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Who Wants to Be a Teacher? Essays on Education Policy and Teacher Supply

Mahmoud Elsayed

ABSTRACT

WHO WANTS TO BE A TEACHER?

ESSAYS ON EDUCATION POLICY AND TEACHER SUPPLY

BY

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Enrollment in education programs has declined substantially in the U.S. over the last few decades, but little empirical evidence addresses the factors driving this decline. This dissertation examines two potential factors, whether government policies such as school accountability and teacher prep performance assessment have discouraged individuals from pursuing teaching as a career.

The first chapter introduces the dissertation and summarizes the key findings. The second chapter tests the effects of No Child Left Behind (NCLB) on individuals' decisions to enter the teaching profession. Opponents of NCLB, and of school accountability systems in general, argue that these systems undermine teaching as a stable and attractive career, discouraging individuals from becoming teachers. I examine whether NCLB has affected enrollment and degrees awarded in education programs. Using a Difference-in-Differences (DID) design, I compare enrollments and degrees awarded in education programs in states with accountability systems prior to NCLB to the same outcomes in states without prior accountability systems, before and after the introduction of NCLB. The results suggest that NCLB has had little or no effect on either

enrollment or degrees awarded in education programs. However, NCLB significantly reduced minority enrollment in education programs by more than 3 percentage points.

The third chapter investigates whether imposing new performance assessment requirements on teacher candidates in education programs affects their college outcomes. Starting from September 2015, Georgia required all teacher candidates to pass a teacher performance assessment exam in order to be certified. This chapter examines whether these requirements affect students' persistence in college, attrition from education programs, or the likelihood of graduating within four years. The findings indicate that teacher prep performance assessment has little or no impact on college outcomes of students in education programs relative to other students.

The fourth chapter examines the demographic characteristics and career paths of former teachers. I also explore the factors that affect former teachers' decisions to return to teaching. Although former teachers represent an important source of teacher supply in the U.S., little attention has been paid to understanding the decisions of former teachers to re-enter teaching. Using restricted-use data that follows a cohort of new teachers for five years after starting their careers, I find that former teachers who work in large schools, high schools, and schools with large percentages of minority students are less likely to return to teaching after their initial exit. Teachers who left schools because of pregnancy or change in residence are more likely to re-enter the profession.

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MAHMOUD ABDUH ALI ELSAYED

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ACCEPTANCE

This dissertation was prepared under the direction of the Mahmoud Abduh A. Elsayed's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Public Policy in the Andrew Young School of Policy Studies of Georgia State University.

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DEDICATION

To my parents, Fawzia Mohamed Akasha and Abduh Ali Elsayed.

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Chapter I: Introduction

Research on teacher labor markets has largely focused on how to identify and retain high quality teachers (2005a, Dee and Wyckoff 2015, Hanushek, Kain, and Rivkin 2004a, Podgursky, Monroe, and Watson 2004a). Students' demographic and socio-economic characteristics and schools' working conditions are key determinants of teacher mobility and retention. Hanushek et al. (2004a), for example, found that schools with large numbers of minority and academically disadvantaged students tend to lose a substantial fraction of teachers each year. Loeb et al. (2005) also found that teacher salaries, class size, school resources, and other working conditions are strong predictors of teacher turnover (See also Boyd et al. 2005a, 2005b, Scafidi, Sjoquist, and Stinebrickner 2007).

How to encourage more individuals to enter (or re-enter) the teaching profession has received less attention. This is surprising for several reasons. First, the supply of new teachers has declined significantly over the last few years. Between 2008-09 and 2014-15, enrollment in teacher preparation programs declined by 42 percent (U.S. Department of Education 2016). High school students are showing less interest in pursuing teaching as a career: only 5 percent of high school students who took the ACT exam in 2014 expressed an interest in education majors, a dramatic drop from 34 percent in 2010 (ACT 2015).

This has major implications for teacher quality, student achievement, and schools' hiring practices. The reduction in teacher supply will negatively affect student learning, especially in hard-to-staff subjects, such as math and science, which are most affected by teacher shortages. Fears of teacher shortages may make principals less willing to dismiss low-performing teachers (Bruno 2015). Second, the demand for teachers is expected to grow due to both high teacher attrition and increasing school enrollment. About 8 percent of the teaching workforce exits

annually, which puts pressure on schools to hire new teachers. The school-going population should increase by 3 million students in the next decade.

Third, over the last few years, several states have introduced reforms that raise the bar to become a teacher. Some of these reforms target teacher candidates by imposing new requirements on teacher certification and licensure, while other reforms focus on improving the transparency and accountability of teacher preparation programs (Boyd et al. 2007, CCSSO Task Force on Educator Preparation and Entry into the Profession Members 2012, Goldhaber, Cowan, and Theobald 2016, Teacher Preparation Task Force 2012, U.S. Department of Education 2011). The purpose of these reforms is to improve the preparation and quality of teacher candidates, increase the transparency of teacher preparation programs, and hold these programs accountable for the performance of their graduates in the classroom. Despite growing concerns about teacher preparation programs among educators and policymakers, little evidence addresses the effect of teacher preparation reforms on the outcomes of teacher candidates. A few studies have examined the effect of these programs on teacher quality (Boyd et al. 2009, Koedel et al. 2015, Mihaly et al. 2012), but little looks at whether changing program requirements affect students' decisions to enter, persist, or graduate from these programs.

Understanding the supply decisions of prospective teachers is important for addressing the expected increase in teacher demand, especially given that new entrants represent a large share of new hires in schools. In 2007-08, for example, more than 42 percent of new hires were new entrants,[1] including recent graduates and returning teachers.

[1] During the same year, new entrants represented 6 percent of all teachers. New hires are teachers who weren't working in their current school the previous year. This includes two main categories: transfers and new entrants. Transfers are teachers who transferred from within or outside the school district whereas new entrants include both individuals who either teach for the first time and former teachers who are returning to the profession.

This dissertation examines how two government policies (school accountability and pre-service performance assessment) affect decisions to enter the teaching profession. The second chapter examines whether school accountability systems have affected students' decisions to enter the teaching profession. Many states have adopted school accountability systems that emphasize standardized testing, evaluate teachers based on students' test scores, and link teacher pay to student performance. The push for school accountability reached its highest point with the passage of the No Child Left Behind Act (NCLB) in 2002. This chapter examines whether the introduction of the NCLB has discouraged individuals from pursuing a career in teaching, using data from the Integrated Postsecondary Education Data System (IPEDS) combined with state-level data from the Current Population Survey (CPS).

Proponents of school accountability argue that these systems incentivize administrators and teachers to improve student achievement and provide an independent source of information that helps policy makers identify low-performing schools and parents make better decisions about where to send their children (Figlio and Loeb 2011). Opponents of school accountability argue that these systems set unrealistic expectations for schools and put pressure on teachers to enhance student performance, which may negatively impact teacher morale and undermine the perception of teaching as a stable career (Byrd-Blake et al. 2010, Heinrich 2015, Ladd 2017).

I take advantage of the fact that some states had implemented school accountability systems prior to the introduction of the NCLB to employ a Difference-in-Differences (DID) design to compare enrollment and degrees awarded in education programs in states with prior accountability systems to the same outcomes in states without prior accountability systems, before and after the introduction of the NCLB in 2002. The results from this essay suggest that NCLB had no impact on either enrollment or degrees awarded in education programs, but did

reduce minority enrollment by more than 3 percentage points. One possible explanation is that minority teachers, who tend to work in schools with large shares of disadvantaged students, might have been discouraged by the severe consequences of NCLB on these schools. In addition, the opportunity costs of becoming a teacher are higher for minority college students than other students. That is, because of the small share of minority students who attend college, minority college students may have better employment and career opportunities aside from teaching (Ingersoll et al., 2017). Therefore, by increasing the costs of becoming a teacher, NCLB has disproportionately affected enrollment of minority students.

The third chapter examines whether imposing new requirements on candidates in education programs affects their college outcomes. Both the federal and state governments introduced policies to improve the quality of teacher preparation programs. Starting in 2015, for example, all teacher candidates who apply for certification in Georgia must pass a performance-based, subject-specific assessment called edTPA, which is designed to assess the knowledge and skills of prospective teachers. The new edTPA performance assessment has also been implemented or considered for implementation in 16 other states.

Using administrative data from the University System of Georgia (USG), I examine whether the introduction of these new performance requirements affected college persistence and degree completion of students in education programs relative to other students. The USG data includes information on students who started their postsecondary education in Georgia between academic years 2008-09 and 2016-17. I estimate the effect of performance assessment on three main outcomes: college persistence, attrition from education programs, and the likelihood of graduating within 4 years. Using a Differences-in-Differences design, I compare college outcomes of students with education major to the same outcomes for students with other majors,

before and after 2015. Teacher prep performance assessment has little or no effect on students' college persistence, attrition from education majors, or the likelihood of graduating within four years.

The fourth chapter focuses on a non-traditional source of teacher supply: former teachers. A large literature on the career choices of current teachers (e.g., Boyd et al. 2005b, Hanushek, Kain, and Rivkin 2004b) suggests that student socio-economic characteristics, schools' working conditions, and teacher qualifications and quality are key determinants of teacher mobility and attrition. Teachers are also more likely to leave schools with large shares of low-income and minority students.

Despite the large literature on teacher labor market, only few studies have examined the career choices of former teachers and the factors that affect their decisions to return to the profession. Former teachers represent an important source of teacher supply in the United States. For example, according to the School and Staffing Survey (SASS), former teachers represented 49 percent of teachers entering the teaching workforce in school year 2011-12, up from 37 percent in 2007-08 (Sutcher, Darling-Hammond, and Carver-Thomas 2016).

In this chapter, I examine the demographic and socio-economic characteristics of former teachers. I also explore the reasons that led former teachers to leave their profession, their career paths after their initial exit, and the factors that affect their decisions to return to teaching. To examine these questions, I rely on restricted-use data from the Beginning Teacher Longitudinal Study (BTLS) administered by the U.S. Department of Education. The BLTS follows a cohort of first-time teachers for five years, starting from the school year 2007-08. To explore the factors that affect the decisions for former teachers to reenter teaching, I use a discrete time hazard

model that estimates the probability that an individual returns to teaching in a given year conditional on not having returned in the previous year.

Former teachers who work in large schools, high schools, and schools with large percentages of minority students are less likely to return to teaching after their initial exit. Results also show that high-paid teachers are more likely to re-enter teaching. A one thousand dollar increase in school salary increases the likelihood of returning to teaching by 0.5 percentage points. The findings also indicate that teachers who left schools because of pregnancy or change in residence are also more likely to re-enter the profession.

Chapter II: The Effect of School Accountability on Teacher Supply

2.1 Introduction

Enrollment in teacher preparation programs has declined over the last two decades. Between 2000 and 2015, the number of individuals attending education programs in the U.S. decreased by 37 percent (U.S. Department of Education 2016). The factors driving the decline in teacher supply are still largely unknown. One potential explanation attracting increasing attention, however, is the increase in school accountability by federal and state governments (Berryhill, Linney, and Fromewick 2009). Over the last two decades, many states have adopted school accountability systems that emphasize standardized testing and evaluation of teachers based on students' test scores. The push for school accountability reached its high point with the passage of the No Child Left Behind Act (NCLB) in 2002. NCLB required states to assess the performance of students in reading and mathematics in grades 3 through 8. The law also required states to identify poorly performing schools based on the degree to which students within these schools, in aggregate and by subgroup, achieved adequate progress towards complete proficiency (Figlio and Loeb 2011).

The rationale behind NCLB, and school accountability systems in general, is fourfold (Figlio and Loeb 2011, Ladd 2017). First, proponents of NCLB argue that it provides increased incentives for educators to enhance student achievement. The empirical evidence on the effects of NCLB on student achievement, however, is mixed. A number of studies have found small positive effects of NCLB on student performance (Ballou, Springer, and Urban 2009, Dee and Jacob 2011, Ladd and Lauen 2010), though some other studies found no effects or negative effects on the performance of at least some groups of students (Lee 2006, Neal and Schanzenbach 2010).

Second, NCLB, and accountability systems in general provide policymakers, parents, and the general public with a valuable source of information regarding the performance of schools/teachers. This information enables policy makers to identify low-performing schools and helps parents make better decisions regarding where to send their children to school. Third, school accountability systems hold schools and teachers accountable not only for the performance of students in aggregate but also for the performance of specific subgroups of students who might otherwise be ignored by schools. As a result, these systems provide incentives to schools to focus on enhancing the performance of disadvantaged students in addition to reducing the achievement gap between advantaged and disadvantaged students. Fourth, School accountability may have positive effects on teacher labor supply. To the extent that high-quality teachers benefit from pay for performance systems that reward success in the classroom or help them avoid working with poorly prepared colleagues, school accountability may encourage highly talented individuals to enter the teaching profession.

However, opponents of school accountability raise some concerns about the potentially negative consequences of school accountability on schools, students, and teachers (Hill and Barth 2004, Santoro 2011). Ladd (2017), for example, argues that school accountability systems, especially NCLB, adopt a very narrow view of schooling that emphasizes standardized testing and overlooks other aspects of teaching that are hard to test/quantify. This narrow view of schooling, according to this view, may provide incentives to schools to shift their resources towards tested subjects, ignoring other areas of schooling. For instance, several studies have shown that, in response to accountability pressures, schools tend to increase their instructional time in tested subjects, such as math and English while reducing time for other subjects such as

social studies, science, and art and music (Au 2009, CEP 2006, Ladd 2017, McMurrer 2007, Smith and Kovacs 2011)

Opponents of school accountability also argue that these systems set unrealistic expectations for students and put more pressure on teachers and schools without providing them with enough support needed to improve student outcomes. The pressure on schools and teachers to enhance student performance may result in adverse effects on teacher morale and satisfaction (Byrd-Blake et al. 2010, Ladd 2017, Smith and Kovacs 2011). Evidence from teachers' surveys and interviews suggests that teachers' stress and anxiety have been on the rise during the last two decades. Half of teachers (51 percent) reported feeling under great stress several days a week in 2012 compared to 36 percent in 1985 and the number of teachers saying they are satisfied with their jobs declined by 23 percentage points between 2008 and 2012, from 62 percent to 39 percent (Markow, Pieters, and Interactive 2012).

School accountability pressures may also lead schools to engage in strategies that artificially improve student performance. Prior research has shown that schools tend to respond to school accountability systems by focusing on students near the proficiency margin, i.e., those who are right below the proficiency cutoff score, while ignoring the most disadvantaged students, especially those at the bottom of the distribution (Ladd and Lauen 2010, Neal and Schanzenbach 2010). Neal and Schanzenbach (2010), for example, found that while NCLB has improved the performance of students in the middle of the achievement distribution, it had no effects on students at the bottom 20%. Schools may also respond to accountability systems by engaging in practices that reshape the testing pool, such as classifying low-achieving students as learning disabled or relying on school discipline to exclude low-performing students from the testing pool (Figlio and Loeb 2011, Figlio 2006, Figlio and Getzler 2006, Hanushek and

Raymond 2005, Jacob 2005, Jacob and Levitt 2003, Ladd 2017). Figlio (2006) found that schools respond to high-stakes standardized exams by selectively disciplining their students. His findings suggest that schools tend to punish low-performing students in testing grades more harshly than high-performing students around the time of testing.

Opponents of school accountability systems, particularly NCLB, argue that the negative consequences of these systems on teachers and schools, in general, are responsible for the decline in the supply of teachers. First, according to this view, school accountability undermines the job security of teachers by linking teacher hiring and tenure decisions to student performance on standardized exams. Second, school accountability reduces teachers' autonomy in the classroom and negatively impact their teaching practices. A number of studies by the Center on Education Policy (CEP) found that schools have responded to NCLB by allocating more resources to tested subjects and aligning their curricula with state standards, diminishing teacher authority in the classroom (CEP 2006, 2007, 2008). The negative effects on teachers' job security and autonomy increase teachers' stress and dissatisfaction and undermine the perception of teaching as a stable career, which may discourage individuals from entering the teaching profession.

Third, school accountability will also increase teacher turnover, especially in schools with large shares of poor and minority students. Fourth, school accountability may affect teacher supply through the experiences of students in schools during the implementation of accountability systems. These experiences may shape students' views about teaching as an attractive career. For example, students who attend disadvantaged schools are likely to be negatively affected by accountability systems and, as a result, they may develop a negative perception towards teaching as a career. Fifth, candidates in education programs may also

experience firsthand the negative consequences of accountability systems on teachers' morale and satisfaction during their filed placements, which may affect their decisions to complete their education degrees.

Due to all the previous reasons, many teachers, school officials and education advocates consider school accountability the key factor behind the decline in teacher supply. For instance, some education officials report accountability systems may have served to make teaching appear less stable and more political, discouraging future teachers from entering the teaching profession (Sawchuk and Yettick 2014). One official summarized the high-stakes test-based environment in which teachers work, "There's a lot of teacher bashing…Do people want to enter careers where they feel they would be unfairly blamed?" (Cooper 2013). Westervelt (2015) concludes that teaching has become less attractive to potential teachers due to high stakes testing, evaluations that tie teachers to student performance, the Common Core, questionable tenure, and state budget issues.

Despite the growing concerns that school accountability systems, and NCLB in particular, contribute to the decline in teacher supply, the evidence is limited. Little previous research has examined the relationship between NCLB and student enrollment in education programs. This lack of evidence is problematic given the large implications of the decline in teacher supply for the educational environment. As the supply of teachers declines, schools become increasingly challenged to find teachers in hard-to-staff STEM areas. Thus, schools may be short-staffed in critical areas, limiting their ability to grow the science and technology

workforce, and leading a growing number of districts to employ teachers holding emergency certificates[2] (Sawchuk and Yettick 2014).

In this chapter, I examine the effects of school accountability, particularly NCLB, on students' decisions to enter the teaching profession. Using panel data from the Integrated Postsecondary Education Data System (IPEDS), I investigate whether the introduction of NCLB in 2002 affected enrollment and number of degrees awarded in education programs. I also explore whether the effects of school accountability are different across subgroups of students in education programs, especially minority students. Prior research has shown that minority individuals are underrepresented in both the teaching workforce and education programs. In 2012, for example, minority teachers represented 18 percent of all public school teachers, whereas minority students accounted for 49 percent of all students in public schools.[3] The extent to which school accountability affects the decisions of minority students to attend or complete education programs has major policy implications for students and schools in the U.S. Prior research has shown that minority teachers have large positive effects on the outcomes of minority students (Dee 2004, Dee 2005, Gershenson, Holt, and Papageorge 2016).

Although the NCLB was replaced in late 2015 with the Every Student Succeeds Act (ESSA), the ESSA maintains most of the key features of NCLB such as standardized testing and holding schools accountable for the performance of their students. If NCLB decreased the supply of teachers in the last decade, ESSA is unlikely to reverse these effects. Further, if NCLB was the main factor behind the decline in enrollment in education programs, then efforts to attract

[2] To address teacher shortage, some states have issued emergency teaching certificates to individuals who do not meet the standard requirements for state certification. These individuals are allowed to teach in schools for a limited period of time while working on completing the state certification requirements.
[3] During the same year, minority individuals represented 20.2 percent of the civilian labor workforce (U.S. Bureau of Labor Statistics 2013).

new teachers to the profession by improving aspects of teaching such as salary or working conditions may not be sufficient to increase teacher supply. This finding would also suggest that, when designing accountability policies similar to NCLB, educators and policymakers should take into account the effects of these policies not only on teacher quality and retention but also its effects on teacher supply.

Following Dee & Jacob (2011), Dee et al. (2013), and Grissom et al. (2014), I take advantage of the fact that some states implemented school accountability systems prior to the introduction of NCLB while other states had not. I employ a Difference-in-Differences (DID) design in which I compare teacher supply in states with prior accountability systems to the same outcome in states without prior accountability systems, before and after the introduction of the NCLB. The results suggest that NCLB has had no significant impact on either enrollment or degrees awarded in education programs. However, there is some evidence that NCLB has significantly reduced minority enrollment in education programs by more than 3 percentage points.

2.2 Literature Review

Over the last few decades, policy-makers have increasingly sought to increase the levels of accountability in public schools. Many of these systems rely on incentives and sanctions that encourage schools to improve student performance, which is largely measured through student test scores (Clotfelter et al. 2004, Figlio and Loeb 2011). The NCLB Act, signed in 2002 and replaced in December 2015 by ESSA, was the most significant federal initiative focused on increasing accountability. NCLB required schools to test students in reading and math to determine whether they were making adequate yearly progress (AYP) towards proficiency in these subjects. Schools that received Title 1 funding, i.e., schools with large shares of low-

income students, received increasingly severe sanctions if they failed to meet these goals; some states also extended these sanctions to all schools (Dee and Jacob 2011).

These accountability policies are intended to motivate teachers and administrators to change their behavior in ways that would benefit students academically (Hanushek and Raymond 2001). However, the empirical evidence on whether NCLB has improved student achievement is inconclusive. Some studies have found positive impacts of NCLB on student performance, especially in math. For instance, Dee and Jacob (2011) and Wong, Cook, and Steiner (2009) found that NCLB has improved student achievement in the fourth and eighth grades. Neal and Schanzenbach (2010) also found positive effects of NCLB on students in the middle of the achievement distribution but not on students at the bottom of the distribution. Other studies, however, have found no effects of NCLB on student performance (Lee 2006).

Prior research has also shown that NCLB, and school accountability policies in general, may result in adverse effects on schools and teachers. Several studies found that the increased emphasis on standardized testing has caused schools to act strategically in order to maximize students' test score, e.g., by ignoring non-tested subjects, manipulating the testing pool, or focusing on students near proficiency levels (Jacob 2005, Murnane and Papay 2010, Reback 2008). School accountability pressures have also led some teachers and school administrators in cities such as Atlanta and Chicago to manipulate students' test scores (Aronson, Murphy, and Saultz 2016, Jacob 2005, Jacob and Levitt 2003).

The evidence is mixed on whether school accountability has influenced teachers' job-related attitudes. Some interview and survey studies suggest that school accountability decreased teacher job satisfaction and commitment and increased burnout (Hill and Barth 2004, Santoro 2011, Smith and Kovacs 2011). Barksdale-Ladd and Thomas (2000) interviewed 50 teachers and

20 parents from two states and found that teachers have negative perceptions towards accountability systems that emphasize standardized tests. Their findings suggest that standardized tests have increased teachers' stress, forced teachers to adopt teach-to-the-test instruction, and undermined their job security. Using survey data from one school district, Smith and Kovac (2011) found that teachers are increasingly dissatisfied with the role that NCLB played in their work environments. Their results also suggest that teachers who were more concerned about the impact of NCLB were least to say that they would encourage others to enter the field and that they were considering leaving teaching. As summarized by one teacher, "If I could retire I would…and I do not advise anyone to choose teaching as a career. There are very little rewards. I used to love it!" (Smith and Kovacs 2011). Berryhill et al. (2009) also found, relying on responses from teachers in a suburban and urban school district, that accountability policies may increase job burnout because of increased role conflict and reduced self-efficacy. Byrd-Blake et al. (2010) found that teachers, especially at the elementary school level, felt that their morale had decreased after the implementation of NCLB.

In contrast, some recent research conducted at a national level suggests that NCLB has had few negative effects on teachers' attitudes. Grissom et al. (2014) found that NCLB had negative effects on the perceived levels of cooperation among teachers but positively influenced perceptions of classroom control and administrative support. The results from Grissom et al. (2014) may suggest that, contrary to the anecdotal evidence emphasizing the negative consequences of school accountability on teachers' labor markets, NCLB may have limited effect on teacher supply. However, unlike student achievement, the evidence on the effects of NCLB on teacher labor markets is very limited. A number of studies, however, have examined the impact of state-level accountability systems on teacher mobility and retention and found

mixed results. Clotfelter et al. (2004) found that the introduction of state-level accountability systems has increased attrition among teachers in low-performing schools. Using national data from the Schools and Staffing Survey, Loeb and Cuhna (2007) exploit the state-level variation in the strength of school accountability systems to examine the effects of these systems on teacher attrition. Unlike Clotfelter et al. (2004), Loeb and Cuhna (2007) found no impact of school accountability on teacher turnover.

