perspectives

In your opinion, please indicate the reasons teachers left the district (Mark all that apply):

- Retired
- Relocated for spouse's work
- Completed contract (e.g. TFA, ATC)
- Started family/care for family member
- Changed career
- Returned to school
- Moved

IRB #17-03-434
Approved: 02/17/2017
Expires: 02/16/2018

- Changed district
- Due to work environment
- Due to salary/benefits
- Other _____
- No idea

Please complete the following statements:

In recent years,	Decreased	Stayed about the Same	Increased
the number of teaching position vacancies has…			
teacher turnover has…			
teacher retirement has…			
the quality of applicants has…			
the quality of new hires has…			

Please state your level of agreement with the following statements:

The reason why some positions are difficult to fill is due to…	Strongly Disagree	Disagree	Agree	Strongly Agree
fewer qualified applicants.				
more vacancies.				
vacancies in hard-to-staff subjects.				
the school/district's location.				
competition with surrounding districts.				

What strategies has your district found to have a positive influence on the recruitment and retention of high-quality teachers?

What needs or challenges does your district face that are NOT addressed in the questions above?

Would you be interested in serving as an OEP advisor in the future? Yes No

M4: Actual District Survey

AR Teacher Supply/Demand Survey Flow

Dear Superintendent/Human Resource Administrator,

Greetings from the Office for Education Policy at the University of Arkansas! We are trying to identify the level of teacher need statewide and where shortages (or surpluses) may be occurring. We have developed an online survey and hope that you will contribute your district's hiring experiences to this project. **The survey should be completed by personnel most familiar with hiring teachers, and will take approximately 15 minutes to complete.** We will share the results with you and others in your district, which may improve your ability to hire quality teachers.

By participating, you certify that you are at least 18 years of age and are consenting to have your responses included in this research. Your privacy is important and your responses will remain anonymous. There is no risk to you in completing this survey. Your participation will be extremely helpful in gaining a better understanding of district needs and experiences.

If you have any additional questions about this survey, please contact the principal researcher, **Leesa Foreman**, at [redacted] **Gary Ritter** at [redacted] project has been reviewed by the Institutional Review Board at the University of Arkansas which oversees research involving human subjects. Any questions or concerns can be directed to Ro Windwalker at [redacted]

Please complete the survey by Sunday, April 23, 2017. Thank you for your cooperation and participation in this research.

Leesa Foreman and Dr. Gary Ritter

Q1 For the current 2016-17 school year how many TEACHING POSITION vacancies were available in your district?

_____

Q3 For the current 2016-17 school year, did you have elementary TEACHER vacancies (K-4)?

- Yes
- No

Q4 Please indicate how many elementary (K-4) TEACHER VACANCIES in each area: (If "More than 5", please provide the number.)

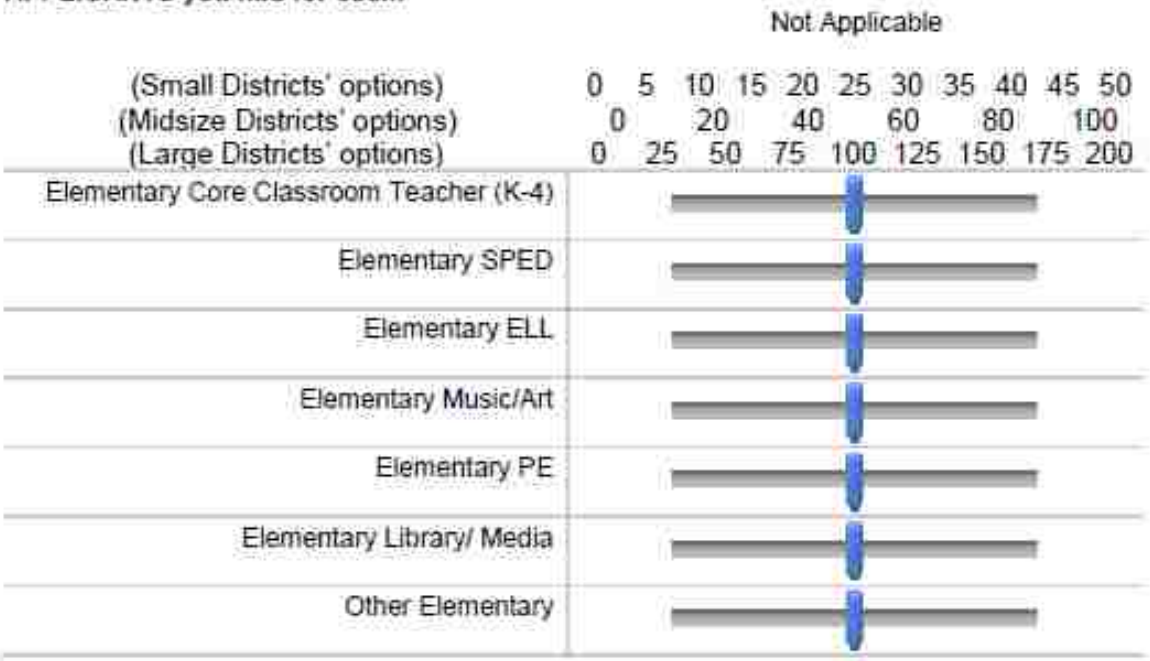
	One	Two	Three	Four	Five	More than Five
Elementary Core Classroom Teacher (K-4)	☐	☐	☐	☐	☐	
Elementary SPED	☐	☐	☐	☐	☐	
Elementary ELL	☐	☐	☐	☐	☐	
Elementary Music/Art	☐	☐	☐	☐	☐	
Elementary PE	☐	☐	☐	☐	☐	
Elementary Library/ Media	☐	☐	☐	☐	☐	
Other Elementary	☐	☐	☐	☐	☐	

