Understanding Teacher Shortages: An Analysis of Teacher Supply and Demand in the United States

Leib Sutcher
Linda Darling-Hammond
&
Desiree Carver-Thomas
Learning Policy Institute
United States

Abstract: This paper reviews the sources of and potential solutions to teacher shortages in the United States. It describes the sources of current and projected increases in teacher demand relative to enrollments, shifts in pupil-teacher ratios, and attrition. It places these in relation to recent declines in teacher supply and evaluates evidence of shortages in fields like mathematics, science, special education, and educators for English learners, as well as

in particular parts of the country. Our analysis using national databases through 2016 predicted an estimated annual teacher shortage of approximately 112,000 teachers in 2017-18. Our recent review of state teacher workforce reports estimated 109,000 individuals were uncertified for their teaching positions in the US in 2017, roughly approximating our projections. We discuss the factors driving shortages and, based on previous research, identify responses that might ameliorate these trends.

Keywords: teacher shortages; teacher supply; teacher demand; attrition

Entendiendo la escasez de profesores: Un análisis de la oferta y demanda de maestros **en los Estados Unidos**

Resumen: Este artículo analiza las fuentes de escasez de maestros en los Estados Unidos y posibles soluciones para este situación. Describe las fuentes de aumentos actuales y proyectados en la demanda de maestros en relación a las matrículas, cambios en las proporciones alumno- maestro y la atrición. En relación con la disminución reciente en la oferta de maestros, encontramos evidencia de escasez en campos como matemáticas, ciencias, educación especial y educadores para estudiantes de inglés, así como en partes específicas del país. Nuestro análisis utilizando bases de datos nacionales hasta 2016 predijo una escasez anual estimada de aproximadamente 112.000 profesores en 2017-18. Nuestra reciente revisión de los informes de la fuerza de trabajo de maestros del estado estimó que 109.000 personas no fueron certificadas para sus posiciones de enseñanza en los EE.UU. En 2017, acercándose a nuestras proyecciones. Discutimos los factores que impulsan la escasez y, sobre la base de investigaciones anteriores, identificamos respuestas que pueden mejorar esas tendencias.

Palabras clave: escasez de maestros; oferta de maestros; demanda de maestros; atrición

Entendendo a escassez de professores: Uma análise da oferta e demanda de professores nos Estados Unidos

Resumo: Este artigo analisa as fontes de escassez de professores nos Estados Unidos e possíveis soluções para este dliema. Ele descreve as fontes de aumentos atuais e projetados na demanda de professores em relação às matrículas, mudanças nas proporções aluno-professor e atrito. Em relação aos declínios recentes na oferta de professores, encontramos evidências de escassez em áreas como matemática, ciências, educação especial e educadores para alunos de inglês, bem como em partes específicas do país.Nossa análise usando bases de dados nacionais até 2016 previu uma escassez anual estimada de aproximadamente 112.000 professores em 2017-18. Nossa recente revisão dos relatórios da força de trabalho de professores do estado estimou que 109.000 pessoas não foram certificadas para suas posições de ensino nos EUA. Em 2017, aproximando-se de nossas projeções. Discutimos os fatores que impulsionam a escassez e, com base em pesquisas anteriores, identificamos respostas que podem melhorar essas tendências.

Palavras-chave: escassez de professores; oferta de professores; demanda de professores; atrito

Introduction

Over the last several years, headlines across the country broadcasted severe teacher shortages: "Nevada needs teachers, and it's shelling out $5 million to get them" (Whitaker, 2015); "Why Oklahoma is racing to put nearly 1,000 uncertified teachers in its classrooms" (Nix, 2015); "New Mexico faces teacher shortages" (KRQE, 2018); and "Teacher Shortages affecting every state as the 2017-18 school year begins" (Strauss, 2017). But not all commentary on current signs of teacher shortages has been unanimous. Amidst the barrage of articles in the popular media voicing concern have been others that have called the teacher shortage "a myth" (Gantert, 2015) or "overblown," (Barshay, 2016). Surprisingly, there has been little academic research on the current nature or extent of shortages, a challenge compounded by a lack of clarity about what constitutes a shortage in what can be a highly localized job market.

This article examines current trends in teacher supply and demand, as well as indicators of teacher shortages. It analyzes the severity and persistence of the labor market imbalance, discusses the impact on students and schools, and investigates what is likely driving teacher shortages. It evaluates key policy levers that research suggests could help create a sustainable supply of well-prepared teachers in the subjects and states where they are needed.