2.3 Data

To estimate the effect of NCLB on teacher supply, I use panel data from the Integrated Postsecondary Education Data System (IPEDS) for 1988-2016. IPEDS collects information on postsecondary institutions across the United States on a broad range of topics including type and level of institution, enrollment, completion rate, financial aid, and student characteristics. I combine the IPEDS data with data from the Current Population Survey (CPS) on state-level characteristics such as unemployment rate, state median wage, and teachers' median wage (Flood et al. 2017). I also use the union membership database created by Hirsch et al. (2001) to control for union density within a state in a given year. Hirsch et al. (2001) provide national and state-level estimates of union membership density that are consistent across years.[4]

Dependent variable. I estimate the effect of school accountability on teacher supply using two measures. The first is the percentage of all college students who major in education. This includes both part-time and full-time undergraduate students. The second measure is the percentage of all undergraduate degrees each year that are awarded to education students.

[4] The database is available at http://www.unionstats.com/ and covers the years 1964 through 2017. Union membership density is measured using the percentage of non-agricultural wage and salary employees who are union members, including employees in the public sector.

Figure 1 displays shares of enrollment and degrees awarded in education programs between 1988 and 2016. As shown, there was a substantial decline in enrollment in education programs between 1994 and 2016. The percentage of undergraduate students enrolled in education programs declined by 35 percent nationally, from 12 percent to 8 percent. Figure 1 also shows a large decline in undergraduate degrees awarded in education programs between 1988 and 2016. In 1988, 12.5 percent of all degrees awarded were in education; by 2016, it was only 6.3 percent, a 50 percent decrease.

Independent variable. The key independent variable is school accountability. I measure school accountability using the 2002 introduction of NCLB. Following prior research (Dee and Jacob 2011, Dee, Jacob, and Schwartz 2013), I distinguish between states that implemented accountability systems prior to NCLB and states that didn't.[5] States with no prior accountability systems should be affected the most by the introduction of NCLB since these states were experiencing the consequences of school accountability for the first time. Therefore, I expect a decline in teacher supply after 2002 in states without prior accountability systems. This decline, however, is not expected to be immediate. The reason is that, during its early years, NCLB was not perceived negatively by many school officials and educators. In fact, many education advocates considered the law to be a positive step in the direction of reducing the achievement gap between advantaged and disadvantaged students. In addition, given the complexity of the NCLB, schools did not experience its negative consequences until after the first few years of implementation. In contrast, the trend in teacher supply in states with prior accountability systems should stay the same after 2002.

[5] Table A1 in the appendix provides a list of states that implemented accountability systems prior to NCLB and the years during which these systems were implemented.

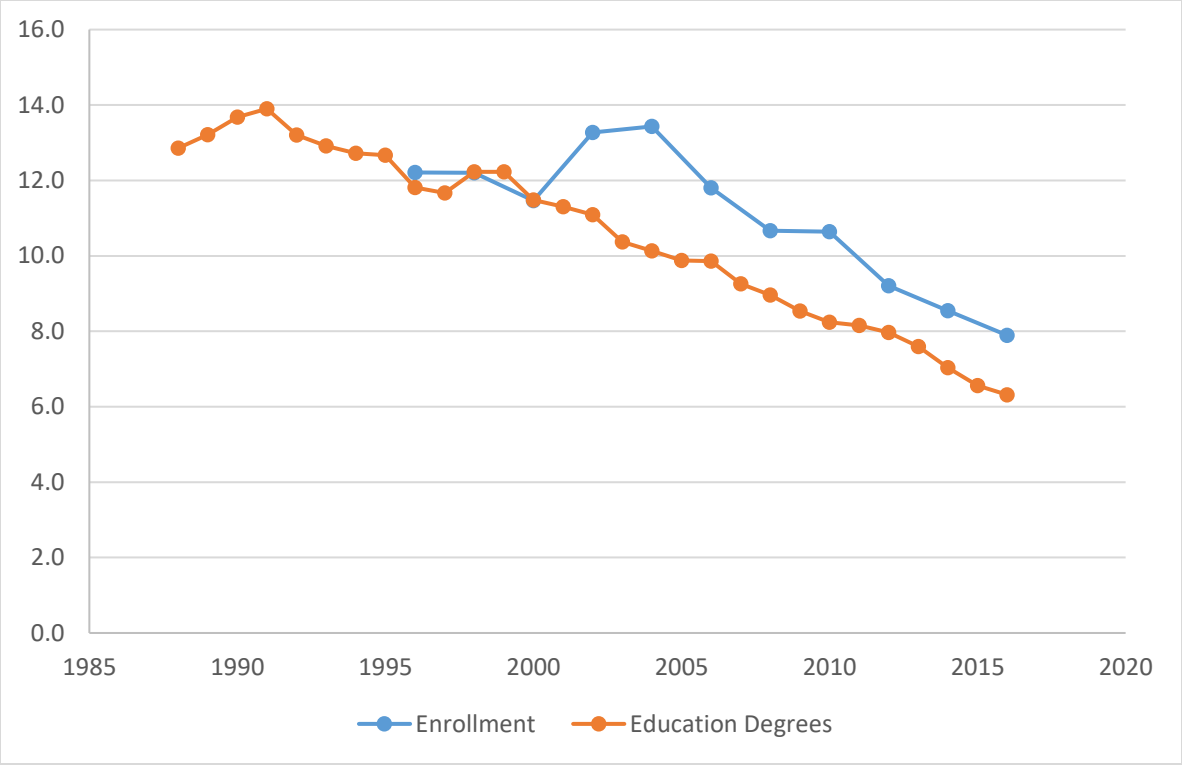

Figure 1: Shares of Enrollment and Degrees Awarded in Education Programs (1988-2016)
Note: Enrollment in education programs is only available every two years starting from 1996.

Unlike teacher supply, enrollment in public and elementary schools in the U.S. has increased substantially over the last three decades. As shown in Figure 2, the number of students enrolled in public schools has increased by 22.8 percent between 1990 and 2016, from 41 million students to 51 million.

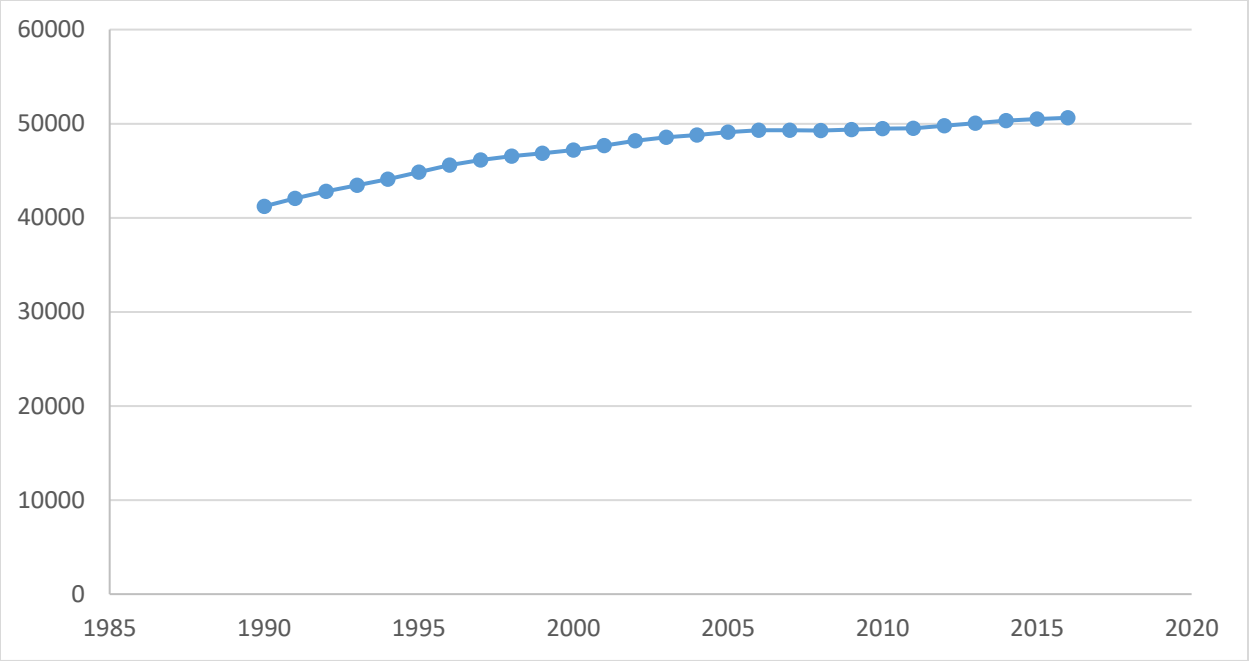

Figure 2: Enrollment in Public Elementary and Secondary Schools (1990-2016)
Source: U.S. Department of Education, National Center for Education Statistics. Available at: https://nces.ed.gov/programs/digest/d16/tables/dt16_203.10.asp

To estimate the effect of NCLB on teacher supply, I create two binary variables. The first binary variable, *No prior accountability*, takes on a value of 1 for states with no consequential school accountability systems prior to NCLB and zero otherwise.[6] The second variable, *NCLB*, is coded as 1 for years that followed the implementation of the NCLB starting from 2002. The interaction term between these two binary variables, *NCLB* No prior accountability*, represents the measure for school accountability. This measure represents the differential effect of NCLB on teacher supply in states with no prior accountability systems.

Control variables. To account for differences across postsecondary institutions, I include institution fixed effects in all models. The institution fixed effects, however, only control for characteristics of postsecondary institutions that are constant over time such as type and level of

[6] I use the same list of states that were used by Dee and Jacob (2011) in their study on the effect of the NCLB on student achievement.

institution. Other time-variant characteristics that might affect enrollment and degrees awarded in education programs are not captured by the institution fixed effects. For example, the size and composition of the student body in a postsecondary institution are key determinants of enrollment in education programs. As prior research has shown, enrollment in education programs tends to high in large institutions and in institutions where white students represent the majority. In addition, economic conditions within a state are expected to affect teacher supply. States with high teachers' wages, for instance, may provide students with incentives to enter the teaching profession. State unemployment rate and school-age population may also affect students' decisions to enroll in education programs.

To account for all these time-variant characteristics that might affect teacher supply, I control for several institution and state-level characteristics such as log enrollment, share of white students enrolled in the fall semester, percentage of students receiving Pell grant, state median wage, teacher median wage, unemployment rate, union membership, and school-age population.

Table 1 provides descriptive statistics for the two samples used in the analysis: the enrollment sample and the education degrees sample. Although data on education degrees is available from 1988 to 2016, data on enrollment in education majors is only available every two years starting from 1996. Overall, 12 percent of students are enrolled in education programs while 10 percent of degrees are awarded in education programs. About 36.2 percent of postsecondary institutions in the enrollment sample are public institutions compared to 49.1 percent for the education degrees sample.[7] The median wage for teachers for the entire time

[7] According to the U.S. Department of Education, there were 640 degree-granting public institutions with first-year undergraduates in 2011-12, which represents 25.1 percent all of degree-granting institutions (Snyder, Dillow, and National Center for Education 2013).

period is $28,000 compared a state median wage of $23,000 and a college median wage of $34,000 (all wages are adjusted for inflation using constant 2017 dollars).[8]

Table 1: Descriptive Statistics

Variable	Enrollment Sample	Education Degrees Sample
Institution-level characteristics		
Enrollment in education programs (%)	11.56 (12.17)	- -
Degrees awarded in education (%)	- -	10.38 (11.33)
Log fall enrollment	7.89 (1.20)	7.88 (1.31)
White enrollment (%)	68.41 (24.76)	68.36 (25.35)
Pell grant (%)	1.72 (8.91)	2.43 (11.02)
Public institutions (%)	36.20 (48.06)	49.34 (50.00)
State-level characteristics		
State median wage ($)	$23,000 ($2,638)	$22,779 ($2,840)
Teacher median wage ($)	$28,364 ($4,285)	$28,469 ($4,359)
College median wage ($)	$33,987 ($3,632)	$34,101 ($3,717)
State unemployment rate (%)	6.13	6.20

[8] Wage is measured using the total pre-tax wage and salary income during the previous year from all jobs (Flood et al. 2017).

	(2.10)	(2.09)
Union membership density (%)	12.45	12.80
	(6.12)	(6.36)
School-age population (%)	19.54	19.50
	(1.48)	(1.49)
Sample size	11,512	38,335

Note: Standard deviations are in parentheses.

2.4 Empirical Strategy

I examine the effect of NCLB on teacher supply using a Difference-in-Differences approach (DID). This approach is similar to that used by Dee et al. (2013) and Grissom et al. (2014) to estimate the effect of NCLB on school resources and teachers' work environments and attitudes, respectively. I estimate a separate equation for each measure of teacher supply: enrollment and degrees awarded in education programs. The DID design is estimated as follows.

$$Teacher\ supply_{ist} = \beta_0 + \beta_1 NCLB_t + \beta_2 NCLB_t * No\ prior\ accountability_s + \beta_3 X_{ist} + \beta_4 Z_{st} + \gamma_t + \lambda_i + \varepsilon_{it} \quad (1)$$

where $Teacher\ supply_{ist}$ is measured using two variables: the percentage of undergraduate students enrolled in traditional education programs within institution *i* in state *s* in year *t* and the percentage of education degrees awarded to undergraduate students by institution *i* in state *s* in year *t.* $NCLB_t$ is a binary variable that takes 1 for years that followed the implementation of the NCLB starting from 2002; $No\ prior\ accountability_s$ is a binary variable that is coded as 1 for states with no accountability systems prior to NCLB and zero otherwise; X_{ist} is a vector of institution-level characteristics such as percentage of white enrollment; Z_{st} is a vector of state-level characteristics such as unemployment rate, median wage, union membership density, and teacher median wage; γ_t is a vector of year dummies, λ_i is institution-level fixed-effects; and ε_{it} is an error term. I estimate equation (1) using a panel data fixed effects model that controls for

time-invariant characteristics of post-secondary institutions. The standard errors are clustered at the state level.

The effect of NCLB on teacher supply is measured using an interaction term between $NCLB$ and $No\ prior\ accountability$. The coefficient on this interaction term, β_2, represents the differential effect of the NCLB on teacher supply in states with no prior accountability systems. To the extent that the accountability requirements imposed by the NCLB resemble the systems adopted by states with prior consequential accountability, I expect the effect of NCLB to be greater among states with no prior accountability systems. That is, I expect a decline in both enrollment and degrees awarded in education programs in states without prior accountability systems after the introduction of NCLB in 2002.

There are two key identification assumptions of the DID approach. The first is that school accountability systems that were in place prior to NCLB are similar to the accountability requirements imposed by NCLB. This suggests that, unlike states without prior accountability systems, NCLB should have very little effects on enrollment and degrees awarded in education in states with prior accountability systems. As a result, the trends in these outcomes in states with prior accountability systems should be similar to the pre-NCLB trend. Dee and Jacob (2011) and Dee et al. (2013) provide some evidence that supports this assumption. These studies compared the main features of the NCLB to state consequential accountability systems that existed prior to the introduction of the NCLB using a variety of sources including state-specific accountability and assessment profiles, annual surveys on state assessment programs, information from state department of education websites, and searches of state and local newspapers. They found that state accountability systems adopted prior to the NCLB "closely resemble the frameworks required under NCLB" (Dee and Jacob 2011, 425).

Second, the DID design assumes that changes in teacher supply in states with prior accountability systems and those without prior accountability systems follow the same trend. That is, in the absence of NCLB, the trend in teacher supply for the comparison group (states with prior accountability) represents a valid counterfactual for the trend in the treatment group (states without prior accountability). This assumption, which is known as the parallel trend assumption, would be violated, and therefore the DID estimator would be biased, if the outcome trends are different for the treatment and the comparison groups. That is, the "parallel trend assumption" would be violated if a) teacher supply in states within the treatment group is driven by changes in the local economy or state education policy or b) states within the treatment group respond differently to any macroeconomic changes that affect teacher supply, such as unemployment rate or federal financial aid. For example, if states with no prior accountability systems have implemented policies that focus on attracting new teachers, such as introducing alternative teacher certification programs, then the estimates from the DID model would underestimate the effect of NCLB on teacher supply.

To address these issues, I conduct several robustness checks. First, I test the plausibility of the "parallel trend assumption" by examining the trend in teacher supply in states with and without prior accountability systems before the implementation of NCLB. If teacher supply follows the same trend in both groups of states before NCLB, then it is more likely that the trend after 2002 would have been similar, had NCLB not being implemented. That is, the differences in outcome trends after 2002 between states without prior accountability systems and states that implemented these systems prior to NCLB should be attributed only to the introducing of NCLB. Second, I include group-specific time trends in the DID models to account for any changes in teacher supply that were specific to either the treatment or the comparison groups. Specifically, I

include interaction terms between *no prior accountability* and a linear time trend. Third, over the last decade, several states have implemented new teacher evaluation systems that hold teachers accountable for the performance of their students (Steinberg and Donaldson 2016). These systems may affect the supply decisions of teacher candidates and, therefore, bias the effects of school accountability. To account for that, I control for whether a state has implemented a teacher evaluation reform during the time period of this study. I create a binary variable that is coded as 1 if a state implemented teacher evaluation reform in a given year and zero otherwise.

Fourth, I account for the fact that the effect of the NCLB may vary across states based on its reliance on traditional education programs. I use data from the U.S. Department of Education on enrollment in both traditional and alternative programs in 2012 to identify states that rely heavily on traditional programs to train teachers, i.e., states where enrollment in traditional programs represent at least 90 percent of total enrollment in education programs. I then estimate the effect of NCLB on this group of states, excluding all other states where enrollment in traditional programs represent less than 90 percent of total enrollment in teacher preparation programs.

In addition to the parallel trend assumption, the DID design assumes that the effects of NCLB on teacher supply are immediate. However, given the complexity of NCLB and the large scale changes that resulted from the law, teacher candidates may have taken years to understand NCLB and experience its effects on teachers and schools. For example, NCLB may have little, or even positive, effects on students who were attending education programs during the early stages of implementing the law. The reason is that, during these early stages, effects of NCLB on teacher and schools weren't fully developed. For example, students may have lacked the information necessary to understand NCLB. In addition, individuals may have developed

positive attitudes towards the law given the overwhelming support of the law in the U.S. Congress during its early phases. To examine whether there were delayed effects of NCLB on teacher supply, I include three variables in the DID model that capture the 1-year, 2-year, and 3-year lagged effects of NCLB.

Finally, the DID model in equation (1) assumes that NCLB only affects the level (i.e., intercept) but not the trend in teacher supply (i.e., slope). To address this limitation, I create a new variable, $Years\ under\ NCLB_t$, that represents the number of years since the NCLB was implemented. This variable is defined as year – 2002, with all years prior to NCLB are coded as zero. Then, I include this new variable, $Years\ under\ NCLB_t$, and its interaction term with *no prior accountable* in the regression model. The model is specified as follows.

$$Teacher\ supply_{ist} = \alpha_0 + \alpha_1 NCLB_t + \alpha_2 Years\ under\ NCLB_t + \alpha_3 No\ prior\ accountability_s * NCLB_t + \alpha_4 No\ prior\ accountability_s * Years\ under\ NCLB_t + \alpha_5 No\ prior\ accountability_s * \varphi_t + \alpha_7 X_{ist} + \alpha_8 Z_{st} + \varphi_t + \delta_i + \upsilon_{it} \quad (2)$$

where $No\ prior\ accountability_s * \varphi_t$ represents an interaction terms between *no prior accountability* and a linear time trend. The total effect of the NCLB, as of 2015, would be $\alpha_3 + 14 \times \alpha_4$.

2.5 Results

I begin the analysis by exploring the trend in teacher supply in states with and without accountability systems prior to NCLB. Figure 3 displays the trend in enrollment in education majors in both groups before and after the introduction of NCLB. I can see that, during the entire time period of the study, enrollment in education programs was greater in states with no prior accountability compared to other states. Figure 3 also shows that the trend in enrollment in education programs in both groups of states followed a similar pattern before the introduction of

NCLB. Between 1996 and 1998, for example, enrollment in education programs in states with and without prior accountability systems has been relatively stable. However, between 1998 and 2000, enrollment in education majors declined in both groups of states. The decline was steeper among states with prior accountability systems. Enrollment in education majors started to rise again in both groups between 2000 and 2002. For example, between 2000 and 2002, enrollment in education majors increased by 19.4 percent in states without prior accountability systems, compared to 14.2 percent for states with prior accountability. Figure 3 also shows that both groups of states experienced a long-term decline in enrollment in education majors starting after 2002.

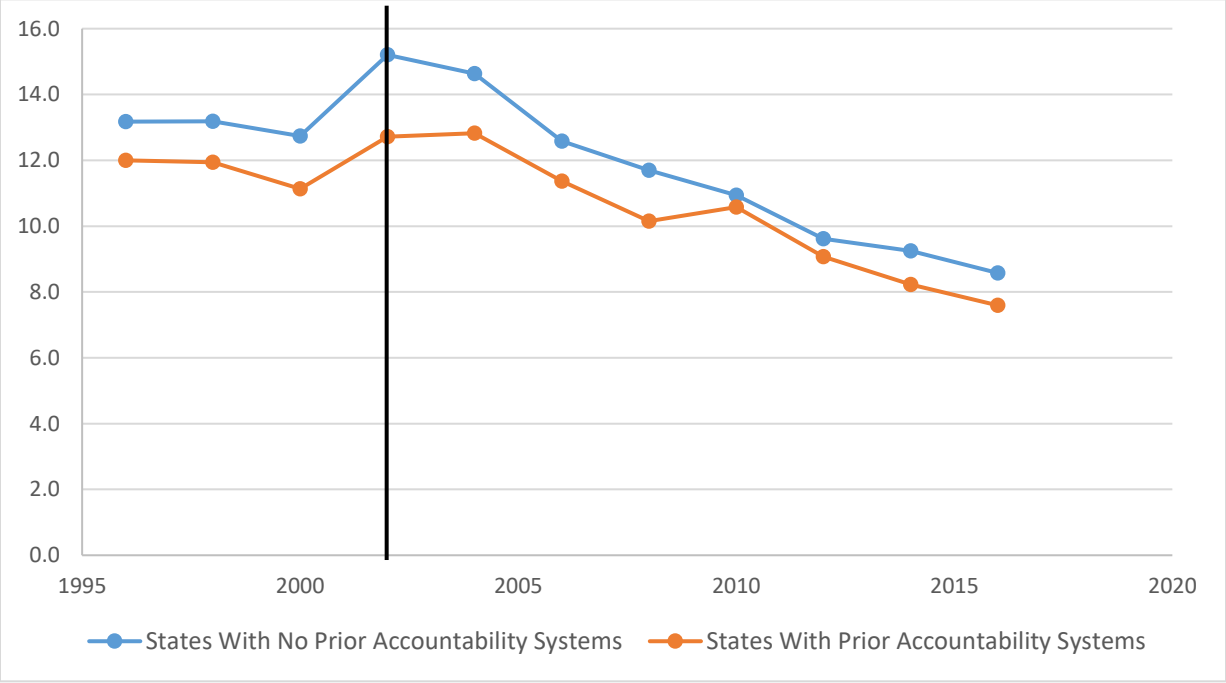

Figure 3: Share of Enrollment in Education Majors Before and After NCLB (1996-2016)

Figure 4 depicts the trend in education degrees in states with and without prior accountability systems. As shown, the trend in education degrees was almost identical in both groups of states before the introduction of the NCLB. In addition, the percentage of degrees awarded in education was relatively stable for most of the time period prior to the NCLB.

Starting from 2002, however, the percentage of degrees awarded in education started to decline, especially in states with prior accountability systems.