Q5 What "Other Elementary" position(s)?

_____

_____

Q6 Of the vacancies identified in the previous question, please indicate how many APPLICANTS you had for each:



Q7 For the current 2016-17 school year, did you have middle level TEACHER vacancies (grades 5-8)?

- Yes
- No

Q8 Please indicate how many middle level TEACHER VACANCIES in each area (5-8): (If "More than 5", please provide the number.)

	One	Two	Three	Four	Five	More than Five

Core Classroom Teacher (Grade 5)	☐	☐	☐	☐	☐	
Middle Math/Science (6-8)	☐	☐	☐	☐	☐	
Middle Language Arts/Social Studies (6-8)	☐	☐	☐	☐	☐	
Middle Computer Science	☐	☐	☐	☐	☐	
Middle CTE	☐	☐	☐	☐	☐	
Middle Foreign Language	☐	☐	☐	☐	☐	
Middle SPED	☐	☐	☐	☐	☐	

Middle ELL	☐	☐	☐	☐	☐	
Middle Music/Art	☐	☐	☐	☐	☐	
Middle PE	☐	☐	☐	☐	☐	
Middle Library/ Media	☐	☐	☐	☐	☐	
Other Middle	☐	☐	☐	☐	☐	

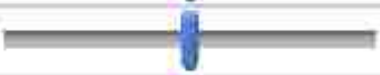
Q9 What "Other Middle" position(s)?

_____

_____

Q10 Of the vacancies identified in the previous question, please indicate how many APPLICANTS you had for each:

											Not Applicable
(Small Districts' options)	0	5	10	15	20	25	30	35	40	45	50
(Midsize Districts' options)	0		20		40		60		80		100
(Large Districts' options)	0	25	50	75	100	125	150	175	200		

Core Classroom Teacher (Grade 5)	
Middle Math/Science (6-8)	
Middle Language Arts/Social Studies (6-8)	
Middle Computer Science	
Middle CTE	
Middle Foreign Language	
Middle SPED	
Middle ELL	
Middle Music/Art	
Middle PE	
Middle Library/Media	
Other Middle	

Q11 For the current 2016-17 school year, did you have secondary level TEACHER vacancies (grades 9-12)?

- ○ Yes
- ○ No

Q12 Please indicate how many secondary level (9-12) TEACHER VACANCIES in each area (include AP within subject area):
(If "More than 5", please provide the number.)