Section I places this research within the existing literature and briefly reviews some of the indicators of teacher shortages in the context of current debates. Section II presents the data and methods used in this paper to evaluate the factors that influence teacher demand, teacher supply, and attrition. Section III presents the results of our teacher shortage analysis and discusses factors that contribute to variation among states, regions, and types of communities. Section IV highlights the role of teacher attrition in shortages. Finally, section V provides a short discussion of policy considerations given the paper's findings.

Background

Although teacher shortages are currently in the public eye, staffing difficulties are not new. There are scholarly articles from the mid-1930s that speak of staffing difficulties after the Great Depression (Sherratt, 2016). Certain subject areas, such math and science, have seen shortages since at least the 1950s, and special education has had perennial shortages since the 1960s (Ingersoll & Perda, 2010; U.S. Department of Education Office of Postsecondary Education, 2017). The seminal 1983 report, *A Nation at Risk,* observed that "severe shortages of certain kinds of teachers exist: in the fields of mathematics, science, and foreign languages; and among specialists in education for gifted and talented, language minority, and handicapped students" (Gardner, 1983). And many states struggled to fill their classrooms in the late 1990s (Darling-Hammond, 2010a).

As a result, there is a body of academic research on the topic of teacher supply, demand, and shortages that provides a theoretical framework for understanding the teacher labor market. (For an overview, see Haggstrom, Darling-Hammond, & Grissmer, 1988.) Over the years, researchers have tried to measure the severity of shortages; however, data limitations at the national level have often precluded precise estimates of the size of shortages. Thus, much literature focuses on whether shortages exist and their relative intensity (Murphy, DeArmond, & Guin, 2003). State reports, where researchers often have access to more complete data, have been successful in analyzing local teacher labor market (Berg-Jacobson & Levin, 2015; Carver-Thomas & Darling-Hammond, 2017; Levin, Berg-Jacobson, Atchison, Lee, & Vontolos, 2015; Shields et al., 2001). In close relation to shortages, there has also been a substantial body of research that examines teacher turnover and how churn relates to the teacher labor market (Ingersoll, 2001; Ingersoll & May, 2012; Ingersoll & Strong, 2011).

Although research has described past shortages and explained key factors driving staffing difficulties, there has been no comprehensive analysis of the current teacher labor market, despite the recent emergence of widespread hiring difficulties documented by articles in the popular press. As more and more districts and states began to report shortages beginning around 2014-15, and policymakers began looking for solutions, we perceived a need for empirical investigation of the status of teacher supply and demand, as well as the size, causes, and variations in shortages and future outlook of the teacher labor market in the US.

This article aims to add to the literature on shortages by addressing the following research questions: (a) What is the status of teacher demand and supply across the United States? How large are the differences between supply and demand? Is it likely that these differences will persist? (b) What is the apparent extent of shortages? Where and in what fields are shortages more severe? And how and why do shortages vary? (c) What factors appear to be driving teacher shortages around the country? (d) What policy levers might mitigate teacher shortages where they exist?

Based on our analysis we found that teacher demand is projected to increase over the next decade, based on expectations that the school-aged population will increase by roughly 3 million students, student-teacher ratios will return to pre-recession levels (suggesting a decrease from 16:1 to 15:1), and teacher attrition rates will remain steady at 8% annually. Teacher supply, meanwhile, has been declining. Between 2009 and 2014, teacher preparation enrollments declined by 35% and 23% fewer preparation candidates completed their programs.

Our analysis using national databases estimated a teacher shortage of approximately 64,000 teachers in the 2015-16 school year and an annual shortage of 112,000 teachers in 2017-18. A recent LPI review of state teacher workforce reports revealed that in the 36 states that reported such data in 2016 or 2017, at least 87,000 positions were not filled by a fully certified teacher. Assuming the same rates of shortages in the remaining states, the national total of uncertified teachers would be approximately 109,000, very close to what our model predicted.

It's important to note that dissent about teacher shortages can be often rooted in different labor market realities that operate across locations and teaching fields, as well as different uses of the term "shortage." Below we discuss the various debates surrounding teacher shortages to bring clarity to the analysis that follows in the remaining sections of the paper.

Defining "Teacher Shortage"

Often, the term *teacher shortage* is used to refer to an insufficient production of new teachers, given the size of student enrollments and teacher retirements. In this narrow definition, a teacher shortage is measured only by teacher production in relation to these factors associated with teacher demand. However, a large body of research indicates that teacher staffing problems are driven by a myriad of factors, including not only production of new teachers in various fields, but also teacher turnover, changes in educational programs and pupil-teacher ratios, and the attractiveness of teaching generally and in specific locations.