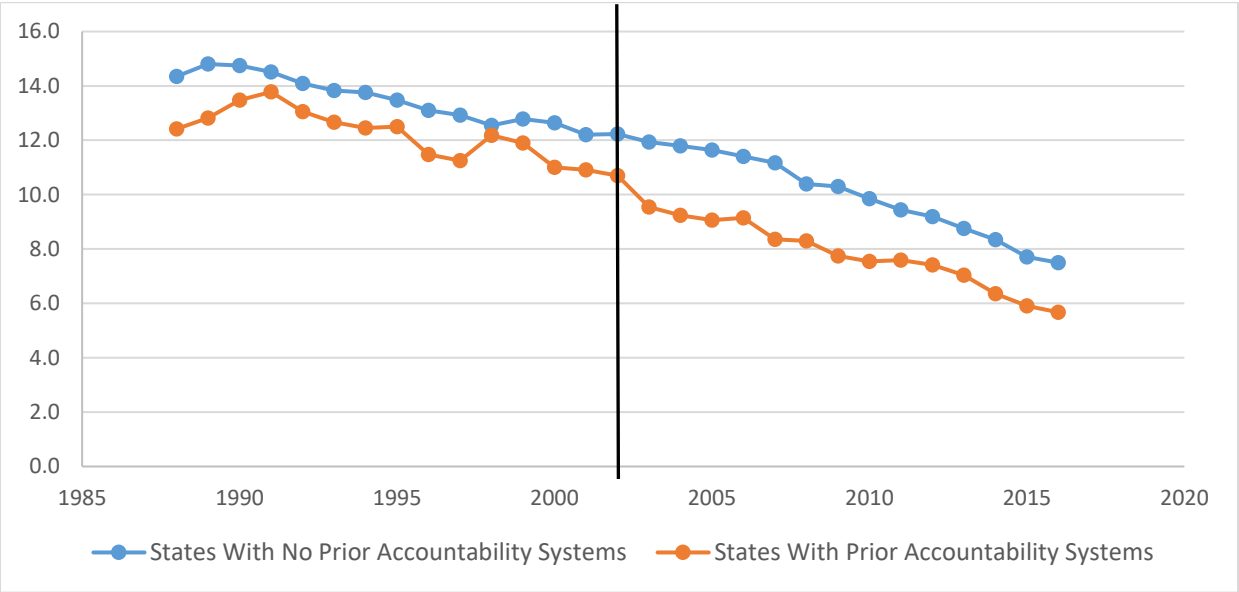

Figure 4: Share of Degrees Awarded in Education Majors Before and After NCLB (1988-2016)

2.5.1 Effects of NCLB on Teacher Supply

Table 2 presents regression estimates for the effect of NCLB on enrollment in education majors. In all models, I include institution-level fixed-effects to account for time-invariant characteristics of postsecondary institutions that might affect students' decisions to choose education as a major. I also include a set of year dummies to control for any changes over time that affect teacher supply.[9] As shown in model 1, the coefficient on the interaction term between *NCLB* and *No prior accountability* is negative but cannot be distinguished from zero, which indicates that NCLB has no significant impact on enrollment in education majors. In models 2 and 3, I account for the possibility that the trend in teacher supply might be different for states in the treatment and comparison groups. As I discussed in the methodology section, the DID model

[9] The binary variables for *NCLB* and N*o prior accountability* are omitted from the model because of institution and year fixed effects.

assumes that the trend in teacher supply in states with prior accountability systems represents a valid counterfactual for the trend in states without prior accountability systems. This assumption would be violated if teacher supply in states within the treatment or comparison groups is driven by changes in the local economy or state education policy. For example, if states with no prior accountability systems have adopted policies that focus on attracting new teachers, such as introducing alternative pathways to teaching, then the estimates from the DID model would underestimate the effect of the NCLB on teacher supply. To address this limitation, I include interaction terms between *no prior accountability* and linear and squared time trends to capture any group-specific trends that might have affected enrollment in education majors. As shown, controlling for group-specific time trends slightly change the magnitude of the coefficient on the interaction between *NCLB* and $No\ prior\ accountability$ but it remains statistically insignificant. That is, the differential effect of NCLB on enrollment in education majors in states without prior accountability systems is positive but cannot be distinguished from zero.

Table 2: Effects of NCLB on Enrollment in Education Majors

VARIABLES	(1)	(2)	(3)	(4)	(5)
NCLB* No prior accountability	-0.1527	0.3173	0.3056	0.2765	0.2771
	(0.5355)	(0.6972)	(0.5125)	(0.5169)	(0.8760)
No prior accountability * years under NCLB				-0.0129	0.1637
				(0.1587)	(0.2790)
Years under NCLB				-0.1249*	-0.1707***
				(0.0670)	(0.0379)
1-year lag effect					0.3483
					(0.5017)
2-year lag effect					-0.2676
					(0.4821)

Log fall Enrollment	-0.9152	-0.9103	-0.9101	-0.9098	0.1204
	(0.6511)	(0.6514)	(0.6513)	(0.6516)	(0.9371)
% White enrollment	0.0382**	0.0383**	0.0383**	0.0383**	0.0333*
	(0.0156)	(0.0157)	(0.0157)	(0.0156)	(0.0192)
% Pell grant	0.0147	0.0148	0.0148	0.0147	0.0045
	(0.0152)	(0.0152)	(0.0152)	(0.0152)	(0.0169)
Teacher median wage	-0.0000	-0.0000	-0.0000	-0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
State median wage	-0.0002	-0.0002	-0.0002	-0.0002	-0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
State unemployment rate	-2.4077	-3.1657	-3.1900	-3.2316	-5.4729
	(9.2250)	(9.0924)	(8.9985)	(8.9677)	(7.1957)
Teacher evaluation	-0.6930	-0.7319	-0.7333	-0.7340	-0.6993
	(0.4649)	(0.4740)	(0.4678)	(0.4707)	(0.4590)
Union membership density	-0.0988	-0.1011	-0.1012	-0.1014	0.0097
	(0.0671)	(0.0687)	(0.0692)	(0.0692)	(0.0843)
School age population	22.9312***	23.3259***	23.3350***	23.3393***	21.4967***
	(8.5217)	(8.4293)	(8.4737)	(8.4451)	(6.0150)
No prior accountability X time trend		-0.0472	0.7806	-0.0368	-0.1813
		(0.0410)	(27.3327)	(0.1108)	(0.2375)
No prior accountability X time trend squared			-0.0002		
			(0.0068)		
Observations	11,512	11,512	11,512	11,512	8,614
R-squared	0.0438	0.0439	0.0439	0.0439	0.0527
Number of unitid	1,613	1,613	1,613	1,613	1,374

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Note: The dependent variable is the percentage of all college students who major in education, including both part-time and full-time undergraduate students.

In model 4, I examine whether NCLB has affected not only the level but also the trend in teacher supply, i.e., the slope. I create a new variable, $Years\ under\ NCLB_t$, which represents the number of years since the NCLB was implemented. This variable is defined as year – 2002, with

all years prior to NCLB are coded as zero. Then, I include this new variable, $Years\ under\ NCLB_t$, and its interaction term with *No prior accountability* in the regression model. The total effect of NCLB on teacher supply from this model is equal to the coefficient on the interaction terms between *No prior accountability* and *NCLB* + (the coefficient on the interaction terms between *No prior accountability* and $Years\ under\ NCLB_t$ * the number of years during which NCLB has been implemented). As of 2015, the effect of NCLB on teacher supply is – 0.25, which indicates that NCLB has decreased enrollment in education majors by 0.25 percentage points as of 2015. This effect, however, cannot be distinguished from zero.

In model 5, I examine whether there were delayed effects of NCLB on teacher supply. I include two variables in the DID model that capture the 1-year and 2-year lag effects of NCLB.[10] Results from these models suggest that there are no immediate or delayed effects of NCLB on enrollment in education programs. Overall, regression estimates from table 2 suggest that, regardless of model specification, the accountability requirements of NCLB have had no significant impact on enrollment in education programs.

In table 3, I examine the effect of NCLB on the percentage of undergraduate degrees awarded in education programs. Similar to table 2, I control for both institution-level and year fixed effects in all models. As shown in model 1, the coefficient on the interaction terms between *NCLB* and $No\ prior\ accountability$ indicates that NCLB has increased education degrees by 1.0 percentage points in states without prior accountability systems relative to other states. Accounting for group-specific time trends in models 2 and 3 slightly reduces the magnitude of the interaction terms but the effect is still positive and tentatively significant. For example, model

[10] Data on enrollment in education programs are only available for three years prior to the introduction of NCLB in 2002: 1996, 1998, and 2000.

2 shows that NCLB has increased education degrees by .0.8 percentage points in states without prior accountability systems relative to other states ($p<0.1$).

In model 4, I explore the differential effect of NCLB on the trend in education degrees in states without prior accountability systems. Consistent with the models 1-3, NCLB seems to have an immediate positive effect on education degrees in states without prior accountability relative to other states. The coefficient on the interaction term between *NCLB* and *no prior accountability* suggests that NCLB has an immediate effect of 0.74 percentage points on education degrees ($p<0.1$). This effect, however, is only significant at the 0.1 level. It also declines by 0.23 percentage points for each year that followed the implementation of NCLB. As of 2015, the total effect of NCLB on education degrees is – 2.2, which indicates that NCLB has reduced education degrees by 2.2 percentage points in states without prior accountability systems relative to other states.

In model 5, I examine whether there were any delayed effects of NCLB on degrees awarded in education programs. Estimates from this model suggest that each year that followed the implementation of NCLB has reduced education degrees in states without prior accountability systems by 0.26 percentage points relative to other states. There is no evidence, however, that NCLB has had any delayed effects on the percentage of degrees awarded in education programs. For example, the coefficients on the 2-year and 3-year lag variables are negative but cannot be distinguished from zero.

There are two possible explanations for the immediate positive effects of NCLB on education degrees. The first is that NCLB required states to ensure that all students are taught by highly qualified teachers. NCLB defined highly qualified teachers as those who have a bachelor's degree, state certification, and knowledge of the subject matter. These requirements

might have improved the job prospects of students in traditional education programs, and therefore, encouraged them to finish their education degrees. Second, during the early stages of its implementation, NCLB was perceived as an important positive step towards improving the performance of students. For instance, NCLB was passed overwhelmingly in the U.S. Congress, supported by both Democrats and Republicans. This early positive perception of NCLB may have encouraged students to complete their education degrees. However, as schools started to experience the negative consequences of the law, the perception of NCLB may have changed.

Table 3: Effects of NCLB on Education Degrees

VARIABLES	(1)	(2)	(3)	(4)	(5)
NCLB* No prior accountability	0.9600**	0.8381**	0.8700**	0.7407*	0.4252
	(0.4330)	(0.4035)	(0.4102)	(0.3901)	(0.3075)
No prior accountability * years under NCLB				-0.2279**	-0.2647**
				(0.1000)	(0.1185)
Years under NCLB				-0.3202***	-0.2845***
				(0.0639)	(0.0684)
1-year lag effect					0.3687
					(0.2954)
2-year lag effect					-0.0478
					(0.2952)
3-year lag effect					-0.0554
					(0.2596)
Log fall Enrollment	-0.9932**	-0.9922**	-0.9819**	-0.9803**	-0.9358*
	(0.4703)	(0.4709)	(0.4686)	(0.4684)	(0.4826)
% White enrollment	-0.0083	-0.0083	-0.0085	-0.0085	-0.0061
	(0.0093)	(0.0093)	(0.0094)	(0.0094)	(0.0079)
% Pell grant	0.0241**	0.0241**	0.0238**	0.0237**	0.0199*
	(0.0113)	(0.0113)	(0.0112)	(0.0112)	(0.0118)
Teacher median wage	0.0000	0.0000	0.0000	0.0000	-0.0000

	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
State median wage	-0.0002**	-0.0002**	-0.0002**	-0.0002**	-0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
State unemployment rate	4.8082	4.8624	3.5027	3.3134	1.8711
	(6.5754)	(6.6081)	(6.4081)	(6.4195)	(8.0863)
Teacher evaluation	-0.0513	-0.0458	-0.1357	-0.1377	-0.1962
	(0.2966)	(0.2943)	(0.2948)	(0.2937)	(0.3103)
Union membership density	-0.0263	-0.0253	-0.0237	-0.0221	-0.0116
	(0.0564)	(0.0567)	(0.0572)	(0.0578)	(0.0632)
School age population	21.5902**	21.5678**	22.1242**	22.0063**	19.4332**
	(9.0560)	(9.0277)	(8.8869)	(8.8991)	(7.7799)
No prior accountability X time trend		0.0111	35.3191**	0.1211**	0.1495**
		(0.0333)	(16.1827)	(0.0581)	(0.0713)
No prior accountability X time trend squared			-0.0088**		
			(0.0040)		
Observations	38,335	38,335	38,335	38,335	34,029
R-squared	0.0598	0.0599	0.0608	0.0610	0.0575
Number of unitid	2,706	2,706	2,706	2,706	2,627

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2.5.2 Subgroup Analysis

In this section, I examine whether the effects of NCLB vary by students' demographic characteristics or the type of their education degrees. In all models, I include the same set of control variables used in the main analysis. However, I only report the coefficients for the key independent variables. In table 4, I investigate the effects of NCLB on the supply decisions of minority students. Columns 1-3 present the results for enrollment in education majors whereas columns 4-6 show the effects for education degrees. Across all specifications, I find that NCLB has large negative effects on minority enrollment in education majors. For example, results from table 4 suggest that NCLB has reduced minority enrollment in education programs by

somewhere between 2.8 (model 1) and 4.0 percentage points (model 3). I also find some negative effects of NCLB on education degrees awarded to minority students. However, these effects cannot be distinguished from zero.

One potential explanation for the large negative effects of NCLB on minority enrollment in education programs is that minority teachers tend to work in schools with large shares of disadvantaged students. These schools have experienced the most severe consequences of NCLB which might have discouraged minority candidates from choosing teaching as a career. In addition, the opportunity costs of becoming a teacher are higher for minority college students than other students. That is, because of the small share of minority students who attend college, minority college students may have better employment and career opportunities aside from teaching (Ingersoll et al., 2017). Therefore, by increasing the costs of becoming a teacher, NCLB has disproportionately affected enrollment of minority students.

Table 4: Effects of NCLB on the Teacher Supply of Minority Students

	Enrollment			Education Degrees		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
NCLB* No prior accountability	-2.8159*	-3.1055**	-3.9827*	-1.5294	-1.2247	-1.0377
	(1.4039)	(1.3850)	(2.2938)	(1.6604)	(1.4508)	(1.4501)
No prior accountability * years under NCLB		0.0061	-0.2458		0.1367	0.2682
		(0.1631)	(0.6153)		(0.3571)	(0.3455)
years under NCLB		-1.1592***	-1.2700***		-0.1268	-0.1411
		(0.2629)	(0.2610)		(0.2429)	(0.2475)
1-year lag			0.9283*			0.6717
			(0.5462)			(1.0881)
2-year lag			-0.4167			-0.9908
			(0.9828)			(1.0220)
3-year lag						-0.5819
						(1.3353)
No prior accountability X time trend	-0.0789	-0.0645	0.1615	0.0619	-0.0490	-0.0724
	(0.0718)	(0.1555)	(0.6212)	(0.1795)	(0.2109)	(0.2075)

Observations	10,445	10,445	7,603	29,817	29,817	29,740
R-squared	0.4366	0.4358	0.4522	0.5133	0.5133	0.5145
Number of unitid	1,609	1,609	1,373	2,547	2,547	2,523

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In table 5, I examine whether NCLB has affected degrees awarded in special education or math & science education. The first three models present the results from special education programs while the last three models provide the results for math & science programs. As shown in models 1-3, there is no effect of NCLB on degrees awarded in special education programs. Across all models, the coefficient on the interaction term between *NCLB* and *No prior accountability* is positive and cannot be distinguished from zero.

Table 5: Effects of NCLB on Degrees Awarded in Special Education and Math & Science

	Special Education			Math & Science		
VARIABLES	(1)	(2)	(3)	(7)	(8)	(9)
NCLB	3.7746	3.2871	3.1188	-0.3639	-0.0794	-0.1048
	(2.5601)	(2.2644)	(2.2723)	(0.3183)	(0.2432)	(0.2566)
NCLB* No prior accountability	0.7603	0.7929	0.4734	-0.0728	-0.0984	-0.3566
	(0.5514)	(0.5597)	(0.4611)	(0.3228)	(0.3274)	(0.2674)
No prior accountability * years under NCLB		0.0858	0.0650		-0.0681	-0.1029*
		(0.2369)	(0.2052)		(0.0460)	(0.0563)
years under NCLB		-0.1624	-0.2329*		0.0933**	0.0875**
		(0.1281)	(0.1355)		(0.0402)	(0.0332)
1-year lag			0.0923			0.0197
			(0.3244)			(0.2925)
2-year lag			0.0861			0.4311
			(0.4941)			(0.3497)
3-year lag			-0.5404			-0.1846
			(0.4879)			(0.1819)
No prior accountability X time trend	-0.0182	-0.0590	0.0206	-0.0135	0.0188	0.0420
	(0.0706)	(0.1162)	(0.1185)	(0.0221)	(0.0278)	(0.0425)
Observations	36,782	36,782	32,496	36,782	36,782	32,496
R-squared	0.0049	0.0049	0.0036	0.0031	0.0033	0.0031
Number of unitid	2,627	2,627	2,541	2,627	2,627	2,541

Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Estimates from models 4-6 show some negative effects of NCLB on degrees awarded in math and science education programs. For example, the coefficient on the interaction terms between *No prior accountability* and *Years under NCLB* in model 6 indicates that each year under NCLB has reduced degrees awarded in math and science education programs by 0.10 percentage points in states without prior accountability systems relative to other states. This effects, however, are only significant at the 0.1 level.

2.6 Robustness Checks

In this section, I test the sensitivity of the results to different sample restrictions and alternative specifications. Up to this point, I measured school accountability using a binary variable, *No prior accountability*, which distinguishes between states with and without accountability systems prior to NCLB. There are two main limitations of this binary variable. First, it doesn't take into account the number of years during which a state accountability system has been in place before the NCLB. That is, the binary treatment variable doesn't distinguish between states that implemented accountability systems shortly before NCLB and other states that had adopted these systems for many years before the law was passed. In fact, as discussed in Dee at al. (2013), more than half of the states with prior accountability systems have adopted these systems 4 years or fewer prior to the NCLB.

Failing to distinguish between states with prior accountability systems based on the length of these systems may attenuate the estimated effect of the NCLB. To address this limitation, I define the treatment variable as the number of years, prior to the NCLB, that a state didn't implement school accountability. Following Dee and Jacob (2011) and Dee et al. (2013), I define the treatment variable as the number of years between the 1991-92 academic year and the introduction of the NCLB in 2002-03 that a state didn't implement an accountability system. The

regression estimates from this specification are presented in Panel A of table 6. I find no significant effects of NCLB on either enrollment in education majors or education degrees.

Table 6: Robustness Checks

	Enrollment	Education Degrees
A. Prior accountability defined in years		
NCLB* No prior accountability	-0.0708	-0.1046
	(0.0952)	(0.1080)
Observations	11,572	38,397
B. States with strong school accountability		
NCLB* No prior accountability	0.5258	0.3648
	(0.9899)	(0.3672)
Observations	11,572	38,397
C. States that rely heavily on traditional programs		
NCLB* No prior accountability	-0.3000	0.4727
	(0.9002)	(0.4324)
Observations	7,325	24,171

Note: All models are estimated using panel data fixed effects and include institution-level and state-level control variables in addition to linear time trend.
Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The second limitation of the binary treatment variable is that it ignores the variation in school accountability systems across states prior to NCLB, especially in terms of the strength of these systems (Lee and Wong 2004). States with weak accountability systems may not represent a good "counterfactual" for states without prior accountability systems and, as a result, the effect of the NCLB may be underestimated. To account for that possibility, I redefine the treatment variable to include only states without strong prior accountability systems. That is, the treatment variable takes 1 for states without strong accountability systems prior to NCLB and zero otherwise. Regression estimates from this specification are shown in panel B of table 6. Similar

to the results from panel A, there is no evidence that NCLB has significantly affected teacher supply.

Another limitation of the main analysis is that the dataset doesn't include information on enrollment in alternative certification programs. As shown in figure A1 in the appendix, enrollment in these programs has increased substantially over the last two decades. Between 2000 and 2015, the percentage of individuals who completed alternative programs increased from 6 percent to 15 percent (U.S. Department of Education 2016). There is, however, a large variation in enrollment in these programs across states (see table A2 in the appendix). While some states still rely heavily on traditional programs to train potential teachers, others have adopted alternative certification programs to address teacher shortages and attract talented individuals to teaching. Because of this large cross-state variation, the effect of the NCLB may vary across states based on its reliance on traditional teacher preparation programs. I test this assumption using data from the U.S. Department of Education on enrollment in both traditional and alternative programs in 2012. I use this state-level data to identify states that rely heavily on traditional programs to train teachers, i.e., states where enrollment in traditional programs represents at least 90 percent of total enrollment in education programs. I, then, estimate the effect of the NCLB on this group of states, excluding all other states where enrollment in traditional programs represents less than 90 percent of total enrollment in teacher preparation programs. Panel C reports the results from this specification. Consistent with the results from panels A and B, I find no effect of the NCLB on enrollment in education majors or degrees awarded in education. Overall, the results from table 6 suggest that NCLB has no effect on teacher supply. Although the main analysis shows some immediate positive impact of NCLB on education degrees, this finding appears to be sensitive to the model specification.

2.7 Conclusion

In this paper, I examine the effect of the NCLB on teacher supply. Following previous research, I take advantage of the fact that several states had adopted consequential school accountability systems prior to the introduction of NCLB. To estimate the effect of NCLB, I use a DID approach in which I compare both enrollment and degrees awarded in education programs in states with and without prior accountability systems, before and after the introduction of the NCLB.

The analysis is based on two key identification assumptions. First, the DID design assumes that changes in teacher supply in states with prior accountability systems and those without prior accountability systems follow the same trend, i.e., the parallel trend assumption. The second identification assumption is that school accountability systems that were in place before the NCLB are similar to the accountability requirements imposed by the NCLB. I test the sensitivity of the results to these two assumptions using several robustness checks. First, to test the parallel trend assumption, I compare the trend in enrollment and degrees awarded in education majors degrees before the introduction of the NCLB among states with and without prior accountability systems. Further, I allow for the slope of teacher supply and its time trend to vary across states in both groups. Particularly, I employ a CITS design that allows for a differential shift not only in the level of teacher supply (the intercept), but also a shift in the trend in this supply after the introduction of the NCLB (the slope) and the time trend for states with and without prior accountability systems.

To test the plausibility of the second identification assumption, I conduct several robustness checks. First, since some of the states with prior accountability systems have adopted these systems immediately prior to the NCLB, I define the treatment variable as the number of

years without prior accountability. Second, I restrict the sample to states with strong accountability systems and exclude any state that implemented weak or moderate accountability systems. The reason is that states with weak or moderate accountability systems will not represent a good counterfactual for states without prior accountability. Third, I restrict the sample to states that rely heavily on traditional teacher preparation programs and exclude any state in which alternative programs comprise a large share of enrollment in teaching programs (more than 10 percent).

Across all specifications, I find no differences in the effect of the NCLB in states with and without prior accountability systems on either enrollment or degrees awarded in education programs. However, I find some evidence that the introduction of the NCLB has significantly reduced percentage of minority students enrolled in education programs.

The findings have important policy implications. The evidence presented in this study provides some support for the popular belief that NCLB has discouraged individuals from pursuing teaching as a career. I find that, NCLB has reduced the percentage of minority students enrolled in education majors by more than 3 percentage points. The large negative effect of NCLB on the teacher supply of minority students suggests that the consequences of school accountability systems may extend beyond the direct impact on student achievement or teacher mobility and retention. These systems may increase the cost of becoming a teacher, especially with respect to the non-pecuniary aspects of the teaching profession such as job autonomy and satisfaction. By putting more pressure on teachers to improve student performance, school accountability systems may increase the level of stress and anxiety among existing teachers and undermine the perception of teaching as a stable career among potential teachers. Therefore,

policymakers should take into account the potential adverse effects on teacher supply when designing school accountability systems.