	One	Two	Three	Four	Five	More than Five

Secondary Math (9-12)	☐	☐	☐	☐	☐	
Secondary Science (9-12)	☐	☐	☐	☐	☐	
Secondary English/Language Arts (9-12)	☐	☐	☐	☐	☐	
Secondary Social Studies (9-12)	☐	☐	☐	☐	☐	
Secondary Computer Science	☐	☐	☐	☐	☐	
Secondary CTE	☐	☐	☐	☐	☐	
Secondary Foreign Language	☐	☐	☐	☐	☐	
Secondary SPED	☐	☐	☐	☐	☐	

Secondary ELL	☐	☐	☐	☐	☐	
Secondary Music/Art	☐	☐	☐	☐	☐	
Secondary PE	☐	☐	☐	☐	☐	
Secondary Library/ Media	☐	☐	☐	☐	☐	
Other Secondary	☐	☐	☐	☐	☐	

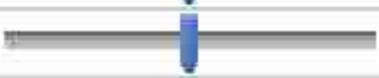
Q13 **What "Other Secondary" position(s)?**

_____

_____

Q14 **Of the vacancies identified in the previous question, please indicate how many APPLICANTS you had for each:**

	Not Applicable
(Small Districts' options)	0 5 10 15 20 25 30 35 40 45 50
(Midsize Districts' options)	0 20 40 60 80 100
(Large Districts' options)	0 25 50 75 100 125 150 175 200

Secondary Math (9-12)	
Secondary Science (9-12)	
Secondary English/Language Arts (9-12)	
Secondary Social Studies (9-12)	
Secondary Computer Science	
Secondary CTE	
Secondary Foreign Language	
Secondary SPED	
Secondary ELL	
Secondary Music/Art	
Secondary PE	
Secondary Library/Media	
Other Secondary	

Q15 **Mark any of the following TEACHER positions that have been *consistently difficult* for your district to fill (K-12) over the past three years:**

- [ ] Art
- [ ] Computer Science
- [ ] Drama/Speech
- [ ] Family and Consumer Science
- [ ] Foreign Language
- [ ] Gifted and Talented
- [ ] Guidance and Counseling
- [ ] Journalism
- [ ] Library/ Media
- [ ] Math
- [ ] Music
- [ ] Physical Science
- [ ] Social Studies
- [ ] Special Education

Q16 **Mark any of the following TEACHER positions that have been *easy* for your district to fill (K-12) over the past three years:**

- [ ] Art
- [ ] Computer Science
- [ ] Drama/Speech
- [ ] Family and Consumer Science
- [ ] Foreign Language
- [ ] Gifted and Talented
- [ ] Guidance and Counseling
- [ ] Journalism
- [ ] Library/ Media
- [ ] Math
- [ ] Music
- [ ] Physical Science
- [ ] Social Studies
- [ ] Special Education

Q17 **Was the district able to fill all vacancies in 2016-17 with credentialed teachers?**

- ○ Yes
- ○ No

Q18 **Were uncertified/non-credentialed teachers hired?**

- ○ Yes
- ○ No

Q19 **Which position(s)?**

_____

_____

Q20 **Were long-term substitutes used?**

- Yes
- No

Q21 **Which position(s)?**

_____

_____

Q2 **Approximately how many TEACHER vacancies have occurred SINCE THE BEGINNING of the 2016-17 school year?**

(Small Districts' options) (Midsize Districts' options) (Large Districts' options)	0 5 10 15 20 25 30 35 40 45 50 0 20 40 60 80 100 0 25 50 75 100 125 150 175 200
School-Year Vacancies	

Q22 **Please select the sources you *use the most* to advertise vacant TEACHER positions and/or seek applicants:**
(RANK UP TO 5 in order from the MOST used (1) to the LEAST used (5).)

Selection
_____ District website
_____ Social media (e.g. Facebook, Twitter, LinkedIn)
_____ Newspaper
_____ Radio/TV
_____ Teacher/Career Fairs
_____ Teacher Job Board (e.g. AAEA, School Spring)
_____ Recruiting agency
_____ TFA/ATC
_____ "Grow your own" (e.g. Paraprofessionals, Teacher cadets (high school students), Parents)
_____ Recruit from nearby districts
_____ Out of state
_____ Other

Q23 **What "Other" sources of advertising were used?**

_____

_____

Q24 **Please indicate what percentage of your NEW TEACHER HIRES** come from the following areas. (Note: Total must equal 100%)

_____ New Teacher Graduates
_____ Nearby Districts
_____ Charter Schools
_____ Out of State
_____ TFA/ATC
_____ Non-Credentialed
_____ Returning to Teaching
_____ Other