Imbalance between demand and presenting supply. In this article, we use a theoretical framework of supply and demand that defines a teacher shortage as an inadequate quantity of qualified individuals willing to offer their services under prevailing wages and conditions. In other words, teacher shortages emerge in different fields and locations when there is an imbalance between the number of teachers demanded and the number of qualified teachers willing to offer their services to fill these demanded positions. This more robust definition allows for a more detailed diagnosis with clearer implications for policy analysis and recommendations. From this perspective, the key issue is not whether there will be enough warm bodies to enter teaching. The key issue is whether there will be enough well-qualified individuals willing to offer their services in

the specific fields and locations that currently lack an adequate supply—and whether this will happen on its own, in response to the market, or will require policy interventions.

       Local and National Dimensions of Shortage. Teacher shortages are, for the most part, not national in nature, and one can argue that there are, in fact, 50 separate state labor markets for teaching, plus local labor markets nested within states. Current shortages differ from state to state, across districts of different types, and among subject areas. The conditions influencing supply and demand—factors like compensation, working conditions, and turnover rates—are very different across states and, in some states, are very different across regions and districts as well.

       However, at a point when nearly every state is reporting shortages in certain subject areas (U.S. Department of Education Office of Postsecondary Education, 2017), as well as experiencing similar national labor market trends, including the contraction during and expansion following the Great Recession and a shared set of national policies impacting schools across the nation, it is also important to understand shortages at the national level. And although it is paramount to look at state and local variation, some solutions will need to be national in nature. About 25% of teachers cross state lines in their careers, and many leave the profession because of barriers to transfer their licenses and pensions, so solving these national labor market problems is part of the solution (U.S. Department of Education, n.d.).

Evidence of Teacher Shortages

       Several commentaries over the past few years have questioned whether widespread teacher shortages exist (e.g., Aldeman, 2016; Antonucci, 2016). However, real-world indicators present compelling evidence of widespread shortages. Nearly every state is reporting shortages in certain subjects, and most are resorting to hiring teachers who are not fully certified for their teaching assignments.

       More than 40 states report shortages in several subject matter areas, such as mathematics, science, and special education, and more than 30 report shortages in a number of other fields, ranging from career technical education to bilingual education (U.S. Department of Education Office of Postsecondary Education, 2017). Another widely used indicator of shortages is the difficulty employers have in filling vacancies. Each year, the American Association for Employment in Education (AAEE) surveys a sample of higher education institutions and districts across the country. In 2016-17, more than two-thirds of surveyed districts (69%) reported not having enough candidates for open positions as "a big challenge." This was more than double the rate from the 2013-14 survey (AAEE, 2017).

       A recent review by LPI of state teacher workforce reports reveals that, in the 36 states that reported such data in 2016 or 2017, a total of at least 87,000 positions were filled by teachers who were not fully certified. When school districts are having trouble finding fully qualified applicants to fill empty positions, it is a sign of labor market imbalances in those fields or locations. Due to variations in state teacher licensure regulations and reporting systems, these teachers may have qualifications that differ considerably. Their training may range from intern style credentials, which support candidates who are completing preparation while they teach, to emergency-style permits which can be held by candidates who are neither trained nor participating in a formal training program. But since such hires are usually prohibited unless there are no candidates meeting the state's requirements for full certification, all indicate shortages. Assuming the same rates of uncertified teachers in the remaining states, the national total of uncertified teachers would be approximately 109,000. This number understates total shortages because some states only report the number of uncertified teachers in core academic areas, and because districts also address shortages by canceling courses, increasing class sizes, or hiring substitute teachers. For example, Florida does

not report uncertified teacher counts, but reported 6,628 unfilled vacancies at the start of 2017-18 (Learning Policy Institute, n.d.).

Data from states and districts, from surveys and credentialing offices, makes it clear that there are currently not enough qualified teachers offering their services in the fields and locations where they are needed in all parts of the country. Below, we investigate the national and local trends that are driving shortages, discuss the severity and projected outlook of shortages, and describe important variation in how states and districts experience shortages.

Shortages Vary By Subject Area, Location, And Student Population

Indicators of shortages by teaching field. Districts, teacher education institutions, and states have all identified special education as a field with severe shortages. In 2017–18, 46 states and DC identified special education as a shortage area in their reports to the U.S. Department of Education (U.S. Department of Education Office of Postsecondary Education, 2017). Similarly, in the 2016–17 AAEE educator supply and demand report, all 10 special education subareas, from dual certification to cognitive disabilities, were reported to have "considerable" shortages—the most severe rating. Of the 19 areas in which most school districts reported "considerable" shortages, 10 of the 19 were in special education (AAEE, 2015).