Chapter III: Teacher Prep Performance Assessment and Retention in Education Majors

3.1 Introduction

Over the last few years, teacher preparation programs in the U.S. have attracted increasing attention from educators, policymakers and academics. Concern is growing that prospective teachers graduate from these programs without acquiring adequate training to succeed in the classroom (Boyd et al. 2007, U.S. Department of Education 2011, Goldhaber, Cowan, and Theobald 2016). Both the federal and state governments have introduced plans to improve the quality of teacher preparation programs. In 2016, for instance, the U.S. Department of Education implemented new regulations that require states to report basic annual information on teacher preparation programs, such as employment outcomes of graduates of each program and whether these graduates demonstrated success in improving student learning. The purpose of this information is to improve the transparency of teacher preparation programs and to help teacher candidates make informed decisions about whether they should enroll in a particular program.

Several states have implemented reforms that seek to improve the effectiveness of preparation programs. In 2014, for example, Georgia required all teacher candidates, including those enrolled in alternative certification programs, to pass a teacher performance assessment exam called edTPA in order to be certified by the state. The purpose of the edTPA exam is to ensure that only qualified candidates enter teaching. By 2018, 18 states have adopted the edTPA performance assessment and an additional 19 states have at least one teacher preparation program that is exploring the implementation of edTPA.[11] Despite the rapid adoption of the

[11] Table A3 in the appendix provides a list of states that have adopted the edTPA performance assessment.

edTPA, we know little about its effects on retention in teacher preparation programs and teacher quality in general.

Proponents of teacher performance assessment argue that the edTPA assessment will improve the quality of teachers through four main channels (Boyd et al. 2007, Goldhaber, Cowan, and Theobald 2016). First, it will improve teacher education programs. Teacher preparation programs will use the edTPA assessment as an educational tool to enhance the performance of teacher candidates. For example, the edTPA assessment will help preparation programs identify whether their teaching practices or curriculum are effective at preparing candidates to succeed in the classroom. It may also enable these programs to identify the type of skills that are necessary for teacher candidates to pass the edTPA exam. Second, by setting high standards for entering the teaching profession, edTPA assessment may encourage teacher candidates to improve their knowledge and teaching practices. Third, teacher performance assessment will serve as a "screening tool" that keeps less qualified teacher candidates out of the teaching profession. For example, candidates who fail to pass the edTPA exam will not be able to apply for teacher certification. Fourth, teacher performance assessment will help school educators identify high quality candidates based on their performance on the edTPA exam, i.e., signaling effect. In other words, school educators may use performance of teacher candidates on the edTPA exam as a signal of their potential job performance which may make them more reluctant to hire candidates with low edTPA scores.

However, the edTPA increases the costs of becoming a teacher in both time and effort[12], which may deter qualified candidates from choosing teaching as a career (Boyd et al. 2007). If

[12] Anecdotal evidence suggest that it takes teacher candidates several months to prepare their portfolios for the edTPA exam (Jette 2014).

edTPA exam scores are only weakly related to performance in the classroom, then requiring it will have limited or even negative effects on student outcomes.

This essay examines whether the introduction of pre-service performance requirements in Georgia has affected college outcomes of students in education programs relative to students in other programs. Thus, this essay seeks to answer the following research questions:

- Did the introduction of teacher performance assessment affect student retention in education programs?
- Did the new performance requirement affect students' choice of college major?
- Does the effect of teacher performance assessment vary by student demographic characteristics or high school performance?

To answer these questions, I use administrative data on postsecondary students from the University System of Georgia (USG). The data includes basic information on student socio-economic and demographic characteristics, such as gender, race, and age, in addition to information on Pell grant eligibility, amount of financial aid received, and high school performance. The USG data, however, doesn't include information on whether students have taken the new performance assessment exam. Therefore, I estimate the effects of the new performance requirements by examining the change over time in college outcomes of students with an education major before and after the implementation of performance assessment in fall 2015, relative to other students.

This chapter doesn't seek to estimate the effect of taking the edTPA test on students' outcomes. Rather, it examines whether requiring all teacher candidates to pass the new edTPA performance assessment has any impact on their college outcomes relative to other students, regardless of whether or not they have taken the test. For example, the mere

knowledge/awareness of the new edTPA requirements may discourage some students from persisting in college or cause them to choose to switch their major.

This paper is one of the first to examine the supply side effects of the edTPA performance assessment, though Goldhaber et al. (2016) has examined the effects of edTPA on teacher quality in Washington State. Understanding the supply side effects of the edTPA performance assessment is important since these effects represent one of the key mechanisms through which the edTPA assessment is expected to improve teacher quality. The direction of this effect, however, is ambiguous. On the one hand, requiring all teacher candidates to pass the edTPA exam may improve the quality of teacher candidates and ensure that poorly prepared candidates don't enter the teaching profession. On the other hand, imposing the new edTPA requirements on teacher candidates may discourage some qualified teacher candidates, especially those with high opportunity costs, from pursuing teaching as a career. As some of the evidence on the licensure requirements suggests (see for example, Gitomer et al. 1999), the edTPA assessment may also disproportionally affect the chances of minority candidates to become teachers which will have long-term implications for the diversity of the teaching workforce.

The results from this paper suggest that teacher prep performance assessment has no impact on students' persistence into their senior year of college, attrition from education majors, or the likelihood of graduating within four years. These results are robust to multiple sample restrictions and alternative specifications.

3.2 Pre-service Performance Assessment

Most states require teacher candidates to pass licensure tests that cover basic skills, general knowledge, content knowledge, and pedagogic skills (Boyd et al. 2007).[13] The edTPA

[13] Most states requiring exams use the Praxis exam administered by Educational Testing Services (ETS).

exam differs from traditional question-and-answer licensure exams in that it focuses on the classroom practices and pedagogical strategies is a specific subject- (Goldhaber, Cowan, and Theobald 2016).[14] This exam was developed by researchers at Stanford University's Center for Assessment, Learning, and Equity (SCALE) in 2009 and was launched operationally in 2013. Since 2013, the edTPA exam has been adopted by more than 700 teacher preparation programs in 38 states and the District of Columbia (edTPA 2015). On April 2014, the Georgia Professional Standards Commissions (GaPSC) announced that all teacher candidates who completed student teaching in fall 2015 or later would be required to pass the edTPA performance assessment to receive certification.[15]

Teacher candidates are required to take the edTPA exam at the end of their preparation programs, i.e., after finishing the coursework and during their field placements. Teacher candidates must pay a $300 fee to create a portfolio of materials that includes lesson plans, instructional materials, samples of student work, and feedback on student work. Candidates also submit unedited video recordings of instruction in a real classroom as part of their portfolios. Then, current teachers and educators score these materials. The evaluation process focuses on three main tasks: Planning, Instruction, and Assessment. Each task contains 5 different rubrics, each of which is scored on a 1-5 scale. Examples of rubrics in the Planning task includes "Planning for Content Understanding," "Planning to Support Varied Student Needs," and

[14] The edTPA assessment is similar to the certification process required by the National Board for Professional Teaching Standards (NBPTS). However, unlike the edTPA performance assessment which targets teacher candidates who still attending teacher preparation programs, the NBPTS only provides certification for current teachers with a valid state license and three years of experience prior to the certification process.

[15] In addition to the edTPA assessment, GaPSC required teacher preparation programs to apply for a Pre-service Certificate for all teacher candidates who complete any field experiences or student teaching in Georgia schools after July 1, 2015. Under the new GaPSC rules, teacher candidates are also required to pass an ethics exam upon entering their preparation programs and prior to graduation. It should be noted that teacher candidates are still required to pass the traditional state licensure exam, the Georgia Assessments for the Certification of Educators (GACE.)

"Identifying and Supporting Language Demands." States set different standards as to what constitutes a passing score (edTPA 2015). In Georgia, the passing is 38, which is below the national average of 42. Georgia also allows teacher candidates to take the edTPA exam more than once.

3.3 Literature Review

This paper contributes to the research on teacher supply. Most of the current literature focuses on whether teacher preparation programs affect, and performance on licensure tests predict, teacher performance in the classroom, measured using teacher value-added models. The evidence is mixed. I begin this section by reviewing the research on teacher supply in general and then discuss the current evidence on teacher preparation programs and certification requirements.

3.3.1 Teacher Supply

Previous research considering teacher entry has largely focused on gender, cognitive ability, salaries, and the quality of the working conditions in schools (Dolton 2006, Guarino, Santibañez, and Daley 2006). Women are more likely to enter the teaching profession than men (e.g., Henke at al. (2000)), but as college-going among women has sharply increased (Goldin, Katz, and Kuziemko 2006), the proportion of women choosing teaching has declined substantially. In 1960, for example, about 50 percent of women who graduated from college entered teaching, compared to less than 10 percent in 1990 (Flyer and Rosen 1997).

As women increasingly became able to enter highly-paid professions, high-ability college graduates are less likely than low-ability graduates to choose teaching as a profession (ACT 2015, Corcoran, Evans, and Schwab 2004b, a, Guarino, Santibañez, and Daley 2006, Podgursky, Monroe, and Watson 2004a). Podgursky et al. (2004a) found that individuals who choose

teaching as a career have significantly lower ACT scores that those who choose other occupations. They also find that, among individuals with high ACT scores, women are less likely to enter the teaching profession than their male counterparts. Henke et al. (2000) found that college graduates who scored in the top quartile of college entrance exams are less likely to enter teaching than those who scored in the bottom quartile. Several other studies have reached similar conclusions (Ballou, Springer, and Urban 2009, Gitomer, Latham, and Ziomek 1999).

Teachers' salaries are a key determinant of individuals' decisions to enter the teaching profession. Using data from the National Longitudinal Study of the High School Class of 1972 (NLS-72), Manski (1987) found that the wage elasticity of teacher supply ranges between 2.4 and 3.2. His findings indicate that a 10 percent increase in teachers' wages will raise the supply of teachers among college graduates by 5 percentage points, from 19 to 24 percent of all college graduates. However, other studies have shown that the relative levels of teachers' wages, i.e., teachers' wages relative to other occupations, are more important than the absolute levels in predicting entry into teaching. Dolton (1990), for example, used data on a cohort of college students from the UK to examine the factors that affect their occupational choices. He found that both relative wages and wage growth in teaching affected individuals' decisions to choose teaching as a career (see also (Zabalza 1979a, b)). Similar evidence is provided by Rickman, Wang and Winters (2015), who found that the share of education majors who became public school teachers was higher in states with higher relative salaries. Other studies have also shown that labor market conditions generally, such as the comparative levels of unemployment and levels of pay, may also influence individuals' decisions of whether to become teachers (Blom, Cadena, and Keys 2015, Dolton, Tremayne, and Chung 2003). Blom et al. (2015), for instance,

found that, during periods of poor economic conditions, students are less likely to choose low-paying college majors or majors with high unemployment rates.

The attractiveness of jobs in teaching in comparison to alternative occupations also seems to matter. For instance, Corcoran, Evans and Schwab (2004b, 2004a) found that between 1957 and 1992, women at the top of their high school class became increasingly unlikely to choose teaching as a profession, finding a decline from 20 percent in 1964 to under 4 percent in 1992. This sharp decline may be attributed to the remarkable increases in the opportunities available to women.

Working conditions, such as the physical attributes of schools, teachers' workload, and the quality and socio-economic characteristics of students also affect teacher labor market outcomes (Johnson 2006, Johnson, Berg, and Donaldson 2005, Ladd 2011, Loeb, Darling-Hammond, and Luczak 2005). Ladd (2011) found that teachers' perceptions of their working conditions increase their intentions to leave their current schools and account for 15 percent of the variation across schools in actual departure rates.

3.3.2 Certification Requirements and Teacher Preparation Programs

A large body of research on the relationship between certification requirements and teacher outcomes has focused on the effect of certification requirements on teacher quality. Goldhaber and Brewer (2000), for example, found that cross-state differences in teacher licensure requirements, such as whether a state requires any type of teacher exam or requires field experience prior to student teaching, have no effects on student achievement. Goldhaber (2007) found some evidence that some teacher licensure tests in North Carolina improve student achievement, but these effects are generally small.

Clotfelter et al. (2007) found that teacher certification requirements have a large positive effect on student math achievement but modest effect on reading achievement. Larsen (2015) uses variation in teacher licensing requirements across states between 1983 and 2008 to find that requiring a certification test for initial licensures may discourage first-year teachers with high ability, measured using their SAT scores, from staying in the profession. Among teachers who remain in the profession, however, Larsen found that requiring a licensing test is associated with an increase in "input quality," measured using the average SAT scores of entering students at the undergraduate institution that a teacher attended.

Using data from North Carolina, Goldhaber & Anthony (2007) examined the effect of certification of teachers by the National Board for Professional Teaching Standards (NBPTS) on teacher performance. In general, their results suggest that NBPTS-certified teachers tend to be more effective than both teachers who applied but failed to obtain the NBPTS certification and teachers who never applied for the program. The effect of the NBPTS certification, however, varies significantly across grades and student subgroups. Using data from Washington State, Goldhaber et al. (2016) found that edTPA scores have positive impacts on student achievement in math in some specifications but not on reading. However, when measuring edTPA assessment using a pass/fail binary indicator, they found that passing the edTPA exam improves student achievement in reading but has no effect on student performance in math.

Teacher preparation programs have attracted growing scholarly interest, but the evidence is inconclusive. Some studies have reported large differences in teacher quality across teacher preparation programs. For example, using data on public school teachers in New York City, Boyd el al. (2009) found large variation across both traditional and alternative preparation programs in the quality of teachers they produce. Their results also suggest that teacher

preparation programs that produce effective math teachers also tend to produce effective language arts teachers. Several other studies, however, found no differences in teacher quality across preparation programs. Noell et al. (2007) and Gansle et al. (2012) examined variation in teacher quality among recent graduates of teacher preparation programs in Louisiana. Their findings showed few significant differences in teacher performance among individuals graduating from different preparation programs. Using data from Washington State, Goldhaber et al. (2013) found little difference in teacher quality between teachers who graduated from state-accredited programs and those who graduated from programs outside the state. Hippel et al. (2016) also found small differences in teacher quality among teachers graduated from different preparation programs in Texas.

The mixed evidence on the effectiveness of teacher preparation programs might be driven by differences in identification strategy across studies. Mihaly et al. (2012), for instance, found that the effects of teacher preparation programs in Florida are sensitive to including school fixed effects. Their findings also suggest that including school fixed effects results in less precise preparation program estimates. Koedel et al. (2015) argue that most of the prior research treats students taught by the same teacher as independent observations and therefore tends to overestimate differences in teacher quality across programs. To address this issue, Koedel et al. (2015) clustered the standard error at the teacher level and found that most of the variation in teacher quality differences across teacher preparation programs can be attributed to estimation-error variance.

Only a handful of studies have examined whether changes in the requirements for teacher preparation programs affect individuals' decisions to enter the teaching profession. Hanushek and Pace (1995) found that individuals are less likely to complete their teacher preparation

programs in states that require potential teachers to complete specific courses and tests, impose a pre-specified cut-off on a standardized test or ask their trainee teachers to complete a significant number of education-related courses. Thus, more lenient certification requirements may increase the supply of teachers (Boyd et al. 2007). Angrist and Guryan (2004) found that teacher testing requirements have no effect on the type or affiliation of education programs that teacher candidates attended. For example, their results show no effect of state testing on the quality of new teachers or their likelihood of attending traditional teacher preparation programs. Gitomer et al. (1999) examined the heterogeneous effects of teacher testing using data on more than 300,000 teacher candidates who took the Praxis exams for admission into college or as part of their licensure requirements between 1994 and 1997.[16] They found substantial differences in Praxis passing rates between white and minority teacher candidates. For example, among individuals who took the SAT exam, 82 percent of white candidates passed the Praxis I exam compared to 46 percent of African American candidates. The results also suggest that while raising the passing scores on the Praxis exam will increase the average ability of teacher candidates, measured using their SAT and ACT scores; it will reduce the diversity of the teaching pool dramatically.

3.4 Data and Methods

To estimate the effects of pre-service performance assessment on students' college outcomes, I use administrative data from the University System of Georgia (USG). The USG data includes information on students who started their postsecondary education in Georgia between academic years 2008-09 and 2016-17.

[16] Several states require teacher candidates' to pass the Praxis exams in order to be certified. These exams are used to assess candidates' skills and knowledge of the subject matter.

Treatment status. The treatment group consists of students with education majors. To identify treatment status, I create a binary variable, *education major*, that takes one for students who declared their education as a major during the first year of their postsecondary education and zero otherwise. The comparison group is composed of all students who did not declare education as their major during their first year. One major limitation of this variable is that it doesn't take into account that students may change their majors during the course of their postsecondary education. Therefore, to address this limitation, I test the sensitivity of the results to excluding students who changed their majors during their postsecondary studies. The results from this specification are discussed in the sensitivity analysis section. In general, the findings from this specification are very similar to baseline results discussed in section 5.

I also create a binary variable, *performance assessment*, to capture the effect of teacher performance assessment on students' college outcomes. This variable takes a value of 1 for students who were enrolled in college at the time of implementing the new performance requirements in fall 2015 and zero otherwise. On April 2014, the Georgia Professional Standards Commissions (GaPSC) announced that all teacher candidates in the state of Georgia would be required to pass the edTPA performance assessment to receive certification. These new performance assessment requirements affected all students who attended education programs in fall 2015 or later, including students in the first, second, third, or last year of their postsecondary education.

The interaction term between *education majo*r and *performance assessment* represents the effect of performance assessment on college outcomes of students with education majors relative to other students.

College outcomes. I examine the effect of teacher prep performance assessment on three college outcomes: persistence in college, change of college major, and graduation within 4 years. First, I examine whether pre-service performance assessment has reduced college persistence among students in education programs. I measure persistence in college using a binary variable that takes one if students persist into their senior year of college and zero otherwise. Second, I examine whether teacher prep performance assessment has led students in education programs to change their college major. To measure change of college major, I create a binary variable that takes one for students who changed their college major between their first and senior years of college and zero otherwise. In addition to college persistence and choice of college major, I also examine the effect of performance assessment on 4-year degree attainment. This outcome is measured using a binary variable that indicates whether a student graduated from college within four years.

Panel A in table 7 shows the treatment and control groups for the pre- and post-periods for the first two outcomes: persistence into senior year and change of college major. As shown, the treatment in the post-period includes students with education majors who started their postsecondary education in school year 2013-14. These students were in their third year at the time of implementing the new performance requirements. I examine whether performance assessment affected the decisions of these students to persist into their senior year or change their education major. The control group for the post-period includes students with non-education majors who were also in their third year in fall 2015. The pre-treatment period includes students who were first enrolled in college in school year 2012-13 or prior to that. Students who started their postsecondary education between schools 2014-15 and 2016-17 are excluded from the

sample since persistence into senior year and change of college major between first and senior years of college cannot be observed for this group of students.

Table 7: Treatment and Control Groups for College Outcomes

	Treatment		Control	
	Pre	Post	Pre	Post
(A) College persistence/Change of major	Students with education majors who were first enrolled in 2012-13 or before	Students with education majors who were first enrolled in 2013-14	Students with non-education majors who were first enrolled in 2012-13 or before	Students with non-education majors who first enrolled in 2013-14
(B) Graduation within 4 years	Students with education majors who started their college between 2009-08 and 2011-12	Students with education majors who started their college between school years 2012-13 and 2013-14.	Students with non-education majors who started their college between 2009-08 and 2011-12	Students with non-education majors who started their college between school years 2012-13 and 2013-14.

Panel B shows the treatment and control groups for the third outcome: graduation within 4 years. As shown, the treatment group for the post-period includes students with education major who were in their third and fourth year at the time of implementing performance assessment, i.e., students who first enrolled in college in school years 2012-13 and 2013-14. These students will be affected by the new requirement since they will not be able to graduate without passing the edTPA exam. Data on 4-year degree attainment is not available for students who started their postsecondary education in fall 2014 or later. Therefore, I exclude these students from the sample. It should be noted that students who first enrolled in school year 2012-13, i.e., those who were in their fourth year at the time of implementing performance assessment, are considered part of the post-period treatment group for the third outcome, graduation within 4 years, but not the first two outcomes, college persistence and change of college major. The reason is that, unlike graduating from college, the decisions of this group of students to enroll in

their fourth year or to change their major in their fourth year are likely to happen at the beginning of school year 2015-16 before taking the assessment test and therefore these two outcomes are less likely to be affected by the introduction of performance assessment in September 2015. Nevertheless, as a robustness check, I exclude this cohort of students from the analysis. The estimates from this regression are reported in table A4 in the main appendix. As shown, the findings are very similar to the baseline results in section 5.

Control variables. To account for differences between students with education majors and other students that may affect their college outcomes, I use information on students' demographic characteristics, residency status, high school achievement, performance on SAT exam, and financial aid eligibility.

Table 8 shows descriptive statistics of the sample. The sample includes students who started their college between school years 2008-09 and 2013-14 and attended 4-year programs. As shown, 45 percent of students in the sample are minority and 55 percent are females. The vast majority of students attending postsecondary education in the sample are in-state residents (91 percent). The average high school GPA is 3.3. About 38 percent of students in the sample receive Pell grant in their first year. About 69 percent of students have persisted into their senior year of college. However, only 22 percent of individuals have completed their college degree within four years.

Table 8: Descriptive Statistics

Variable	Mean	Std. Dev.
Minority	45.1	-
female	55.3	-
In-state resident	91.3	-
High school performance		
High school GPA	3.3	0.5
SAT math	548.7	100.0
SAT verbal	543.4	90.3

Financial aid		
Receive Pell grant (1st year)	38.4	-
Total aid (1st year)	30.6	31.3
College Outcomes		
Persistence to senior year	68.1	-
Change college major	49.1	-
Degree completion with 4 years	21.8	-
Sample size	184,812	

Table 9 provides mean characteristics of the treatment and control groups before and after the implementation of teacher performance assessment. Overall, the average student enrolled in education programs is more likely to be female, white, and in-state resident. Students with education majors tend to have high school GPA that is similar to other students but they score lower on the SAT exam. Table 8 also shows that students in education programs are less likely to change their college major after the first year and more likely to graduate from college within 4 years.

Table 9: Mean Characteristics of the Treatment and Control Groups

	Education Major		Non-Education Major		
Variable	Pre	Post	Pre	Post	
Minority	34.97	37.17	45.55	46.49	***
	(47.69)	(48.34)	(49.80)	(49.88)	
Female	78.39	80.01	53.54	54.62	***
	(41.16)	(40.00)	(49.87)	(49.79)	
In-state resident	96.42	95.49	91.08	90.65	***
	(18.52)	(20.66)	(28.46)	(29.08)	
High school performance					
High school GPA	3.21	3.28	3.27	3.33	***
	(0.50)	(0.49)	(0.53)	(0.52)	
SAT math	516.04	507.51	550.53	551.71	***
	(80.70)	(85.91)	(99.96)	(103.80)	
SAT verbal	520.57	517.50	544.21	547.69	***
	(78.64)	(84.22)	(90.13)	(93.78)	

Financial aid					
Receive Pell grant (1st year)	38.27	45.21	37.87	40.85	***
	(48.61)	(49.79)	(48.51)	(49.16)	
Total first-year aid (in hundreds)	29.41	34.45	30.13	33.29	**
	(28.09)	(30.09)	(31.17)	(33.02)	
College Outcomes					
Persistence to senior year	70.09	64.38	69.19	62.76	***
	(45.79)	(47.90)	(46.17)	(48.35)	
Change college major	41.97	38.42	49.39	50.79	***
	(49.35)	(48.66)	(50.00)	(49.99)	
Degree completion with 4 years	26.22	29.27	21.04	23.30	***
	(43.98)	(45.51)	(40.76)	(42.27)	
Sample size	9,791	1,606	143,280	30,135	

Note: Standard deviations are in parentheses. Asterisks indicate whether differences between students with education majors and other students are statistically significant at the conventional levels. *** p<0.01, ** p<0.05, * p<0.1

Figure 5 compares the changes in the share of first-year students who were enrolled in education major to the share of students enrolled in other majors between 2008 and 2016. Overall, shares of enrollment in Business, Health Professions, and Science majors have shown substantial increases over time. For example, between 2008 and 2016, the share of enrollment in Business, Management, and Marketing major increased by 6.1 percentage points, from 8.4 percent to 14.5 percent, compared to 6.3 percentage points for Health Professions major, and 6.7 percentage points for Science majors. Enrollment in education major, however, has declined during the same period from 6.4 percent to 4.4 percent. Several factors might be responsible for this decline, such as cuts in school budgets during the recession, rise of school accountability, or any other changes in state and federal education policies. However, the empirical evidence on these factors is limited.