Q25 **Please explain "Other":**

_____
_____

Q26 **Does your district participate in internship/student teacher training?**

- Yes
- No

Q27 **Please indicate your Primary Training Partner(s):**

Institution/Program

_____ Arkansas Professional Pathway to Educator Licensure APPEL
_____ Arkansas State University ASU
_____ Arkansas Tech University ATU
_____ Central Baptist College CBC
_____ Harding University HU
_____ Henderson State University HSU
_____ Hendrix College HC
_____ John Brown University JBU
_____ Lyon College LC
_____ Ouachita Baptist University OBU
_____ Philander Smith College PSC
_____ Southern Arkansas University SAU
_____ University Of Arkansas - Fayetteville UAF
_____ UA - Fort Smith UAFS
_____ UA - Little Rock UALR
_____ UA - Monticello UAM

_____ UA - Pine Bluff UAPB

_____ University Of Central Arkansas UCA

_____ University Of The Ozarks UO

_____ Williams Baptist College WBC

_____ Other

Q28 **What "Other" institutions/programs?**

_____

_____

Q29 **Would your district like to participate in internship/student teacher training?**

- Yes
- No

Q30 **Of your teachers on staff now, where did most of them receive their education degree?**
(Please RANK UP TO 5 in order from MOST (1) to LEAST (5).)

Institution/Program

_____ Arkansas Professional Pathway to Educator Licensure APPEL

_____ Arkansas State University ASU

_____ Arkansas Tech University ATU

_____ Central Baptist College CBC

_____ Harding University HU

_____ Henderson State University HSU

_____ Hendrix College HC

_____ John Brown University JBU

_____ Lyon College LC

_____ Ouachita Baptist University OBU

_____ Philander Smith College PSC

_____ Southern Arkansas University SAU

_____ University of Arkansas - Fayetteville UAF

_____ UA - Fort Smith UAFS

_____ UA - Little Rock UALR

_____ UA - Monticello UAM

_____ UA - Pine Bluff UAPB

_____ University Of Central Arkansas UCA

_____ University Of The Ozarks UO

_____ Williams Baptist College WBC

_____ Out of state

_____ Other

Q31 **What "Other" institutions/programs?**

_____

_____

Q32 **Which of the following TEACHER incentives does your district offer? (Select all that apply)**

- ☐ No incentives offered
- ☐ Signing bonus (one-time)
- ☐ Minority teacher bonus (one-time)
- ☐ Hard-to-staff position bonus (one-time)
- ☐ Additional pay differential (step or experience increase)
- ☐ Job sharing
- ☐ Student loan forgiveness
- ☐ Tuition reimbursement
- ☐ Paid licensure exams
- ☐ Merit pay
- ☐ Moving expenses
- ☐ Non-monetary incentives
- ☐ Other

Q33 **What "Non-monetary" incentive(s)?**

_____

_____

Q34 What "Other" incentive(s)?

_____

_____

Q35 Do you advertise the availability of incentives to prospective applicants?

- Yes
- No

Q36 Please indicate the primary reason(s) and the percentage of TEACHERS who left the district for those reasons (to the best of your knowledge). (Note: Total must equal 100%)

_____ Retired
_____ Relocated for spouse's work
_____ Completed contract (e.g. TFA, ATC)
_____ Started family/care for family member
_____ Changed career
_____ Returned to school
_____ Moved
_____ Changed district
_____ Due to work environment
_____ Due to salary/benefits
_____ Other
_____ No idea

Q37 What "Other" reason(s)?

_____

_____

Q38 Please complete the following statements:

In the past five years or so,

	Decreased	Stayed about the Same	Increased
the number of teaching position vacancies has...	○	○	○
teacher turnover has...	○	○	○
teacher retirement has...	○	○	○
the quality of teaching applicants has...	○	○	○
the quality of new hire teachers has...	○	○	○

Q39 Please state your level of agreement with the following statements:

The reason why some positions are difficult to fill is...

	Strongly Disagree	Disagree	Agree	Strongly Agree
fewer qualified teacher applicants.	○	○	○	○
more teacher vacancies.	○	○	○	○
teacher vacancies in hard-to-staff subjects.	○	○	○	○
the school/district's location.	○	○	○	○
competition with surrounding districts.	○	○	○	○

Q40 Please share any strategies that your district has found to have a positive influence on the recruitment and retention of high-quality teachers.

_____

_____

Q41 What hiring or retention needs or challenges does your district face that are NOT addressed in the previous questions?

_____

_____

Q42 What is your position?