In California, for example, one state experiencing such shortages, almost two-thirds (64%) of entering special education teachers in 2016 were on substandard credentials designating less than full preparation for teaching (Carver-Thomas & Darling-Hammond, 2017). It is striking that the field that serves the most vulnerable students and, arguably, requires the most wide-ranging teacher knowledge—drawing on medical, psychological, and pedagogical fields—is increasingly populated by underprepared teachers.

Mathematics and science are close behind special education as shortage areas. In 2017–18, 47 states and DC reported teacher shortages in mathematics, as did 43 states in science, a marginal increase from the previous year (U.S. Department of Education Office of Postsecondary Education, 2017). With greater job opportunities offering stronger compensation in the broader labor market for individuals who have trained in mathematics and science fields, these subjects are up against a particularly difficult recruitment challenge.

Along with special education, these fields have faced perennial staffing difficulties (Ingersoll & Perda, 2010). One 2012 analysis suggested these problems are caused less by an underproduction of mathematics and science teachers than by high levels of attrition for these teachers (Ingersoll & May, 2012). Since that time, demand has rapidly increased, signaling a shift in the labor market. This shift could indicate that hiring for these already difficult-to-staff subject areas will only become more challenging.

In many states, bilingual education or teaching of English as a second language (ESL) is another subject area with intense shortages. In all, 32 states report shortages in these fields (U.S. Department of Education Office of Postsecondary Education, 2017). The need for bilingual/ESL teachers varies based on state demographics, so it makes sense that somewhat fewer states list shortages.

Shortage indicators by state. Each state experiences teacher supply and demand differently, because there are state-level labor markets created by different policies and contexts affecting teaching. These include funding levels and allocations, salary levels, teaching conditions, licensure and accreditation policies, concentration of preparation institutions, demographics of the teaching force, concentration or sparsity of the population, and topography, among others (Haggstrom et al., 1988).

Even when the teacher labor market is balanced overall, teaching fields or regions within a state may be prone to shortages. In 2017–18, seven states reported shortages in every major subject area (math, science, career technical education, special education, bilingual education, English, social studies, elementary, world languages, and art/dance/music) and about half of states report shortages in seven or more subject areas (U.S. Department of Education Office of Postsecondary Education, 2017).

As examples of the variable landscape across states: California's recent teacher shortages led to a quintupling in the number of emergency and temporary permits over a period of four years. By 2016, almost half of the credentials and permits issued (about 10,000) went to teachers who were not fully prepared for their teaching assignments. (Carver-Thomas & Darling-Hammond, 2017). A survey of over 200 districts that year found 75% of districts reported a shortage of qualified teachers. Of those, nearly 9 in 10 report shortages in special education, nearly 6 in 10 report shortages in both math and science, and more than 1/3 report shortages in elementary, traditionally an area of surplus. Districts also reported shortages in foreign languages, English, music, bilingual education, PE, and Art (Podolsky & Sutcher, 2016).

Arizona's teacher shortage has had an intense impact on the school system. In 2015-16 a survey revealed 4,000 teaching positions were vacant or staffed with an underprepared teacher four weeks into the school year. This includes more than 2,000 vacancies at the start of the school year, more than 1,800 classrooms filled by individuals not meeting standard teacher requirements, and more than 400 teachers who left in the first four weeks, creating additional vacancies. This count likely underestimates teacher shortages because it is based on survey responses from only 130 of more than 600 districts and charter schools in the state (Arizona School Personnel Administrators Association, 2016).

Oklahoma's teacher demand projections over the years from 2015 to 2020 are only slightly greater than its annual supply, or about 320 vacancies each year. However, with imbalances by field and regional shortages in the southern half of the state (Berg-Jacobson & Levin, 2015), there has been a sharp increase in emergency credentials issued to underprepared teachers by the Education Department, increasing from just 98 in 2010–11 to more than 900 by 2015–16 (Nix, 2015).

By contrast, in Massachusetts, where there are many teacher preparing institutions and generally higher teacher salaries, recent supply and demand projections showed an overall surplus. The projections vary by subject, though, with an expected surplus of more than 1,000 general education teachers (almost 2% of the teacher workforce) offset by shortages in special education (3% of the special education workforce) and English Language Learner (ELL) education (9% of the ELL workforce; Levin, Berg-Jacobson, Atchison, Lee, & Vontsolos, 2015). We discuss the factors influencing state and regional variations in supply and demand further in Section III.