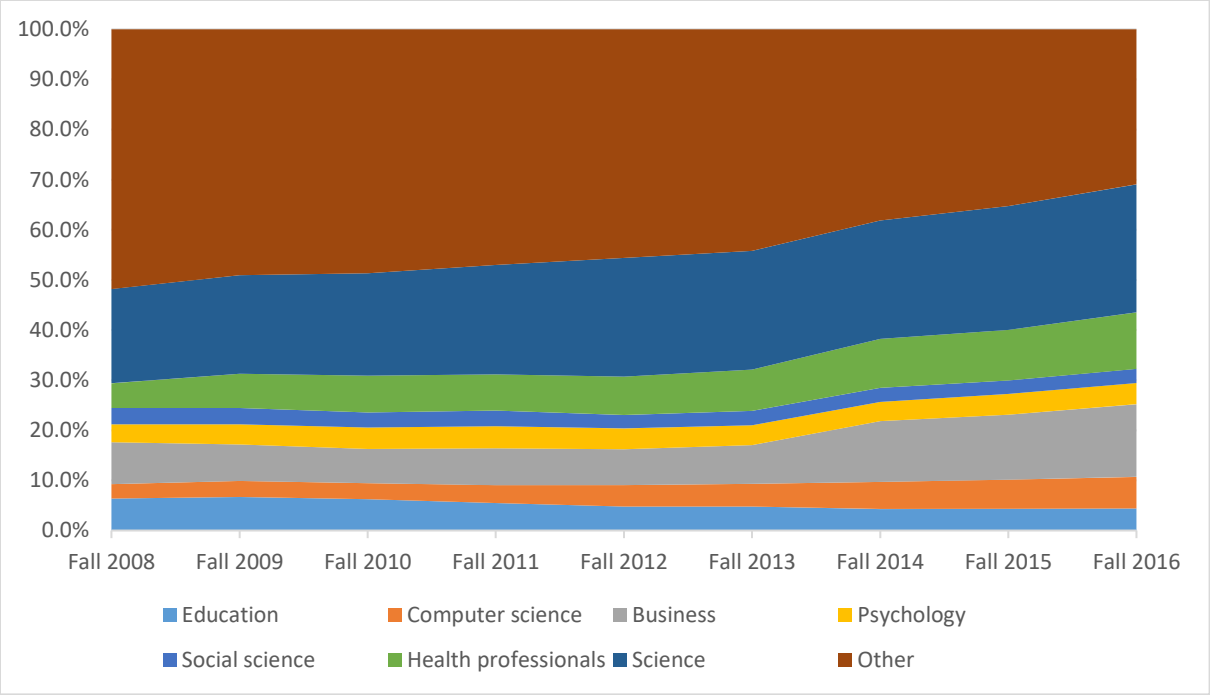

Figure 5: Shares of Enrollment in College Majors (2008-2016)

To examine the effect of pre-service performance assessment on students' college outcomes. I use a Difference-in-Differences (DID) model. I compare college outcomes of students with education major to the same outcomes for students with other majors, before and after the introduction of performance assessment in fall 2015. The DID model is specified as follows.

$$College\ outcomes_{ist} = \beta_0 + \beta_1\, Education\ major_i + \beta_2\, Performance\ assessment_t + \beta_3\, Performance\ assessment_t * Education\ major_i + \beta_4\, X_{ist} + Cohort_c + Institution_s + \varepsilon_{it}$$

where $Education\ major$ is a binary variable that takes 1 for students with education major and zero otherwise; $Performance\ assessment$ is also a binary variable that takes 1 for students attending college at the time of the implementation of performance assessment in fall 2015; the interaction term between E$ducation\ major$ and *performance assessment* represents the effect of

performance assessment on college outcomes of students with education majors relative to other students; X_{ist} is a vector of student-level characteristics such as demographic characteristics, high school GPA, and financial aid eligibility; $Cohort_c$, and $Institution_s$ represent cohort and institution fixed effects, respectively; and ε_{it} is an error term. All standard errors are clustered at the institution level.

3.5 Results

Teacher performance assessment may affect the decisions of students in education programs in three ways. First, edTPA performance assessment may discourage some individuals from choosing education as a major or lead them to change their education major. Second, edTPA may cause students to stay longer in college to prepare for the test, which may also delay their degree completion. Third, by increasing the barriers to becoming a teacher, edTPA may discourage some students in education programs from persisting in college. I explore these potential effects in tables 10-12. Table 10 presents the effects of teacher performance assessment on persistence into senior year of college, whereas tables 11 and 12 show the effects for change of college major between the first and senior years and degree completion within 4 years, respectively.

3.5.1 Persistence in College

Table 10 presents the effect of teacher performance assessment on students' college persistence, measured using a binary variable that indicates whether a student persists to his/her senior year of college. In all models, I include a set of cohort dummy variables that capture differences across different cohorts of college students. Standard errors are clustered at the institution level. Because scores on the SAT exam are only available for a subset of students in

the sample, I examine the effects of performance assessment on students' college outcomes with and without controlling for their SAT scores.

As shown in model 1, prior to the implementation of performance assessment in fall 2015, students with education majors were 1.5 percentage points more likely to persist into their senior year than students with other majors. The coefficient on the interaction term between *education major* and *performance assessment* is positive but not statistically significant, which suggests that the implementation of teacher performance assessment has no impact on persistence rate among students with education majors relative to other students.

Table 10: Effects of Teacher Performance Assessment on Persistence in College

VARIABLES	(1)	(2)	(3)
Education major	1.53*	2.86***	3.35***
	(0.88)	(0.69)	(0.60)
Performance assessment	-15.77***	-13.79***	-27.01***
	(1.66)	(1.52)	(3.48)
Education major * performance assessment	0.71	1.49	0.72
	(1.31)	(1.21)	(1.18)
Minority	-0.08	0.90	1.14
	(1.30)	(0.82)	(0.83)
Female	1.31**	2.59***	2.76***
	(0.55)	(0.62)	(0.69)
Year of birth	0.80***	0.58***	0.66**
	(0.22)	(0.20)	(0.24)
In-state resident	6.77***	9.86***	9.76***
	(1.77)	(1.21)	(1.31)
HS GPA	29.56***	21.00***	20.18***
	(1.50)	(1.65)	(1.57)
HS graduation year	0.05	0.08	2.60***
	(0.32)	(0.27)	(0.71)
Total financial aid (1st year)	0.03***	0.02**	0.02**

	(0.01)	(0.01)	(0.01)
Receive Pell grant (1st year)	-8.31***	-5.54***	-4.74***
	(0.88)	(0.83)	(0.84)
SAT math			0.01*
			(0.00)
Cohort FE	YES	YES	YES
Institution FE	NO	YES	YES
Observations	184,812	184,812	147,590
R-squared	0.13	0.15	0.15

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In model 2, I control for institution-level fixed effects to account for any time-invariant characteristics of postsecondary institutions that might affect student persistence in college. The coefficient on the interaction between *education major* and *performance assessment* is still positive and not statistically significant at the conventional levels. Model 3 shows the effects of performance assessment on college persistence after controlling for students' scores on the SAT math exam. Consistent with the first two models, the coefficient on education major is positive and highly significant, which suggests that, prior to 2015, education majors were more likely to persist into their senior year than students with other majors. However, there is no evidence that teacher performance assessment has affected college persistence of students with education major relative to other students.

The coefficients for the control variables have the expected sign. For instance, the results from table 10 show that female students are more likely than male students to persist in college by somewhere between 1.3 and 2.8 percentage points. Also, students who receive a Pell grant in their first year are less likely to persist in college than other students.

3.5.2 Attrition from Education Major

In table 11, I examine whether teacher performance assessment has increased attrition from education majors. In all models, the dependent variable is measured using a binary variable that takes 1 if a student has changed his/her major between first and senior years of college and zero otherwise.

Across all specifications, the coefficient on education major is negative and highly significant. This indicates that students with education majors were less likely to change their college majors compared to other students, prior to the implementation of performance in fall 2015. For example, model 1 shows that, prior to 2015, students in education programs were 8.9 percentage points less likely to change their college majors than other students. Estimates from models 1 and 2 show that the coefficient on the interaction term between *education major* and *performance assessment* is not statistically significant at the conventional levels which suggests that the introduction of teacher performance assessment has no impact on students' attrition from education majors relative to other students. The results from model 3, however, show that performance assessment is associated with a 4.2 percentage points decline in attrition from education major relative to other majors. This effect is only significant at the 10 percent level.

It should be noted that using change of college major as a dependent variable may be problematic, and, therefore, subject to measurement error. The reason is that, during a given semester, students may declare themselves in a specific major without satisfying the requirement for that major. In other words, change of college major does not imply that students have met or failed to meet certain requirements of a specific program.

Table 11: Effects of Teacher Performance Assessment on the Probability of Changing College Major

VARIABLES	(1)	(2)	(3)
Education major	-8.92***	-8.23***	-7.38***
	(1.50)	(1.44)	(1.42)
Performance assessment	-4.60**	-2.92	-11.82***
	(1.76)	(1.77)	(2.02)
Education major * performance assessment	-2.81	-2.09	-4.22*
	(2.59)	(2.35)	(2.34)
Minority	-5.79***	-3.05***	-2.81***
	(1.38)	(0.60)	(0.54)
Female	3.64**	2.96**	2.30**
	(1.61)	(1.09)	(1.00)
Year of birth	0.19	0.00	0.07
	(0.40)	(0.25)	(0.30)
In-state resident	10.70**	7.67***	7.72***
	(4.88)	(2.19)	(2.09)
HS GPA	8.78*	2.16	2.25
	(4.31)	(1.36)	(1.41)
HS graduation year	0.77	0.75**	2.42***
	(0.49)	(0.32)	(0.53)
Total financial aid (1st year)			-0.01**
			(0.01)
Receive Pell grant (1st year)	0.02*	0.01*	0.01
	(0.01)	(0.01)	(0.01)
SAT math	-3.38**	-1.29*	-0.86
	(1.53)	(0.67)	(0.75)
Cohort FE	YES	YES	YES
Institution FE	NO	YES	YES
Observations	184,812	184,812	147,590
R-squared	0.02	0.06	0.06
Robust standard errors in parentheses			

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.5.3 Degree Completion

Table 12 presents regression estimates for the effect of teacher performance assessment on the probability of graduating within four years. Across all models, students with an education major were more likely to graduate from college within four years compared to students with other majors, prior to fall 2015. For example, estimates from model 1 suggest that, prior to 2015, students with an education major were 4.7 percentage points more likely than other students to graduate from college within four years. This effect is robust across different specifications. The coefficient on the interaction terms between *education major* and *performance assessment*, however, is negative but cannot be distinguished from zero.

Table 12: Effects of Teacher Performance Assessment on Four-Year Degree Completion

VARIABLES	(1)	(2)	(3)
Education major	1.53*	5.59***	6.01***
	(0.88)	(0.95)	(0.82)
Performance assessment	-15.77***	2.28	-0.43
	(1.66)	(1.44)	(2.44)
Education major * performance assessment	0.71	1.92	2.07
	(1.31)	(1.47)	(1.67)
Minority	-0.08	-0.73	-0.35
	(1.30)	(1.04)	(1.12)
Female	1.31**	6.78***	8.40***
	(0.55)	(1.11)	(1.13)
Year of birth	0.80***	0.50**	0.56*
	(0.22)	(0.24)	(0.32)
In-state resident	6.77***	-2.44***	-1.77**
	(1.77)	(0.84)	(0.85)
HS GPA	29.56***	17.34***	16.84***

	(1.50)	(1.30)	(1.29)
HS graduation year	0.05	-0.79***	-0.35
	(0.32)	(0.28)	(0.41)
Total financial aid (1st year)	0.03***	-0.01	-0.00
	(0.01)	(0.00)	(0.00)
Receive Pell grant (1st year)	-8.31***	-4.14***	-3.85***
	(0.88)	(0.38)	(0.35)
SAT math			0.03***
			(0.00)
Cohort FE	YES	YES	YES
Institution FE	NO	YES	YES
Observations	184,812	184,812	147,590
R-squared	0.13	0.17	0.17

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.6 Sensitivity Analysis

In this section, I examine the sensitivity of the results to multiple sample restrictions and alternative specifications. In general, the results are consistent with the baseline analysis in section 5. There is no evidence the teacher prep performance assessment affects students' persistence in college, attrition from education majors, or the likelihood of graduating within 4 years.

3.6.1 *Changing the Control Group*

A major concern about the main results in section 5 is that students with education majors may be systematically different from other students. In fact, as shown in table 9, students with education majors differ from other students across most of the baseline characteristics such as race, age, and high school achievement. However, to the extent that the changes over time in

college outcomes are similar across both the treatment and the control groups, the differences in baseline characteristics between the two groups will not bias the estimates from the DID model. Nonetheless, I account for the differences between students in education majors and other students by following two approaches. First, I exclude individuals who majored in science from the control group. This includes all individuals who majored in Engineering & Technology, Architecture & Related Services, Biological & Biomedical Sciences, and Physical Sciences. The reason is that students who major in science tend to be very different from students who choose other majors in terms of both observable characteristics such as socio-economic status and college preparedness, and unobservable characteristics such as motivation. The regressions estimates from this specification are reported in column 1 of table 13. Consistent with the main analysis, there are no effects of performance assessment on college outcomes of students with education majors relative to other students.

Second, I use nearest neighbor propensity score matching (without caliper) to select a control group that looks similar to the treatment group in terms of baseline characteristics.[17] Table A5 in the appendix shows the average marginal effects from the propensity score equation whereas figure A2 compares the pre-and post-matching standardized bias from the PSM model.[18] Overall, the average standardized bias is reduced by more than 94% after matching. The

[17] First, I use nearest neighbor Propensity Score Matching (PSM) to estimate propensity scores for individuals in the sample using the following variables: race, gender, age, high school GPA, year of graduation from high school, residency status, score on SAT math exam, eligibility for financial aid, in addition to cohort and institution fixed effects. Then, I assign a propensity score weight for each individual. The propensity score weight is equal to 1 for students in education programs and $e_i/(1-e_i)$ for students with other majors, where e_i is the propensity score for individual i estimated by the PSM model. The effect of teacher performance assessment is then estimated using a DID model that incorporates propensity score weights.

18 Standardized bias represents the standardized difference in mean characteristics between eligible and ineligible students. It is calculated for each covariate (represented by a horizontal line in Fig. A2) included in the eligibility equation before and after matching.

estimates from the PSM model are shown in column 2 in table 13. The results suggest that teacher prep performance assessment doesn't affect students' college outcomes.

3.6.2 *Excluding Students Who Change their Majors*

Another concern about the main results in section 3.5 is that students may change their major during the course of their postsecondary education. Therefore, the binary variable on education major may be measured with error. This may bias the effects of performance assessment on college persistence and degree attainment. To account for this limitation, I restrict the sample to students who did not change their major and re-estimate the effects of performance assessment on these two outcomes.

Table 13: Sensitivity of Results to Choice of the Control Group

	(1)	(2)
	Exclude Science Majors	Matched Control Group
College Persistence	1.63	1.73
	(1.20)	(1.29)
Attrition from Education Majors	-2.68	-2.24
	(2.41)	(2.29)
Graduating Within 4 Years	1.28	1.93
	(1.50)	(1.36)
Sample size	141,787	184,812

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses

As shown in table 14, there is no effect of performance assessment on either college persistence or the likelihood of graduating with four years among students with education majors. These results are consistent with the main effects in tables 10 and 12.

Table 14: Sensitivity of Results to Excluding Students Who Changed their Majors

VARIABLES	(1) College Persistence	(2) Graduation Within 4 Years
Education Major * Performance Assessment	1.08	0.93
	(1.68)	(1.23)
Observations	94,014	94,014
R-squared	0.1967	0.1747

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses

3.6.3 *Pre-treatment Trends*

A key assumption of the DID is that both the treatment and control groups have similar trends overtime. That is, changes in college outcomes for students in education programs are similar to the changes in outcomes for other students. If the DID assumption is plausible, then there should not be significant differences in outcomes between students with education major and other students among pre-treatment cohorts. However, if these differences exist, then the observable effect of performance assessment may be due to pre-existing differences between the two groups. To test the validity of this assumption, I include a set of interaction terms between the binary variable on education major and school year dummies. Using this set of interaction terms, I examine whether a) the parallel trend assumption is plausible by assessing whether the pre-treatment trends are similar for both the treatment and control groups; and b) the announcement of the new performance requirements prior to its implementation in fall 2015 has any impact on students' college outcomes.

Figure 6 shows the regression coefficients on the interaction terms between education major and each school year dummy, along with 95 percent confidence intervals. It should be

noted that the outcomes observed for each school year represent 4-year outcomes. For example, college persistence observed in school year 2012-13 represents the persistence of students who started college in 2009-10 into their senior year. The base year in figure 2 is school year 2011-12. As can be seen, the differences between the treatment and control groups in the pre-treatment period are not statistically significant which suggests that the two groups have very similar trends prior to the introduction on performance assessment. In addition, consistent with the results from the main analysis, teacher prep performance has no effect on persistence into senior year of college, attrition from education majors, or graduation within four years.

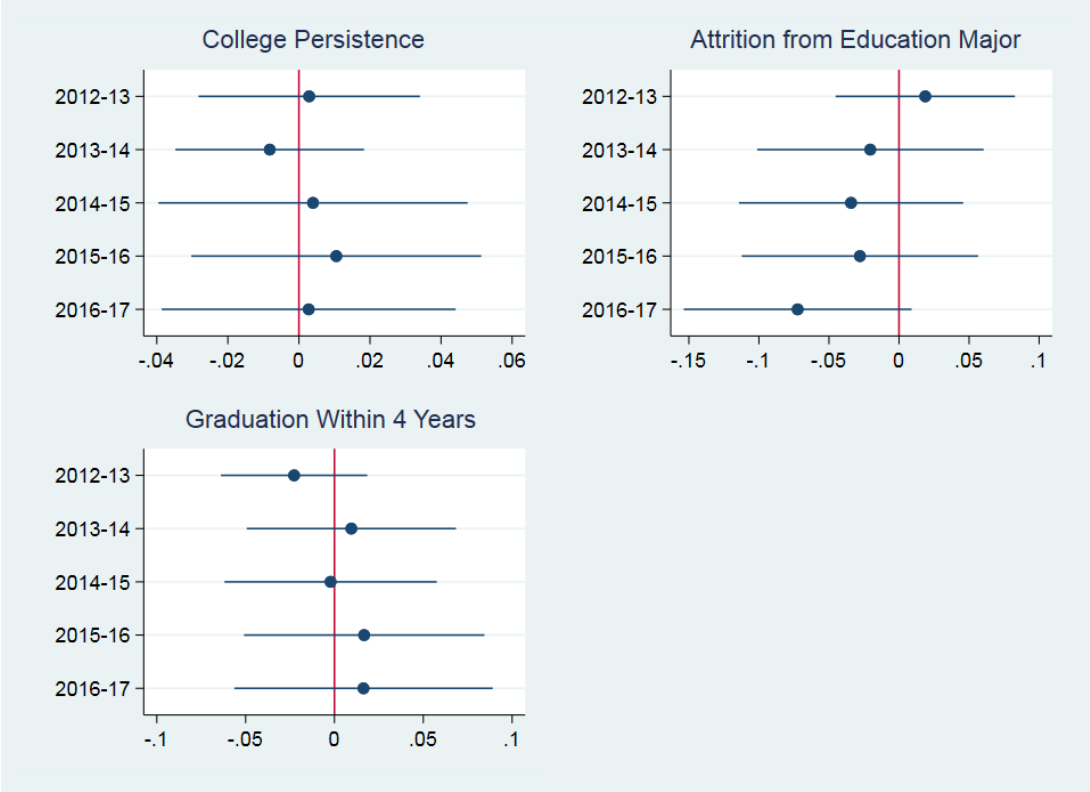

Figure 6: Effects of Teacher Prep Assessment on College Outcomes
Note: The base years is 2011-12.

3.7 Subgroup Analysis

This section examines whether the effects of teacher performance assessment vary based on students' demographic characteristics and high school achievement. First, I examine the extent to which performance assessment has affected the college outcomes of students who are underrepresented in education programs: male students and minority students. Table 15 presents the coefficients on the interaction term between education major and performance assessment for each outcome. Columns 1 and 2 provide the results for minority and white students while columns 3 and 4 show the results for male and female students, respectively. Across all different subgroups of college students, there is no evidence that teacher performance assessment affects students' persistence into their senior year, attrition from education major, or the likelihood of graduating within four years.

Table 15: Heterogeneous Effects of Teacher Performance Assessment by Race and Gender

	Race		Gender	
	(1)	(2)	(3)	(4)
	Minority	White	Male	Female
College Persistence	1.18	1.85	2.38	0.87
	(1.64)	(1.46)	(2.27)	(1.32)
Attrition from Education Majors	-1.16	-2.70	-2.71	-1.62
	(2.55)	(2.83)	(2.44)	(2.70)
Graduating Within 4 Years	0.10	3.17	1.42	2.03
	(1.43)	(1.88)	(1.19)	(1.64)
Sample size	83,295	101,517	82,676	102,136

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses

In table 16, I examine whether increasing the costs of becoming a teacher by imposing new performance requirements has discouraged highly talented individuals from choosing education majors. Using students' high school GPA, I create four binary variables that

distinguish between students in the first, second, third, and fourth quartile of the GPA distribution. Then, I estimate the effect of performance assessment for each of the four groups. Overall, the results show no effects of performance assessment on college outcomes of students in the bottom 50 percent of the high school GPA distribution. Students in the top 25 percent are also not affected by the implementation of teacher prep performance assessment. There is some evidence, however, that performance assessment is associated with an increase in college persistence among students in the third quartile of the GPA distribution. Estimates from table 16 also indicate that performance assessment is associated with a decline in attrition from education major among this group of students. This effect, however, is only significant at the 10 percent level.

Table 16: Effects of Teacher Performance Assessment by High School Achievement

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
College Persistence	-2.13	2.07	5.55***	-0.76
	(1.77)	(2.20)	(1.54)	(1.45)
Attrition from Education Majors	-3.22	0.93	-5.48*	-1.60
	(3.36)	(2.45)	(2.85)	(3.91)
Graduating Within 4 Years	-0.35	1.54	2.34	3.22
	(0.63)	(1.51)	(2.32)	(4.16)
Sample size	48,181	47,703	46,103	42,825

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses

3.8 Conclusion

This paper examines the effect of teacher performance assessment on college outcomes of students with education major relative to other students. I use administrative data from the University System of Georgia (USG) that includes information on students who started their

postsecondary education in Georgia between academic years 2008-09 and 2016-17. To examine the effect of teacher performance assessment on college outcomes, I use a difference-in-differences approach in which I compare the outcomes of students with education major to the same outcomes for students with no education major before and after the introduction of teacher performance assessment in Georgia in fall 2015.

The results from this essay suggest that teacher prep performance assessment has no effects on students' college persistence, attrition from education majors, or the likelihood of graduating within four years. These findings are consistent across different robustness checks. For example, when excluding students who majored in sciences from the control group, I still find no effect of teacher performance assessment on students' college outcomes. I also find no effect of the new performance assessment requirements on the outcomes of students who are underrepresented in education programs such as minority and male students.

These findings have important policy implications. First, the results suggest that teacher performance assessment has no impact on the compositions of students in education majors. This indicates that one of key assumptions behind the implementing performance assessment, i.e., teacher performance assessment serves as a "screening tool" that keeps less qualified teacher candidates out of the profession, is not supported by the findings from this chapter. These null effects, however, do not necessarily suggest that performance assessment does not affect teacher quality. It only indicates that performance assessment doesn't deter less qualified candidates from choosing education as a major. Teacher performance assessment may improve teacher quality through other channels that are not tested in this chapter. For example, performance assessment may ensure that newly certified teachers can meet minimum performance standards as measured by the edTPA assessment which might improve teacher quality. Teacher

performance assessment may also help preparation programs identify whether their teaching practices or curriculum are effective at preparing candidates to succeed in the classroom.