- ○ District Superintendent
- ○ Human Resources Administrator
- ○ Other

Q43 What is your position?

_____

Q44 Would you be interested in participating in a follow-up interview?

- Yes
- No

Q45 Please provide your contact information.

_____

M5: Actual Short Survey

AR Teacher Supply/Demand (short survey) Survey Flow

Dear Superintendent/Human Resource Administrator,

We are interested in learning about your district's hiring practices, but we've noticed that your district has not yet completed the survey we sent last month about **teaching vacancies and applicants for the CURRENT (2016-17) school year now ending.** We have created a **SHORTER version** of the survey that **will only take about 5 minutes to complete**, and hope that you will share your district's experiences with hiring teachers.

Remember that this is a ***different survey*** than the ADE's recent request for information on vacancies and teacher need. If you have any questions about this survey, please feel free to contact us.

We greatly appreciate your participation and look forward to including your district's information in our study.

Thank you,
Gary Ritter and Leesa Foreman
[redacted]

Q2 For the current 2016-17 school year how many TOTAL TEACHING POSITION vacancies were available in your district?

_____

Q3 Please indicate approximately how many VACANCIES you had for each level:
(Note: Total must equal 100%)
_____ Elementary (K-4)
_____ Middle Level (5-8)
_____ Secondary (9-12)

Q4 For the current 2016-17 school year how many TOTAL APPLICANTS did you receive for vacant positions?

_____

Q5 Please indicate approximately how many APPLICANTS you had for each level:
(Note: Total must equal 100%)
_____ Elementary (K-4)
_____ Middle Level (5-8)
_____ Secondary (9-12)

Q6 Does your district participate in internship/student teacher training?

- Yes
- No

Q7 Please indicate your Primary Training Partner(s):

Institution/Program
_____ Arkansas Professional Pathway to Educator Licensure APPEL
_____ Arkansas State University ASU
_____ Arkansas Tech University ATU
_____ Central Baptist College CBC
_____ Harding University HU
_____ Henderson State University HSU
_____ Hendrix College HC
_____ John Brown University JBU
_____ Lyon College LC
_____ Ouachita Baptist University OBU
_____ Philander Smith College PSC
_____ Southern Arkansas University SAU
_____ University Of Arkansas - Fayetteville UAF
_____ UA - Fort Smith UAFS
_____ UA - Little Rock UALR
_____ UA - Monticello UAM
_____ UA - Pine Bluff UAPB
_____ University Of Central Arkansas UCA
_____ University Of The Ozarks UO
_____ Williams Baptist College WBC

Q8 Would your district like to participate in internship/student teacher training?

- Yes
- No

Q9 Of your teachers on staff now, where did most of them receive their education degree?
(Please RANK UP TO 5 in order from MOST (1) to LEAST (5).)

Institution/Program

_____ Arkansas Professional Pathway to Educator Licensure APPEL

_____ Arkansas State University ASU

_____ Arkansas Tech University ATU

_____ Central Baptist College CBC

_____ Harding University HU

_____ Henderson State University HSU

_____ Hendrix College HC

_____ John Brown University JBU

_____ Lyon College LC

_____ Ouachita Baptist University OBU

_____ Philander Smith College PSC

_____ Southern Arkansas University SAU

_____ University of Arkansas - Fayetteville UAF

_____ UA - Fort Smith UAFS

_____ UA - Little Rock UALR

_____ UA - Monticello UAM

_____ UA - Pine Bluff UAPB

_____ University Of Central Arkansas UCA

_____ University Of The Ozarks UO

_____ Williams Baptist College WBC

_____ Out of state

Q10 **Which of the following TEACHER incentives does your district offer? (Select all that apply)**

- [ ] No incentives offered
- [ ] Signing bonus (one-time)
- [ ] Minority teacher bonus (one-time)
- [ ] Hard-to-staff position bonus (one-time)
- [ ] Additional pay differential (step or experience increase)
- [ ] Job sharing
- [ ] Student loan forgiveness
- [ ] Tuition reimbursement
- [ ] Paid licensure exams
- [ ] Merit pay
- [ ] Moving expenses
- [ ] Non-monetary incentives
- [ ] Other

Q11 **What "Non-monetary" incentive(s)?**

_____

_____

Q12 **What "Other" incentive(s)?**

_____

_____

Q13 **What is your position?**

- ○ District Superintendent
- ○ Human Resources Administrator
- ○ Other