Second, critics of teacher performance assessment argue that it increases the barriers of becoming a teacher and, therefore, disproportionately affects specific subgroups of teacher candidates, such as minority individuals. The findings from this chapter, however, indicate that the effects of performance assessment are similar across all students, i.e., the introduction of teacher performance assessment doesn't negatively affect college outcomes of students who are underrepresented in education programs such as male students and minority students.

These results, however, should be interpreted with cautious for several reasons. First, the effects of teacher performance assessment may be driven by policy changes that happened at the same time of implementing the new performance requirements in fall 2015. Second, the results could also be affected by any unobservable time-variant factors that affect students' college outcomes. To the extent that these unobservable factors affect both the treatment and control in similar ways, the results from the DID model will not be biased. However, if these time-variant factors have disproportionate effects on students in education programs, then the estimates from the DID model will be biased. Third, this essay focuses mainly on the short-term effects of performance assessment requirements since these requirements are still in its early stages of implementation. As a result, the effects of performance assessment may change as teacher candidates and educator programs become more familiar with the new performance assessment.

Chapter IV: Former Teachers: Who They Are, Why They Leave and What Factors Affect Their Decisions to Come Back

4.1 Introduction

Research on the teacher labor market has largely focused on the career choices of current teachers (Boyd et al. 2005b, Hanushek, Kain, and Rivkin 2004b). Student socio-economic characteristics, schools' working conditions, and teacher qualifications seem to be key determinants of teacher mobility and attrition. Teachers are more likely to leave schools with large shares of low-income and minority students. Little is known on the labor supply decisions of former teachers.

The lack of evidence on the supply decisions of former teachers is problematic for several reasons. First, former teachers represent an important source of teacher supply in the United States. For example, according to the School and Staffing Survey (SASS), former teachers represented 49 percent of teachers entering the teaching workforce in school year 2011-12.[19] Second, the costs and uncertainty associated with hiring former teachers are likely to be lower than those associated with hiring new teachers, because hiring authorities can rely on the past performance to assess their quality.

Third, demand for teachers is expected to grow during the next decade due to both increased student enrollment and high attrition rates among current teachers. For example, the school-going population is expected to increase in the next decade by roughly 3 million students (Sutcher, Darling-Hammond, and Carver-Thomas 2016). However, about 8 percent of the teaching workforce exit annually, which puts pressure on schools to hire new teachers. The increase in demand for teachers doesn't pose a serious challenge to schools as long as there are

[19] In school year 2007-08, former teachers represented 37 percent of those entering the teaching workforce.

enough new teachers to fill teaching vacancies. However, between 2008-09 and 2014-15, the number of individuals attending teacher preparation programs declined by 42 percent, and the number who completed these programs declined by over 23 percent. In addition, data from ACT entrance exam indicates that high school students are showing less interest in teaching. In 2014, for example, only 5 percent of high school students who took the ACT exam expressed an interest in pursuing education as a profession, compared to 34 percent in 2010 (ACT 2015).

Former teachers represent a potentially significant source of teacher supply that school district can rely on to meet the expected increase in demand for teachers. Compared to other college-educated workers, teachers are more likely to return to their profession after their initial exit. (Flyer and Rosen, 1997). Between 25 percent and 33 percent of teachers who exit return to teaching (DeAngelis and Presley 2007, Stinebrickner 2002).

This essay examines three main research questions:

- What are the demographic and socio-economic characteristics of former teachers?
- Why do teachers leave their profession and what are their post-teaching career paths?
- What are factors that affect the decisions of former teachers to return to teaching?

To answer these questions, I use a restricted-use data from the Beginning Teacher Longitudinal Study (BTLS) administered by the U.S. Department of Education. The BLTS follows a cohort of first-time teachers for five years, starting from school year 2007-08. The survey collects information on schools' characteristics, teachers' demographic and socio-economic characteristics, and teacher labor market outcomes. The results suggest that about 25

percent of teachers left the profession during the first 5 years of their career, 38 percent of them after the first year. About 18 percent of former teachers reported leaving teaching because of pregnancy or to care for a child. However, the majority of those who left teaching reported other reasons. For example, 7 percent have left to look for jobs with better financial benefits and 18 percent have left because of dissatisfaction with schools, students or school environment in general. Out of those who left teaching at any point during the 5-year study period, 29 percent still work in the field of education, 20 percent are working outside the field of education, 16 percent are unemployed, and 35 percent are out of labor force.

Also, 23 percent of all leavers return to teaching at least once during the 5-year study period. Former teachers who work in large schools, high schools, and schools with large percentages of minority students are less likely to return to teaching after their initial exit. Highly paid teachers are also more likely to re-enter teaching: A one-thousand-dollar increase in school salary increases the likelihood of returning to teaching by 0.5 percentage points. The findings also indicate that teachers who left schools because of pregnancy or change in residence are also more likely to re-enter the profession.

4.2 Literature Review

Previous research on the teacher labor markets has mainly focused on career choices of current teachers. In general, student characteristics, teacher quality, early-career experience, and alternative certification are key determinants of teacher mobility, retention, and attrition. For example, using data on Texas elementary public schools, Hanushek et al. (2004a) found that schools with large numbers of minority and academically disadvantaged students tend to lose a higher fraction of teachers each year, especially among white teachers. Scafidi et al. (2007) found that teachers in public elementary schools in Georgia are more likely to leave schools with

lower test scores and schools with large shares of low-income and minority students. Other studies reached similar conclusions (Boyd et al. 2005a).

One potential explanation for the high turnover of teachers in high-poverty schools is the working conditions within these schools (Boyd et al. 2011, Johnson, Kraft, and Papay 2012, Ladd 2011, Loeb, Darling-Hammond, and Luczak 2005). Loeb et al. (2005) found that teacher salaries, class size, facilities, school resources, and other working conditions are strong predictors of teacher turnover in California. They also found that controlling for working conditions diminished the effect of student characteristics on teacher turnover significantly. Using data from Massachusetts, Johnson et al. (2012) found that most of the effect of student demographics on teacher turnover can be explained by differences in school culture, principal's leadership, and relationship among colleagues. Ladd (2011) also found that perceptions of working conditions account for 15 percent of the variation in actual departure rates. Teacher salaries play a key role in determining teacher mobility (Imazeki 2005, Kirby, Berends, and Naftel 1999). For example, using data on public school teachers in Texas, Kirby et al. (1999) found that a $1,000 increase in teacher salary reduced attrition by 2.9 percent. Imazeki (2005) also found that increasing teacher salaries in Wisconsin reduces attrition among new teachers.

Teachers with high pre-service qualifications (measured by their ACT score, certification level, and educational attainment) are more likely to leave schools with large shares of poor and low-performing students than less qualified teachers (Lankford, Loeb, and Wyckoff 2002, Podgursky, Monroe, and Watson 2004b). For example, Podgursky et al. (2004b) and Lankford et al. (2002) found that less qualified teachers in Missouri and New York State, respectively, tend to sort into low-income and minority schools, especially those in urban areas. Their results also indicate that highly qualified teachers have higher turnover rate than other teachers. Using data

from the Schooling and Staffing Survey (SASS), Ingersoll et al. (2014) found that teachers with more training in teaching methods and pedagogy-- especially practice teaching, observation of other classroom teaching and feedback on their own teaching—were far less likely to leave teaching after their first year on the job. However, they found no evidence that college selectivity, educational degree, or certification type affect teacher retention.

Teacher quality also plays a role in teacher mobility. Previous research suggests that high-quality teachers, measured using teacher value added, are less likely to leave schools and the teaching profession in general (Boyd et al. 2011, Goldhaber, Gross, and Player 2011, Hanushek and Rivkin 2010, Krieg 2006). For example, Krieg (2006) found that fourth-grade teachers in Washington State with high value-added scores are less likely to leave schools. Similarly, using data on elementary and middle school teachers in New York City, Boyd et al. (2008) found that first-year high-quality teachers have lower probability of leaving public schools in both low-achieving and high-achieving schools. Goldhaber et al. (2011) found that teachers in the lowest quintile of the performance distribution have higher probabilities of moving to another school within a district, changing school district, and leaving the public school system. Feng and Sass (2017) found no evidence that teacher quality affects teacher mobility within or across districts in Florida. They found, however, that teachers from both the top and lowest quartiles are more likely to leave the public school sector than teachers from the middle of the quality distribution. Their results also suggest that teacher mobility tends to increase the achievement gap between white and minority students and between poor and more affluent students.

The effect of performance pay on teacher retention and mobility is inconclusive (Podgursky and Springer 2007). While some studies have found performance pay has a positive

impact on the retention of high-quality teachers (Dee and Wyckoff 2015), results from other studies question this effect (Glazerman and Seifullah 2012). For example, Dee and Wyckoff (2015) found that a teacher evaluation system in Washington D.C., called IMPACT, has increased the turnover of low-performing teachers by 11 percentage points. In contrast, Glazerman and Seifullah (2012) found no consistent effects of the Chicago Teacher Advancement Program (Chicago TAP) on teacher retention.

In addition to performance pay, alternative certification also affects teachers' mobility and attrition. Prior research has shown that alternatively certified teachers tend to have higher attrition rates than traditionally certified teachers. Using data on all teachers from New York City between from 2000-01 to 2007-08, Boyd et al. (2012) found that teachers from the Teach For America (TFA) program are more likely than other teachers to transfer or exit teaching, after their second and third year in teaching. For example, they found that, after year 3, 67 percent of TFA teachers exit teaching, compared to 31 percent for teachers from the NYC Teaching Fellows program and 20 percent for traditionally certified teachers. Using national data from the SASS survey, Redding & Smith (2016) found that, by school year 2007-08, alternatively certified teacher were 10 percentage points more likely to exit school than teachers from traditional programs within 8 years, a gap that persists even after controlling for several teacher and school characteristics.

Despite the large literature on teacher mobility and retention, few studies have examined the labor supply decisions of former teachers. For example, DeAngelis and Presley (2007) found that, in Illinois, more than a third of new teachers that leave eventually return to teaching; between 8 and 17 percent return after just one year. Beaudin (1993) found that the likelihood of

returning to teaching was lower for teachers in subject areas with high opportunity costs (e.g., physical sciences and mathematics), and less experienced, younger teachers.

Using data from the National Longitudinal Survey of the High School Class of 1972 (NLS-72), Stinebrickner (2002) found that about one third of teachers who exit teaching return to the profession within five years. He also found that the decision to leave teaching is mainly driven by changes in teachers' family circumstances, especially the birth of a child. Grissom and Reininger (2012) found that more experienced teachers, as well as women, are more likely to return to teaching.

4.3 Data

The data for this study come from the Beginning Teacher Longitudinal Study (BTLS) administered by the U.S. Department of Education. The BLTS follows a cohort of first-time teachers for five years, starting in 2007-08. The survey collects information on schools' characteristics, teachers' demographic and socio-economic characteristics, and teacher labor market outcomes. In this chapter, I examine the characteristics of teachers who exit teaching during their early career in addition to the key determinants that affect their likelihood of returning to the profession.

The dependent variable is re-entry into teaching. I measure this variable using a binary variable that indicates whether former teachers have returned to teaching in a given year after their initial exit. This includes teachers who returned to teaching in public or private schools. I examine the effects of six groups of independent variables on former teachers' decisions to return to their profession: teachers' demographic characteristics, pre-service qualifications, schools' characteristics, former teachers' reported reasons for leaving teaching and current occupational status, and economic conditions within a state.

The first group includes *teachers' demographic characteristics*, measured using teachers' age, gender, and race. The second group includes *teachers' pre-service qualifications* which are measured using teachers' certification level, college major, and type of postsecondary degrees. Certification level is coded as 1 for alternatively certified teachers and zero otherwise. College majors is measured using a binary variable that takes 1 for teachers with education major and zero otherwise while postsecondary degree is also measured using a binary variable that takes 1 for teachers who have BA degree only and zero otherwise.

The third group of independent variables includes *schools' characteristics* such as school enrollment, shares of minority teachers and students, student-teacher ratio, teachers' base salary, in addition to two binary variables that indicate whether a school is charter or secondary school, respectively. The fourth group of variables describes the *current occupational status of former teachers*, measured using five binary variables that indicate whether former teachers are currently unemployed, caring for a family member, working outside the field of education, working inside the field of education, or reported other activity.

I also examine whether former teachers' *reported reasons for leaving teaching* predict their likelihood of returning to the profession. This group includes six binary variables that indicate whether former teachers exit their profession due to contract non-renewal, financial needs, change in residence, pregnancy, dissatisfaction with teaching; to pursue positions other than teaching; or for other reasons. The last group of variables, *state's economic conditions,* examines whether economic conditions within a state affect former teachers' likelihood of reentering teaching after their initial exit. This group includes state median wage, unemployment rate, and teacher median wage.

Table 17 presents summary statistics for the full sample. Panel (A) shows characteristics of teachers while panel (B) provides characteristics of schools. As shown in panel (A), 68 percent of teachers in the sample are females and 90 percent are white. The average age in the sample is 35 years. About 28 percent of teachers are alternatively certified, 63 percent graduated from education programs, and 75 percent have a Bachelor degree only. The average teacher salary is $33,622 in 2008 dollars. Overall, about 51 percent of schools in the sample are secondary schools and 6 percent are charter schools. Table 17 also shows that, during the 5-year period of the BTLS survey, 25 percent of teachers left teaching and 6 percent returned to the professions after their initial exit.

Figure 7 depicts the share of teachers who left, stayed, moved, or returned to teaching during each wave of the BTLS survey, out of all teachers in the sample. As shown, in school year 2008-09, 68 percent of teachers stayed in their schools, 15 percent moved to another school, and 10 percent exit teaching. Over time, the share of teachers who stayed in their schools has declined while the share of teachers who left teaching has increased. For example, between school year 2008-09 and 2011-12, the percentage of teachers who stayed in the same school decreased from 68 percent to 53 percent whereas the percentage of leavers has increased from 10 percent to 17 percent. A small percentage of teachers (2 percent) in the sample have returned to teaching after their initial exit.

Table 17: Summary Statistics

Variable	Mean	Std. Dev.
A) Teacher-level Characteristics		
Female	67.9	-
White	89.8	-
Age	34.6	8.6
Alternative certification	27.5	-
Education major	63	-

BA degree	74.3	-
Teacher salary	$33,622	$7,450
Leaver	24.8	-
Returner	5.6	-
B) School-level Characteristics		
School enrollment	781.4	634.2
% Minority teachers	14.8	22.3
% Minority students	42.2	35.2
Student-teacher ratio	14.8	5.3
Secondary school	51.2	50.0
Charter school	5.8	23.3
Sample size	1990	

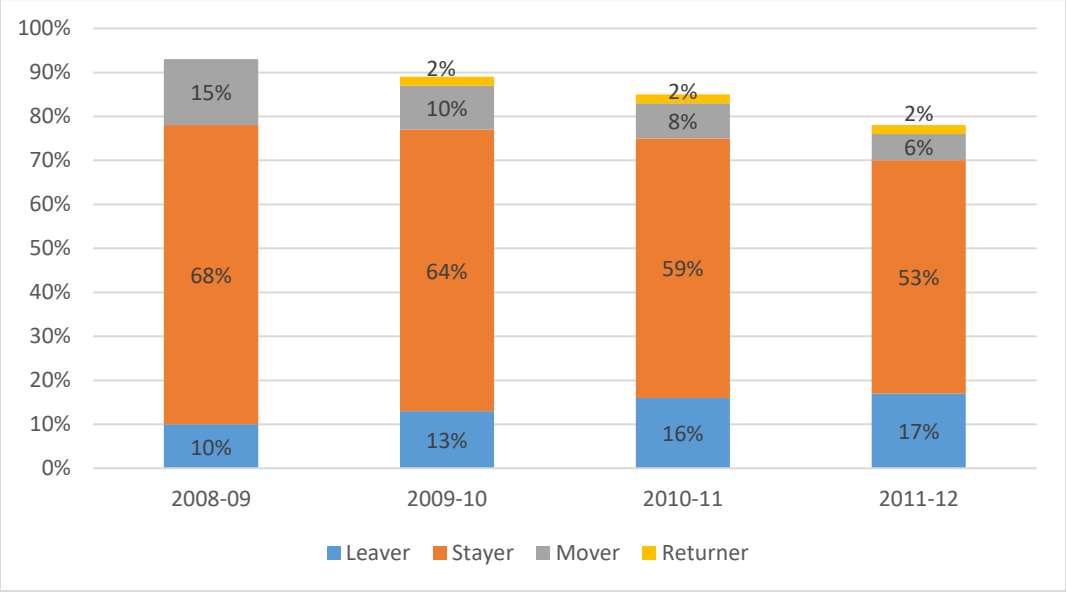

Figure 7: Shares of Stayers, Movers, Leavers, and Returners per Survey Wave

Figure A3 in the appendix depicts the share of former teachers who left during each wave of the BTLS survey, out of all teachers who exit teaching during the 5-year period. As shown, a large portion of those who left teaching exit the profession after the first year. For example, 38 percent of all leavers exit teaching after the first year (wave 2 leavers), compared to 24 percent after the second year (wave 3 leavers), 22 percent after the third year (wave 4 leavers) and 15 percent after the fourth year (wave 5 leavers). Figure A4 shows the share of teachers who

returned to teaching out of all teachers who left the profession during the first 5 years. As can be seen, out of all leavers, 23 percent returned to teaching at one point during the study period. Out of which, 37 percent returned during the third year (wave 3 returners), 31 percent returned during the fourth year (wave 4 returners), and 32 percent returned during the fifth year (wave 5 returners).

Table 18 presents the percentage of former teachers who returned during each of the last three years of the survey period (school years 2009-10 to 2011-12) for each cohort of leavers. For example, column 1 provides the percentage of wave 2 leavers; i.e., those who left after the first year, who returned in the 3rd, 4th, or 5th year of the survey. As shown, 23 percent of wave 2 leavers returned to teaching in wave 3 (i.e., in school year 2009-10), 8 percent returned in wave 4 and 3 percent returned in wave 5. Overall, 33 percent of those who left teaching after school year 2007-08 returned during the last three years of the survey. Similarly, 25 percent of those who left teaching after school year 2008-09 (wave 3 leavers) returned in school years 2010-11 and 2011-12 (waves 4 and 5) whereas 21 percent of those who left after school year 2009-10 (wave 4 leavers) returned in school year 2011-12.

Table 18: Returners by Each Cohort of Leavers

	Leavers		
	(1)	(2)	(3)
Returner	Wave 2 (Left after 2007-08)	Wave 3 (Left after 2008-09)	Wave 4 (Left after 2009-10)
Wave 3 (2009-10)	22.6	-	-
Wave 4 (2010-11)	7.9	17.8	-
Wave 5 (2011-12)	2.6	7.6	20.7
Sample size	190	120	110

4.3.1 Who Leaves Teaching and Why?

Table 19 provides mean differences between teachers who left at any time during the BTLS 5-year period (leavers) and teachers who stayed in the profession (stayers). Minority teachers, alternatively certified teachers, teachers who didn't major in education, and teachers with more than a BA degree are more likely to leave teaching. Table 19 also shows that teachers who work in charter schools or schools with large numbers of minority students and teachers are more likely to exit teaching.

Table 19: Mean Differences between Leavers and Stayers

	Leaver	Stayer	
Female	67.8	68.0	
White	87.2	90.6	***
Age	35.6	34.2	***
Alter certification	29.6	26.8	***
Education major	57.3	64.8	***
BA degree	74.3	78.5	***
Teacher salary	32,800	33,900	***
School enrollment	837.7	741.8	***
% Minority teachers	18.5	14.3	***
% Minority students	48.1	41.6	***
Student-teacher ratio	15.0	14.9	***
Secondary school	53.0	53.3	***
Charter school	10.1	5.1	***
Sample size	490	1500	

Note: Asterisks indicate significant differences at the conventional levels. *** p<0.01, ** p<0.05, * p<0.1

As shown in figure 8, about 18 percent of all leavers have left because of pregnancy or to care for a child, but 82 percent left for other reasons. For example, 12 percent left because they moved, 7 percent have left to look for jobs with better financial benefits, and 18 percent have left because of dissatisfaction with schools, students or school environment in general. Also, more than 31 percent of teachers have left for other reasons such as retiring, having concern about job

security, not being able to pass the required test(s), or taking courses to improve career opportunities.[20]

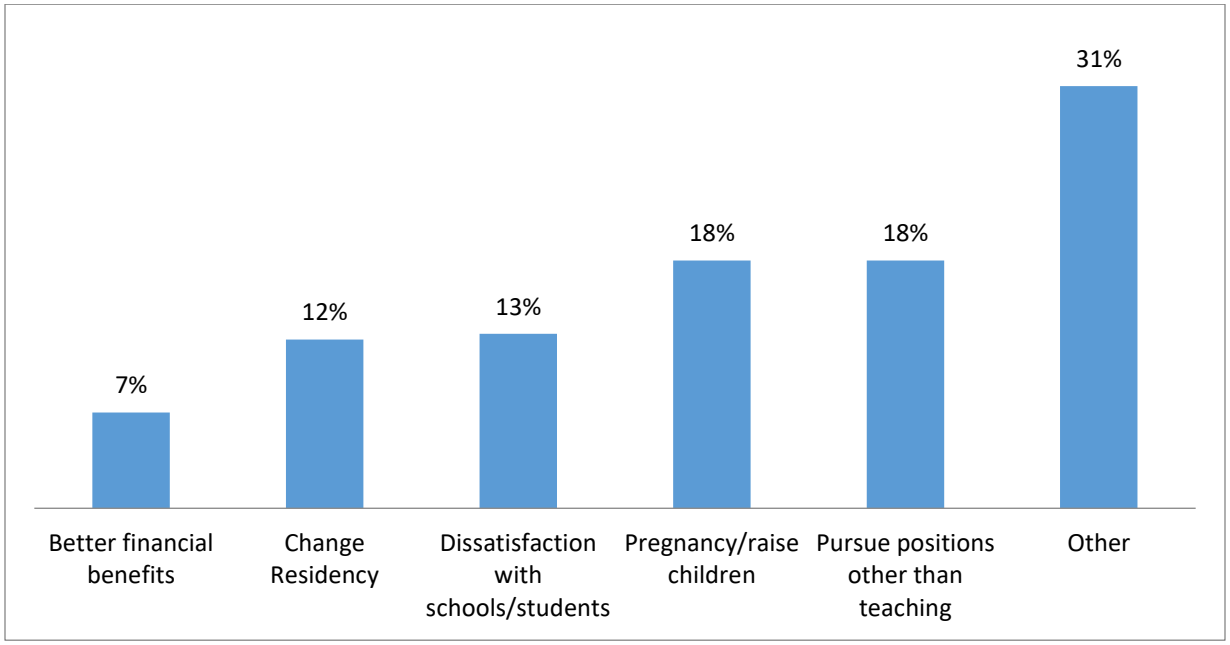

Figure 8: Most Important Reasons for Leaving Teaching
Note: Out of all leavers, only 49 percent reported their reasons for leaving teaching.

Figure 9 shows the most important reasons for leaving teaching that are reported for each wave of leavers. As can be seen, the percentage of those who left teaching because of dissatisfaction with schools/students or school environment, in general, has increased sharply overtime. Only 7 percent of wave 2 leavers reported leaving because of dissatisfaction with their schools compared to 27 percent of wave 3 and wave 4 leavers. Similarly, the percentage of teachers who left because of pregnancy or to care for a child has increased from 15 percent in wave 2 to 20 percent and 22 percent among leavers in waves 3 and wave 4 respectively. In contrast, the percentage of former teachers who leave to look for jobs with better financial benefits has declined from 15 in wave 3 percent to 12 percent in wave 4.

[20] About 28 percent of all leavers exit teaching because their contracts were not renewed. Figure A5 in the appendix shows the share of former teachers who left due to contract non-renewal during each wave.

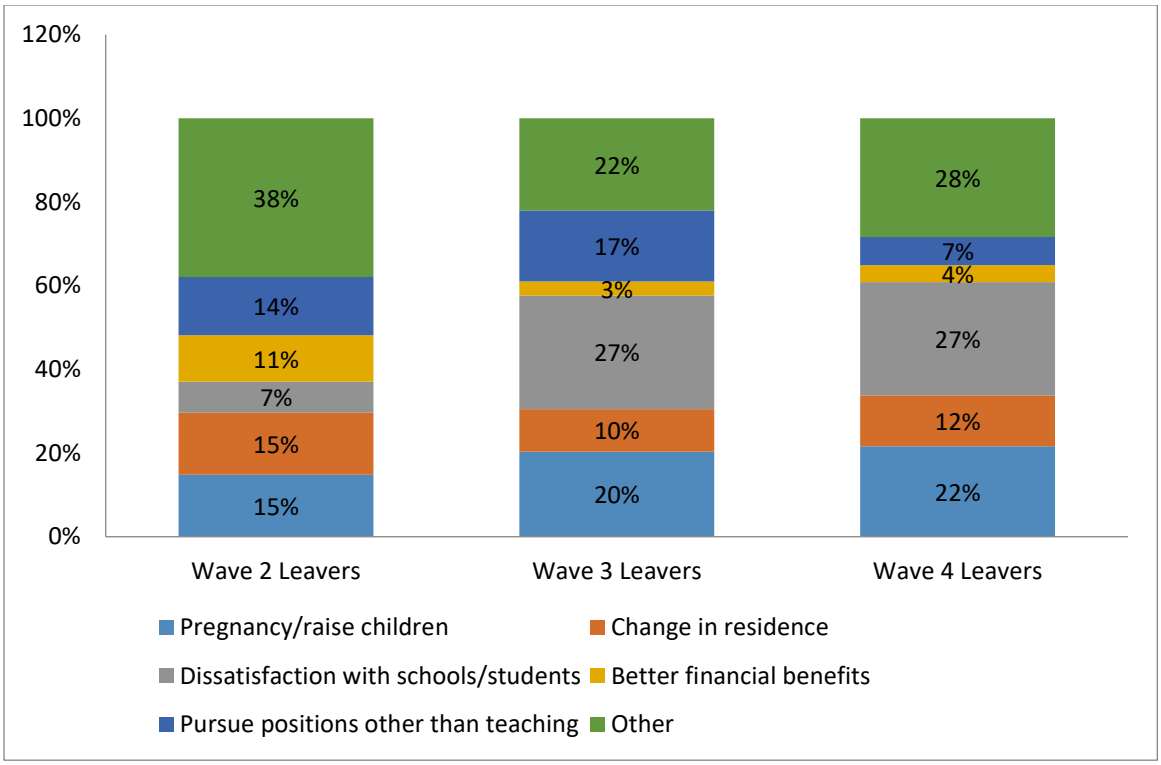

Figure 9: Most Important Reasons for Leaving Teaching by Wave

4.3.2 Employment and Occupational Statuses of Former Teachers

Table 20 presents the employment and occupational statuses of all leavers in the sample. Out of those who left teaching at any point during the 5-year study period, 29 percent still work in the field of education, either in non-regular K-12 teaching position in a school or a school district or in a position in the field of pre-k or postsecondary education. About 20 percent are working outside the field of education, 16 percent are unemployed, and 35 percent are out of the labor force.

Figure 10 shows the current occupational status for each wave of leavers. As shown, among those who left after the first year (wave 2 leavers), 25 percent work inside the field of education, 21 percent have a job outside the field, 11 percent are currently caring for a family member, and 17 percent are unemployed. The figure also shows that compared to wave 2 leavers, wave 3 and wave 4 leavers are less likely to be unemployed and more likely to work

inside the field of education. That is, the longer you have been teaching, the more likely you are to work again as a teacher rather than in an alternative occupation.

Table 20: Primary Activity of Former Teachers

In labor force	
Working for a school or school district in a non-teaching position	21.9
Working in a position in the field of pre-K or postsecondary education	7.1
Occupation outside the field of education	20.4
Unemployed	16.4
Out of the labor force	
Caring for a family member	8.7
Student at College or University	10.5
Retired/disabled	1.0
Others	10.7

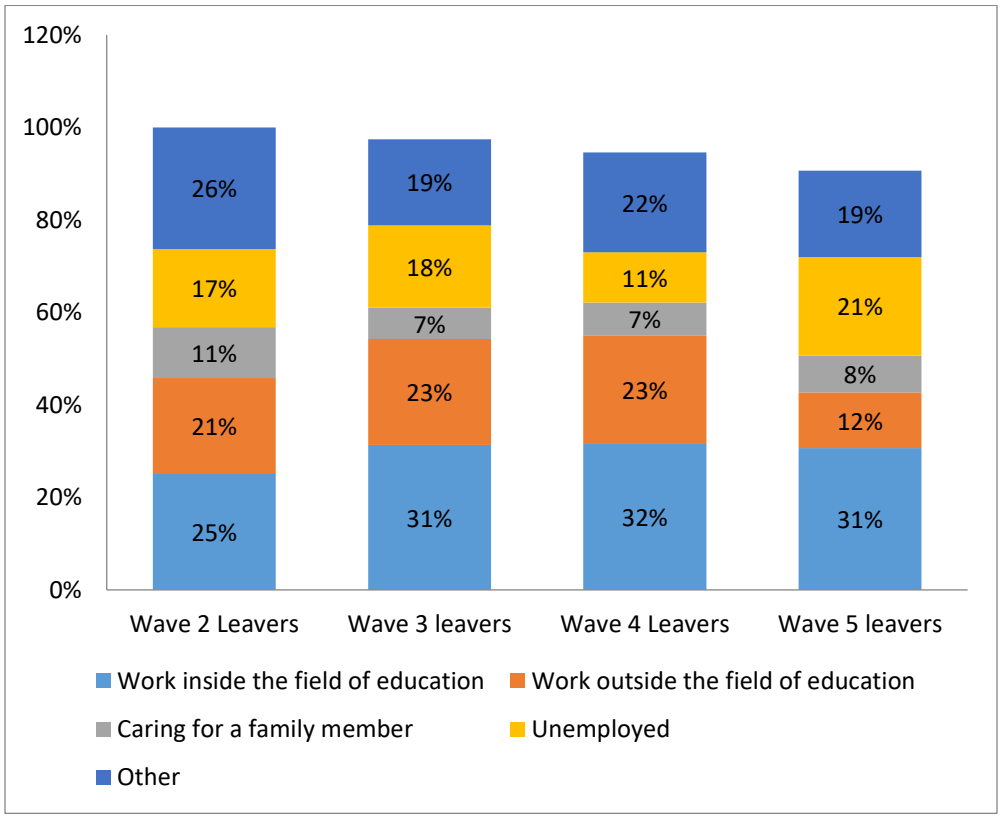

Figure 10: Occupational Status of Former Teachers by Wave

4.3.3 Who Returns to Teaching?

Table 21 presents the differences in mean characteristics between former teachers who return to the profession and those who do not. As shown, female teachers, traditionally certified teachers, and teachers with education major are more likely to return to teaching, but teachers who work in large schools and high schools are less likely to re-enter teaching.

Table 21: Mean Differences between Returners and Never-Returners

	Returned		
	Yes	No	
Female	75.9	65.4	**
White	88.4	86.9	
Age	34.3	36.0	
Alter certification	23.2	31.4	*
Education major	68.9	53.9	***
BA degree	67.9	76.2	**
Teacher salary	33,465.4	32,622.1	
School-level characteristics			
School enrollment	637.4	772.4	**
% Minority teachers	15.9	19.2	
% Minority students	45.0	49.0	
Student-teacher ration	14.7	15.0	
Secondary school	38.4	57.3	***
Charter school	7.1	11.0	
Reasons for leaving			
Financial reasons	5.4	2.9	
Dissatisfaction with schools/students	8.9	8.9	
Pursue other positions	4.5	6.5	
Change in residence	8.0	5.8	
Pregnancy	8.9	8.9	
Contract not renewed	20.5	29.8	*
Occupational status before returning			
Unemployed	11.6	22.5	**
Caring for a family member	5.4	15.2	***
Working outside the field of education	14.3	33.8	***
Working inside the field of education	11.6	22.5	**
Sample size	110	380	

Note: Asterisks indicate significant differences at the conventional levels. *** p<0.01, ** p<0.05, * p<0.1

4.4 Methods and Results

4.4.1 Empirical Strategy

I estimate the impact of alternative certification on former teachers' decisions to return to the profession using survival analysis. I use a discrete time hazard model that estimates the probability that an individual returns to teaching in a given year, conditional on not having returned in the previous year. The hazard function is specified as follows.

$$\lambda_i(t|x_i) = \lambda_0(t)\exp\{x_i'\beta\}$$

where $\lambda_0(t)$ is a baseline hazard and $x_i'\beta$ is a vector of independent variables that includes teachers' demographic characteristics, pre-service qualifications, schools' characteristics, former teachers' reported reasons for leaving teaching and current occupational status, and economic conditions within a state. This hazard function is estimated using a logistic regression, specified as follows.

$$logit\ [\lambda_{is}(t|x_{is})] = \alpha_0(t) + x_{is}'\beta$$

where $\lambda_i(t|x_i)$, the dependent variable, represents the probability that a former teacher i in school s returns to the profession in a given year conditional on not having returned in the previous year.

4.4.2 Baseline Results

I begin the analysis by estimating a standard probit regression. The sample is restricted to teachers who left teaching at any point during their first five years. The dependent variable is measured using a binary variable that is coded as 1 for teachers who returned to teaching in a given year after their initial exit and zero otherwise. Column 1 in Table 22 reports the average

marginal effects from the probit model. Across all models, I control for state and year fixed effects.[21] Standard errors are also clustered at the state level.

As can be seen, neither gender nor race has an effect on the decisions' of former teachers to return to the teaching professions. Age, however, has significant negative effect on the likelihood of returning to teaching. Each additional year of age reduces the likelihood of reentering teaching by 0.2 percentage points. The coefficient on alternative certification is negative but not statistically significant at the conventional levels. Estimates from column 1 also show that teachers who worked in high schools and schools with large shares of minority students are less likely to return to teaching by 2.8 and 0.08 percentage points respectively. Surprisingly, teachers who worked in schools with large shares of minority teachers are more likely to reenter teaching after their initial exit. The coefficient on the share of minority teachers indicates that each one percentage point increase in the share of minority teachers increases the likelihood of returning to the teaching profession by 0.1 percentage points.[22]

Highly-paid teachers are more likely to return to teaching than others. A one-thousand-dollar increase in teachers' school salary increases the likelihood of retuning to teaching by 0.5 percentage points. Former teachers with only BA degree are 6.5 percentage points less likely to return to teaching.

[21] Over last two decades, four states have implemented paid family leave policies: California in 2004, New Jersey in 2009, Rhode Island in 2014, and New York in 2018. The effect of paid family leave in Rhode Island and New York could not be estimated given that these policies were introduced years after the end of the BTLS survey. The effect of paid family leave in California and New Jersey, however, is captured using state fixed effects since the paid family leave policies in these two states were constant during the time period of the study.

[22] In table A6 in the appendix, I examine whether are non-linear effects of the shares of minority students and teachers of the former teachers' likelihood of returning to teaching. The coefficients on the squared terms for both variables ate negative but cannot be distinguished from zero.

Column 1 also shows that former teachers' decisions to re-enter the profession are affected by their current occupations or reasons for exiting teaching, respectively.[23] As shown, former teachers who are currently caring for a family member are less likely to come back to teaching by 9.5 percentage points, as compared to unemployed former teachers. Former teachers who are currently working outside the field of education are also less likely to return to teaching by 4.4 percentage points than those who are currently unemployed. The findings also suggest that teachers who left teaching because of pregnancy are 4.7 percentage points more likely to return to teaching. Former teachers who left because of change in residence are also more likely to come back to teaching by 4.2 percentage points. Surprisingly, teachers who left teaching because of their dissatisfaction with their schools are more likely to re-enter teaching. State unemployment rate, median wage, or teacher median wage do not appear to affect the likelihood of returning to teaching.

In column 2 of table 22, I examine the factors that affect former teachers' decisions to return to the profession using a discrete time hazard model. This model estimates the probability that an individual returns to teaching in a given year conditional on not having returned in the previous year. Similar to the probit model, I control for state and year fixed effects. As shown, the results are very similar to the estimates from the probit regression. For example, estimates from column 2 suggest that alternative certification has no effect on the decisions of former teachers to return to the profession. The findings also indicate that low-paid teachers, teachers who work in schools with large percentage of minority students are less likely to re-enter

[23] The baseline analysis in table 22 only includes former teachers who reported their reasons for leaving teaching. These teachers represent only 49 percent of all leavers. To examine whether the results are sensitive to excluding former teachers with missing values, I re-estimate both the probit and discrete time hazard models without controlling for former teachers' reasons for leaving the teaching profession. The results are very similar to the estimates in table 22.

teaching after their initial exit. Former teachers who are currently caring for a family member are also less likely to return to teaching by about 9.6 percentage points. Similarly, former teachers who are currently working outside the field of education are less likely to re-enter teaching by somewhere between 4.3 percentage points. Teachers who exit teaching because of pregnancy or due to change in residence are more likely to come back to the profession. Surprisingly, teachers who left because of their satisfaction with schools are also more likely to return to teaching.

Table 22: Average Marginal Effects on Returning to Teaching from Probit and Time Hazard Models

VARIABLES	(1) Probit	(2) Discrete Time Hazard
Female	0.185 (0.022)	1.067 (0.026)
White	1.172 (0.025)	0.197 (0.032)
Age	-0.188** (0.001)	-0.193* (0.001)
Alternative certification	-1.837 (0.024)	-1.774 (0.031)
School enrollment	0.004 (0.001)	-0.006 (0.001)
% Minority teachers	0.142*** (0.000)	0.127*** (0.000)
% Minority students	-0.079*** (0.000)	-0.084** (0.000)
Student-teacher ratio	-0.134 (0.002)	-0.209 (0.002)
Secondary school	-2.796* (0.017)	-3.055 (0.022)
Charter school	-2.163 (0.023)	-2.341 (0.026)
Education major	2.608	2.412

	(0.024)	(0.030)
BA degree	-6.424***	-5.540**
	(0.017)	(0.024)
Teacher salary	0.516***	0.529***
	(0.000)	(0.000)
Current Occupation		
Caring for a family member	-9.450***	-9.871***
	(0.032)	(0.037)
Working outside education	-4.378***	-4.505**
	(0.016)	(0.021)
Working inside education	-1.835	-1.513
	(0.022)	(0.027)
Other activity	-1.239	-0.812
	(0.016)	(0.020)
Reasons for leaving		
Financial benefits	5.619	5.279
	(0.049)	(0.061)
Dissatisfaction with schools	7.230***	7.832**
	(0.024)	(0.032)
Pursue other positions	1.765	0.807
	(0.041)	(0.061)
Change in residence	4.212**	4.509*
	(0.021)	(0.023)
Pregnancy	4.727**	4.377
	(0.024)	(0.028)
Contract not renewed	-0.229	-0.219
	(0.021)	(0.024)
State unemployment rate	1.104	0.939
	(0.010)	(0.012)
Teacher median wage	-0.060	-0.149
	(0.003)	(0.004)
State median wage	-0.819	-0.534

	(0.014)	(0.017)
State FE	YES	YES
Year FE	YES	YES
Observations	1,130	1,130

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 23 tests the sensitivity of the results by excluding former teachers who still work inside the field of education (columns 1-2) and formers teachers who exit teaching because their contracts were not renewed (columns 3-4). Restricting the sample to former teachers who don't work inside the field of education or those who left teaching voluntarily has very little effects on the results. Overall, the findings are consistent with the baseline analysis in table 22. Low-paid teachers and teachers who work in schools with large shares of minority students are less likely to return to the teaching profession after their initial exit. Also, former teachers who currently care for a family member or work outside the field of education are less likely to return to teaching. Teachers who exit teaching because of change in residence are more likely to reenter teaching.

Table 23: Sensitivity Analysis

VARIABLES	(1) Probit	(2) Discrete Time Hazard	(3) Probit	(4) Discrete Time Hazard
Female	2.524	3.768	1.407	1.972
	(0.028)	(0.033)	(0.032)	(0.035)
White	-1.105	-2.282	-1.508	-2.643
	(0.027)	(0.034)	(0.031)	(0.036)
Age	-0.187*	-0.192	-0.220*	-0.251
	(0.001)	(0.001)	(0.001)	(0.002)
Alternative certification	-1.018	-1.006	-1.287	-1.258
	(0.030)	(0.038)	(0.027)	(0.033)

School enrollment	0.166	0.176	-0.132	-0.178
	(0.001)	(0.002)	(0.002)	(0.003)
% Minority teachers	0.189***	0.169***	0.190***	0.186***
	(0.000)	(0.000)	(0.000)	(0.000)
% Minority students	-0.080**	-0.079*	-0.108***	-0.135***
	(0.000)	(0.000)	(0.000)	(0.000)
Student-teacher ratio	-0.297	-0.409	-0.279	-0.344
	(0.002)	(0.003)	(0.003)	(0.004)
Secondary school	-3.280	-3.883	-2.332	-2.832
	(0.020)	(0.026)	(0.022)	(0.024)
Charter school	-2.164	-2.630	-1.025	-0.938
	(0.027)	(0.030)	(0.031)	(0.036)
Education major	5.023*	4.895	3.769	3.319
	(0.030)	(0.036)	(0.028)	(0.036)
BA degree	-5.197**	-3.040	-7.660***	-6.137*
	(0.022)	(0.030)	(0.023)	(0.035)
Teacher salary	0.555***	0.560***	0.548***	0.558***
	(0.000)	(0.000)	(0.000)	(0.000)
Current Occupation				
Caring for a family member	-10.823***	-11.295**	-10.162***	-11.025**
	(0.040)	(0.045)	(0.039)	(0.047)
Working outside education	-4.251**	-4.117	-4.554*	-4.677
	(0.020)	(0.027)	(0.025)	(0.032)
Working inside education			-4.753	-4.374
			(0.033)	(0.042)
Other activity	-3.417*	-3.746	-2.326	-2.113
	(0.020)	(0.025)	(0.020)	(0.025)
Reasons for leaving				
Financial benefits	6.717	6.645	6.391	5.109
	(0.051)	(0.062)	(0.054)	(0.064)
Dissatisfaction with schools	8.639***	9.169**	8.033***	8.974**
	(0.030)	(0.040)	(0.028)	(0.039)

Pursue other positions	1.684	-0.063	1.077	0.242
	(0.054)	(0.073)	(0.047)	(0.072)
Change in residence	4.685**	5.000*	3.846*	4.413*
	(0.022)	(0.026)	(0.021)	(0.025)
Pregnancy	5.556**	5.285*	2.883	1.989
	(0.025)	(0.030)	(0.032)	(0.033)
Contract not renewed	-0.703	-0.263		
	(0.026)	(0.030)		
State unemployment rate	1.411	1.364	1.436	1.119
	(0.012)	(0.016)	(0.013)	(0.016)
Teacher median wage	0.087	-0.068	-0.228	-0.539
	(0.004)	(0.005)	(0.005)	(0.005)
State median wage	-0.916	-0.434	-0.531	0.158
	(0.018)	(0.022)	(0.020)	(0.023)
State FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	890	890	770	770

Note: All regression coefficients and standard errors are multiplied by 100. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

4.5 Conclusion

A large body of research has examined the career choices of current teachers (Boyd et al. 2005b, Hanushek, Kain, and Rivkin 2004b). Little is known, however, on the labor supply decisions of former teachers and the factors that affect their likelihood of returning to the teaching profession. This is surprising given that former teachers represent an important source of teacher supply in the United States. In 2011-12, for example. Former teachers represented 49 percent of teachers entering the teaching workforce (Sutcher, Darling-Hammond, and Carver-Thomas 2016).

This paper examines the demographic characteristics and career paths of former teachers in addition to the factors that affect their decisions to return to the teaching profession. I use a restricted-use data from the Beginning Teacher Longitudinal Study (BTLS) that follows a cohort of first-time teachers for five years, starting from school year 2007-08. The results from this paper suggest that former teachers who work in large schools, high schools, and schools with large percentages of minority students are less likely to return to teaching after their initial exit. There is also some evidence that high-paid teachers are more likely to re-enter teaching. A one-thousand-dollar increase in school salary increases the likelihood of returning to teaching by 0.5 percentage points. The findings also indicate that former teachers who currently care for a family member or work outside the field of education are less likely to return to teaching. Teachers who left schools because of pregnancy or change in residence are also more likely to re-enter the profession.

The findings from this chapter should be interpreted with cautious for several reasons. First, the BTLS survey targets early career teachers only. Therefore, the results may not be generalizable to teachers who decide to leave the profession in their mid or late-careers. Second, given that teachers in the sample started their careers in 2007-08, their decisions to whether or not to leave/return to teaching may have been affected by the 2008 recession. For example, some teachers who planned to leave their jobs may have decided to stay given the limited alternative job opportunities during the recession. Those who decided to leave may have also been affected by the recession. For instance, the recession may have affected the types of occupations that former teachers had after their initial exit, the likelihood of their return to the teaching profession, and the length of time between their initial exit and return to teaching. Third, the BTLS survey followed teachers for only five years after they started their careers in 2007-08.

Therefore, the analysis in this chapter doesn't include teachers who left teaching after the first 5 years of their careers or those who decided to return to teaching after 4 years of their initial exit.

Chapter V: Conclusion

Over the last few years, enrollment in education programs in the U.S. has declined substantially. Between 2009 and 2015, the number of students attending teacher preparation programs decreased by more than 40 percent. This decline is consistent across both traditional and alternative education programs (U.S. Department of Education 2016). It is also part of a long-term decline in individuals' interest in pursuing teaching as a career. Data from the Integrated Postsecondary Education System shows that between 1996 and 2016, the share of undergraduate students enrolled in education programs decreased by 35 percent nationally, from 12 percent to 8 percent. During the same period, the share of undergraduate degrees awarded in education programs decreased by 47 percent.

The factors driving the decreased interest in teaching are still largely unknown. Anecdotal evidence, however, suggests the rise of school accountability, cuts in school funding, and the decline in the status of teaching as a middle class career might be responsible for the sharp decrease in teacher supply (Byrd-Blake et al. 2010, Clotfelter et al. 2004, Cohen and Gebeloff 2018, Heinrich 2015, Ladd 2017). For example, some school officials believe that policies that emphasize high stakes testing and link teachers' evaluation to student performance have made teaching less stable and more political. These policies, according to these officials, undermine the perception of teaching as a stable career, discouraging individuals from entering the teaching profession (Sawchuk and Yettick 2014, Westervelt 2015).

Despite this anecdotal evidence, the empirical evidence on the factors that affect individuals' decisions to enter the teaching profession is limited. Most of the current literature focuses on the supply decisions of current teachers. The findings from this research suggest that student demographic and socio-economic characteristics, teacher quality, and early-career

experience are key determinants of teacher mobility and retention (Feng and Sass 2017, Goldhaber, Gross, and Player 2011, Guarino, Santibañez, and Daley 2006, Hanushek, Kain, and Rivkin 2004a, Imazeki 2005, Johnson, Berg, and Donaldson 2005, Kirby, Berends, and Naftel 1999, Krieg 2006, Lankford, Loeb, and Wyckoff 2002, Loeb, Darling-Hammond, and Luczak 2005, Scafidi, Sjoquist, and Stinebrickner 2007). Little attention, however, has been paid to the supply decisions of teacher candidates.

In this dissertation, I examine the effects of government policy on the supply decisions of teacher candidates and former teachers. Over the last two decades, several states have implemented policies that seek to enhance students' academic achievement. Some of these policies, such as school accountability, focus on improving the quality of current teachers by linking teacher pay and evaluation to students' performance on standardized exams. Other policies, such as teacher prep performance assessment, have targeted teacher candidates in education programs. Critics argue that these policies adopt a very narrow view of teaching that emphasizes standardized testing and overlooks other aspects of teaching that are hard to test/quantify. These policies also, according to this view, put more pressure on teachers and schools without providing them with enough support needed to improve student outcomes, which may result in adverse effects on teacher morale and undermines teaching as an attractive career.

Opponents of school accountability and performance assessment policies also point to the increasing dissatisfaction among teachers and teacher shortages as adverse effects of these policies. For example, according to a recent survey, more than half of teachers (51 percent) reported feeling under great stress several days a week in 2012 compared to 36 percent in 1985 and the number of teachers saying they are satisfied with their jobs declined by 23 percentage

points between 2008 and 2012, from 62 percent to 39 percent (MetLife Inc., 2013). Teachers have also become more vocal in expressing their dissatisfaction with the current conditions of their schools. Thousands of teachers across several states have protested the lack of funding for their schools by walking out of their schools and/or organizing strikes during the last few months (Cohen and Gebeloff 2018). Teachers in West Virginia, for instance, organized a 9-day strike, demanding higher wages and better benefits (Bidgood 2018).

Although a large body of research explores the effects of school accountability policies on student achievement and teacher mobility and retention, little examines whether these policies discourage individuals from pursuing teaching as a career. There is also limited evidence on the effects of teacher preparation programs on students' decisions to enter the teaching profession, i.e., whether requirements for teacher preparation programs affect individuals' decisions to enter teaching.

This dissertation contributes to the small number of studies on teacher supply by examining the effects of school accountability and pre-service performance assessment on the supply decisions of teacher candidates. In the second chapter of this dissertation, I examine whether the introduction of NCLB in 2002 has affected enrollment and degrees awarded in education programs. Using data from the Integrated Postsecondary Education Data System combined with data from the Current Population Survey, I find that NCLB had no effects on either enrollment or degrees awarded in education programs. There is some evidence, however, that NCLB reduced the percentage of minority students enrolled in education majors by more than 3 percentage points. These findings have major policy implications. While there is no evidence that NCLB has affected overall enrollment in education programs, the evidence from this chapter indicates that NCLB has large negative effects on minority enrollment in these

programs. This suggests that the consequences of school accountability systems may extend beyond the direct impact on student achievement or teacher mobility and retention.

The third chapter examines whether requiring teacher candidates to pass a performance assessment test in order to be certified affects their college outcomes. Using administrative data on students who started their postsecondary education in the state of Georgia between 2008-09 and 2016-17, I examine whether the introduction of the edTPA performance assessment in Georgia has affected students' persistence in college, attrition from college major, or graduation within 4 years. The findings suggest that the edTPA assessment has no effects on college outcomes of students in education programs relative to other students. These findings are robust across different specifications and subgroups of college students.

In the fourth chapter, I examine the demographic and socio-economic characteristics of teachers who leave the profession in addition to their career paths. I also examine the factors that affect their decisions to return to the teaching profession. I use restricted-use data from the Beginning Teacher Longitudinal Study that follows a cohort of first-time teachers for five years, starting from 2007-08. The results suggest that about one quarter of teachers leave the profession during the first 5 years of their career. A large portion of those who leave teaching (38 percent) exit after the first year. Contrary to conventional wisdom, a large portion of teachers who leave the profession exit for non-family related reasons. For example, only 18 percent of former teachers reported leaving teaching because of pregnancy or to care for a child. The findings also indicate that former teachers who work in large schools, high schools, and schools with large percentages of minority students are less likely to return to teaching after their initial exit. There is also some evidence that high-paid teachers are more likely to re-enter teaching.

Appendix

Table A1: States with Accountability Systems Prior to NCLB

State	Year
Illinois	1992
Wisconsin	1993
Texas	1994
Indiana	1995
Kansas	1995
Kentucky	1995
North Carolina	1996
Nevada	1996
Oklahoma	1996
Alabama	1997
Rhode Island	1997
West Virginia	1997
Delaware	1998
Massachusetts	1998
Michigan	1998
New Mexico	1998
New York	1998
Virginia	1998
Arkansas	1999
California	1999
Connecticut	1999
Florida	1999
Louisiana	1999
Maryland	1999
South Carolina	1999
Vermont	1999
Georgia	2000
Oregon	2000
Tennessee	2000
Alaska	2001

Source. Dee and Jacob. (2011).

Table A2: Share of Teacher Candidates Enrolled in Alternative Certification Programs in 2012

State	%
Alabama	23.3
Alaska	2.3
Arizona	1.8
Arkansas	26.9
California	9.2
Colorado	3.1
Connecticut	5.1
Delaware	4.0
District of Columbia	49.2
Florida	21.4
Georgia	4.9
Hawaii	29.6
Idaho	2.2
Illinois	3.8
Indiana	9.5
Iowa	0.1
Kansas	2.9
Kentucky	8.3
Louisiana	45.7
Maine	7.6
Maryland	8.0
Massachusetts	3.1
Michigan	0.3
Minnesota	0.0
Mississippi	1.5
Missouri	30.2
Montana	10.9
Nebraska	4.5
Nevada	0.5
New Hampshire	10.0
New Jersey	10.1
New Mexico	7.8
New York	23.0
North Carolina	6.1
North Dakota	33.5
Ohio	0.0
Oklahoma	0.0
Oregon	7.1
Pennsylvania	0.0
Puerto Rico	4.1
Rhode Island	1.8
South Carolina	12.0

South Dakota	1.0
Tennessee	16.4
Texas	36.0
Utah	3.3
Vermont	12.8
Virginia	3.3
Washington	5.2
West Virginia	1.2
Wisconsin	2.6
Wyoming	0.0

Table A3: edTPA Participation across States

State	Participation Stage	Institutions
Alabama	Policy in Place	27
Arizona	State Participating in edTPA	4
Arkansas	Policy in Place	8
California	Policy in Place	49
Colorado	State Participating in edTPA	4
Connecticut	Taking Steps Toward Implementation	18
Delaware	Policy in Place	5
District of Columbia	State Participating in edTPA	1
Florida	State Participating in edTPA	5
Georgia	Policy in Place	65
Hawaii	Policy in Place	6
Idaho	State Participating in edTPA	2
Illinois	Policy in Place	61
Indiana	State Participating in edTPA	16
Iowa	Policy in Place	21
Kentucky	State Participating in edTPA	1
Louisiana	State Participating in edTPA	1
Maryland	State Participating in edTPA	15
Michigan	State Participating in edTPA	7
Minnesota	Policy in Place	31
Nebraska	State Participating in edTPA	2
New Jersey	Policy in Place	35
New York	Policy in Place	107
North Carolina	Policy in Place	36
Ohio	Taking Steps Toward Implementation	53
Oklahoma	State Participating in edTPA	8
Oregon	Policy in Place	18
Pennsylvania	State Participating in edTPA	16
Rhode Island	State Participating in edTPA	2
South Carolina	Policy in Place	2
South Dakota	State Participating in edTPA	1
Tennessee	Policy in Place	40
Texas	State Participating in edTPA	5
Utah	State Participating in edTPA	4
Vermont	State Participating in edTPA	1
Virginia	State Participating in edTPA	5
Washington	Policy in Place	26
West Virginia	Policy in Place	11
Wisconsin	Policy in Place	45

Wyoming	State Participating in edTPA	1

Source: edTPA. Participation Map. Available at: http://edtpa.aacte.org/state-policy
Note: The table includes three groups of states: a) states with policy in place, i.e., states that have already implemented the edTPA assessment; b) states that have at least one teacher preparation that is exploring adopting the edTPA assessment; and c) states that are taking steps towards implementation, i.e., considering a state-wide implementation of the edTPA assessment.

Table A4: Effects of Performance Assessment after Excluding the 2012-13 Cohort from the Sample

VARIABLES	(1) College Persistence	(2) Change of Major	(3) Graduation Within 4 Years
Education major	0.0288***	-0.0819***	0.0563***
	(0.0069)	(0.0144)	(0.0095)
Performance assessment	-0.1372***	-0.0277	0.0251*
	(0.0155)	(0.0181)	(0.0141)
Education major * performance assessment	0.0183	-0.0422	0.0181
	(0.0160)	(0.0259)	(0.0191)
Minority	0.0081	-0.0312***	-0.0066
	(0.0075)	(0.0068)	(0.0101)
Female	0.0251***	0.0282**	0.0685***
	(0.0060)	(0.0109)	(0.0105)
Year of birth	0.0069***	0.0003	0.0051*
	(0.0020)	(0.0023)	(0.0025)
In-state resident	0.0983***	0.0753***	-0.0294***
	(0.0117)	(0.0212)	(0.0085)
HS GPA	0.2048***	0.0228	0.1729***
	(0.0162)	(0.0136)	(0.0124)
HS graduation year	-0.0003	0.0073**	-0.0083***
	(0.0029)	(0.0030)	(0.0028)
Total financial aid (1st year)	0.0001	0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0000)
Eligible for Pell grant (1st yesr)	-0.0535***	-0.0117	-0.0410***
	(0.0083)	(0.0070)	(0.0040)
Cohort FE	YES	YES	YES
Institution FE	YES	YES	YES
Observations	152,480	152,480	152,480
R-squared	0.1504	0.0587	0.1734

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

Table A5: Average Marginal Effects from the Propensity Score Equation

VARIABLES	Education Major
Minority	-0.0341***
	(0.0011)
Female	0.0649***
	(0.0012)
In state resident	0.0447***
	(0.0024)
HS GPA	-0.0207***
	(0.0010)
Year of birth	-0.0015**
	(0.0006)
HS graduation year	0.0006
	(0.0007)
Total financial aid	-0.0085**
	(0.0040)
Eligible for Pell grant	0.0001***
	-0.0085**
Institution FE	YES
Cohort FE	YES
Observations	252,291

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

Table A6: Non-linear Effects

VARIABLES	(1) Probit	(2) Discrete Time Hazard
Female	0.374	1.408
	(0.023)	(0.027)
White	1.238	0.506
	(0.026)	(0.031)
Age	-0.203**	-0.224**
	(0.001)	(0.001)
Alternative certification	-1.603	-1.411
	(0.026)	(0.033)
School enrollment	0.006	-0.167
	(0.004)	(0.005)
School enrollment squared	0.000	0.008
	(0.000)	(0.000)
% Minority teachers	0.219**	0.234**
	(0.001)	(0.001)
Minority teachers squared	-0.001	-0.001
	(0.000)	(0.000)
% Minority students	-0.073	-0.060
	(0.001)	(0.001)
Minority students squared	-0.000	-0.000
	(0.000)	(0.000)
Student-teacher ratio	-0.624	-0.872
	(0.005)	(0.006)
Student-teacher ratio squared	0.015	0.021
	(0.000)	(0.000)
Secondary school	-2.805	-3.148
	(0.017)	(0.022)
Charter school	-2.584	-3.071
	(0.026)	(0.028)
Education major	2.926	2.771
	(0.025)	(0.032)
BA degree	-6.618***	-5.704**
	(0.017)	(0.024)
Teacher salary	0.523***	0.543***
	(0.000)	(0.000)
Caring for a family member	-9.552***	-10.355***
	(0.033)	(0.037)
Working outside education	-4.274***	-4.409**
	(0.016)	(0.022)
Working inside education	-1.640	-1.323
	(0.022)	(0.027)
Other reasons	-1.230	-0.754

	(0.017)	(0.021)
Financial benefits	5.716	5.498
	(0.051)	(0.065)
Dissatisfaction with schools	7.014***	7.471**
	(0.024)	(0.032)
Pursue other positions	2.050	1.511
	(0.043)	(0.062)
Change in residence	4.259**	4.477*
	(0.021)	(0.023)
Pregnancy	4.851**	4.703
	(0.024)	(0.029)
Contract not renewed	-0.256	-0.227
	(0.021)	(0.024)
State unemployment rate	1.077	0.954
	(0.010)	(0.012)
Teacher median wage	-0.051	-0.138
	(0.004)	(0.004)
State median wage	-0.799	-0.535
	(0.014)	(0.017)
State FE	YES	YES
Year FE	YES	YES
Observations	1,130	1,130

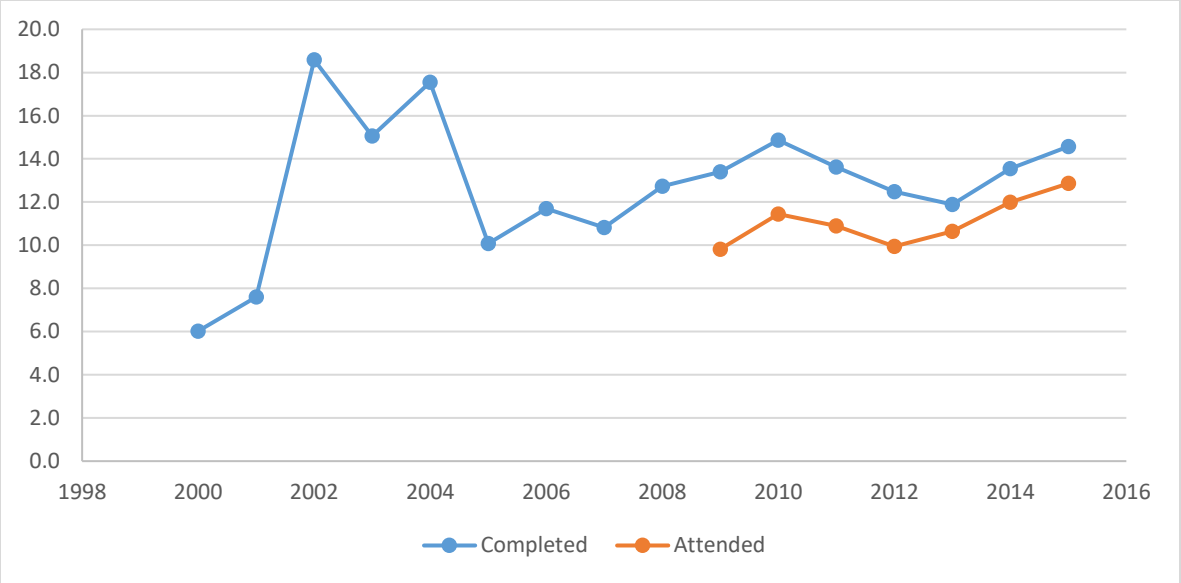

Figure A1: Percentage of Individuals Who Attended/Completed Alternative Certification Programs (2000-2015)
Source: U.S. Department of Education. Higher Education Act Title II State Report Card System.

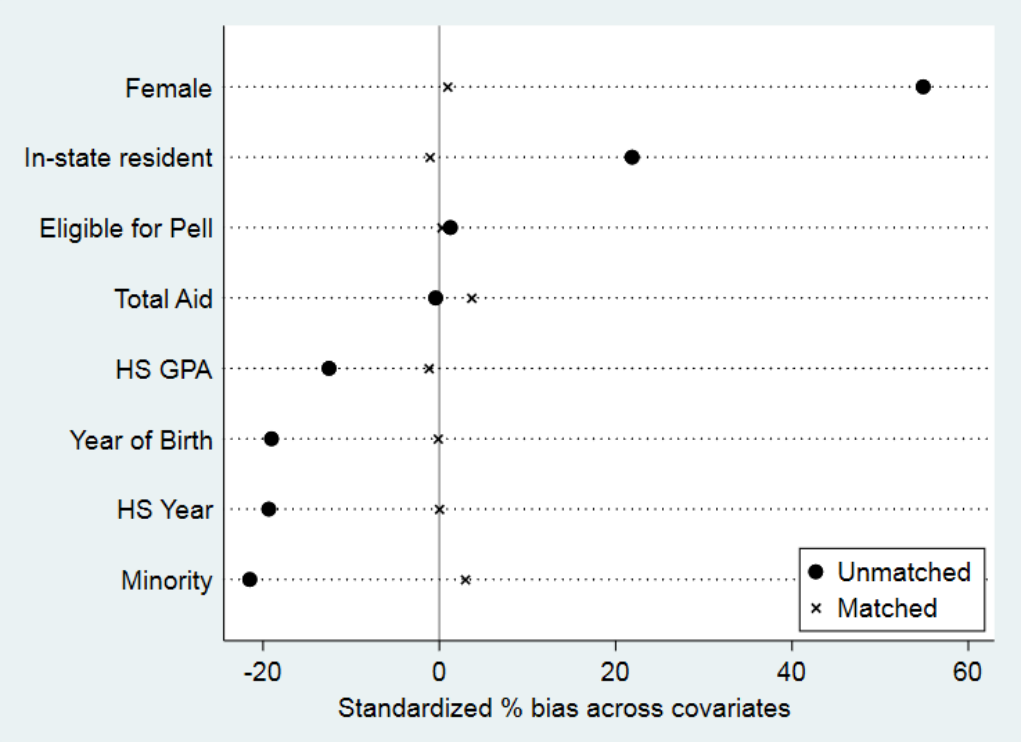

Figure A2: Standardized Bias across Covariates Before and After Matching

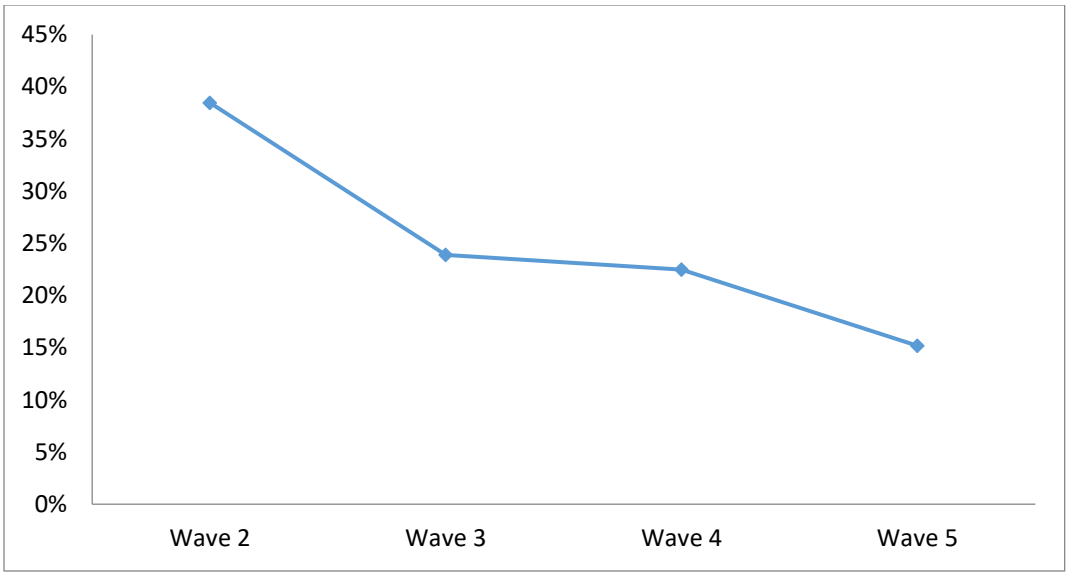

Figure A3: Share of Leavers by Survey Wave
Note: This figure presents the share of former teachers who left teaching during each wave, out of all leavers.

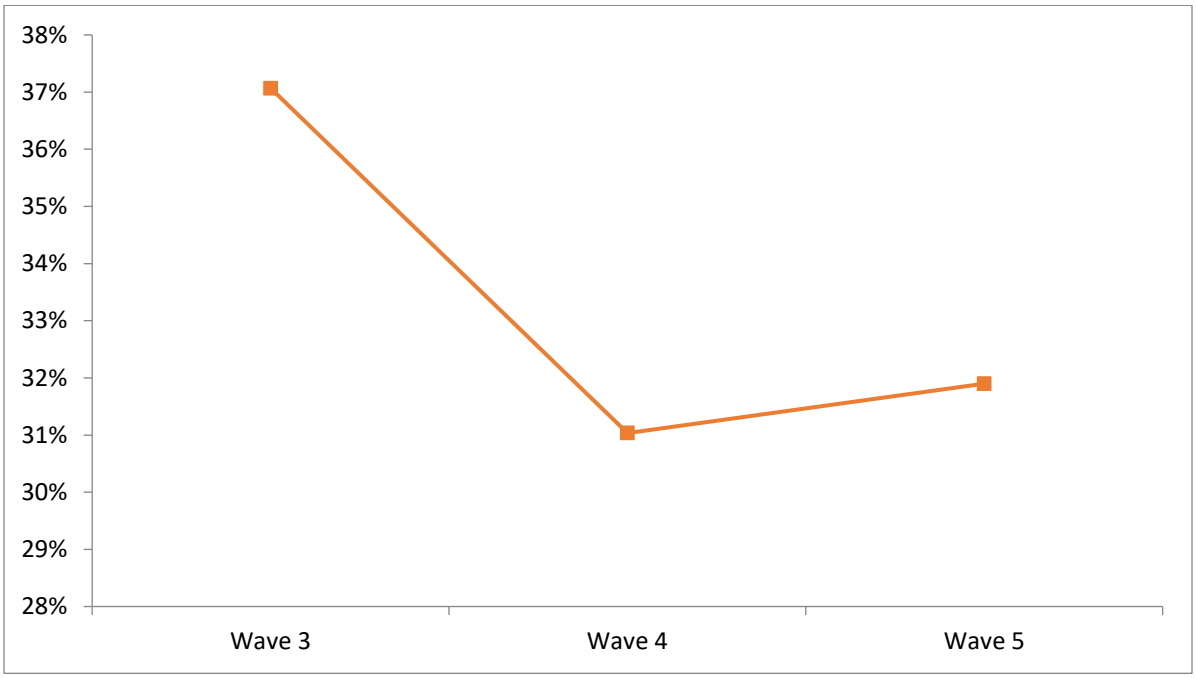

Figure A4: Share of Returners by Survey Wave
Note: This figure shows the share of former teachers who returned to teaching during each wave, out of all leavers.

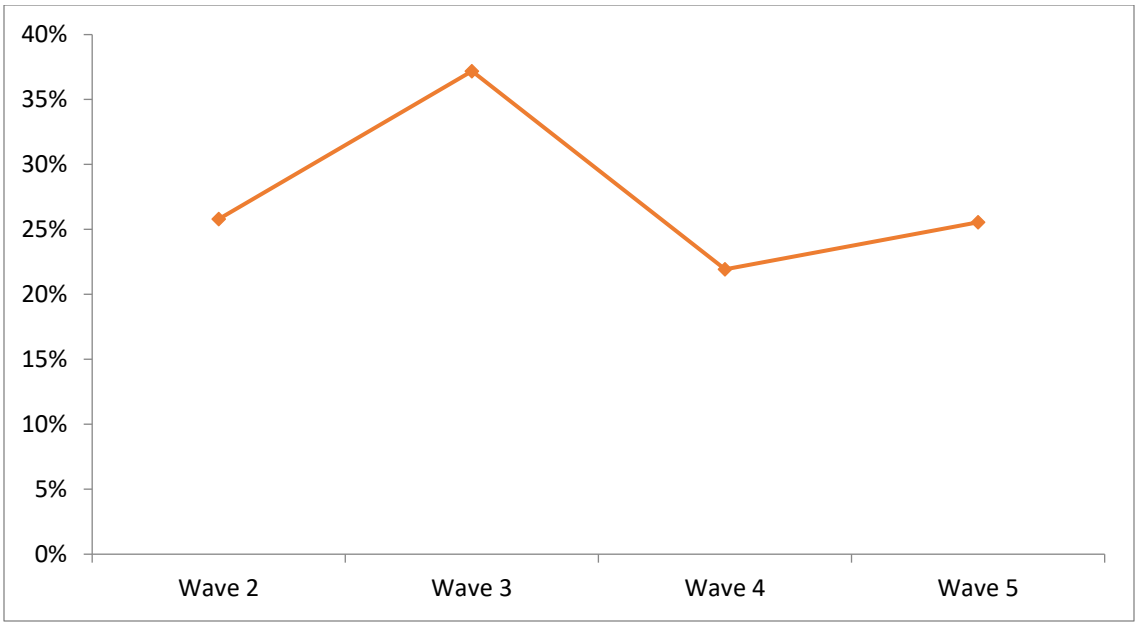

Figure A5: Share of Former Teachers Who Left due to Contract Non-Renewal
Note: This figure shows the share of former teachers who left due to contract non-renewal during each wave, out of all leavers.

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