Shortage indicators by type of school and student. Some of the greatest variation in teacher shortages is not between states, but between schools, both within and across districts. Regardless of the state, students in high-poverty and high- minority schools typically feel the largest impact of teacher shortages. Historical patterns reveal a long-standing trend that has been a subject of many desegregation and school finance lawsuits: Students in high-poverty, high-minority schools are most likely to be taught by underprepared, inexperienced, and out-of-field teachers. These schools often experience difficulty hiring and high turnover on a regular basis, and they are the most severely affected when teacher shortages become widespread (Darling-Hammond, 2010a). This happens, in part, because inequitable funding of schools leaves many low-wealth urban and rural communities with inadequate resources, so they pay lower salaries and typically have poorer working conditions (Darling-Hammond, 2010a; Adamson & Darling-Hammond, 2012).

The Civil Rights Data Collection (CRDC), a universal survey of all public schools and districts, provides a more comprehensive overview of the distribution of teachers who lack certification. In 2013-14, on average, schools in the top quartile of minority student enrollment had nearly four times as many uncertified teachers as schools in the bottom quartile of minority student enrollment. In Maryland, Louisiana, and Colorado, high-minority schools had, respectively, 12, 8, and 5 times as many uncertified teachers as their low-minority counterparts. The Office of Civil Rights defines certified teachers as those who have "met all applicable state teacher certification requirements for a standard certificate" for a beginning teacher or one who has completed the state-required probationary period. In Colorado and DC, more than 20% of the teachers in high-minority schools were uncertified (NCES, 2014c). The proportion of uncertified teachers grew from 2014 to 2016 by nearly 50%, as schools experienced increasing difficulty in hiring and retaining certified teachers, and high-minority schools continued to have nearly four times as many uncertified teachers as low-minority schools (Learning Policy Institute, 2018).

In an effort to hold states accountable for the inequitable distributions of teachers, the U.S. Department of Education requires each state to create a state equity plan to address differential access to high-quality educators. The equity reports filed in 2015 reveal these same patterns across the nation, with unqualified, inexperienced, or out-of-field teachers disproportionately found in high-poverty and high-minority schools (Williams, Adrien, Murthy & Pietryka, 2015). These data can be interpreted as shortages in high-minority and high-poverty schools and/or as distributional problems within the contexts of districts and states. Either way, the extent to which underprepared teachers are hired in these schools is a constant factor that grows greater during times of broader shortages.

The Debate about Shortages

As we have noted, some argue that there is not a teacher shortage, but only staffing difficulties in certain locations or hard to staff subject areas that can be addressed with subject-specific salary bonuses rather than across-the-board pay hikes or changes in teaching conditions (Aldeman, 2016; Antonucci, 2016).

Others argue that teacher shortages are cyclical and will ultimately solve themselves (California Legislative Analyst's Office, 2016). The reasoning is that, with news of growing teacher vacancies, more teachers may join the profession to bring the labor market toward equilibrium. The key policy question is whether that can happen without policy interventions such as increases in salaries or improvements in teaching conditions? In a regulated occupation where the market is unable to fully respond, would such a natural rebalancing occur? Could it happen in a way that benefits all students? And what will happen to students in the meantime, especially those who are likely to bear the brunt of shortages by being assigned to untrained teachers, experiencing cancelled courses or larger class sizes where qualified teachers cannot be found (Podolsky & Sutcher, 2016)?

History suggests that the market has not traditionally responded effectively to all shortages. In math and science—fields in which individuals can earn a lot more outside of education—there have been shortages since the 1950s (Darling-Hammond, 2010a). Special education similarly has made its way on the perennial shortage list year after year, creating serious staffing challenges (U.S. Department of Education Office of Postsecondary Education, 2017). If policy interventions are to ensure there are enough teachers to go around, and that they are being directed to the subject areas and locations where they are needed the most, it is necessary to have a clear idea of what the sources of shortages are in order to understand how they might be addressed.

Data and Methodology

The analyses in this article rely on a number of databases. To analyze and project demand, we first examine teacher turnover in the workforce using the Schools and Staffing Surveys (SASS) Teacher File 2003–04, 2007–08, and 2011–12, and the SASS Teacher Follow–Up Surveys 2004–05, 2008–09, and 2012–13. Both of these are nationally representative data sources that monitor teachers and schools over time. The Common Core of Data (CCD), years 1999–00 through 2012–13, a universal database on teachers and students in the United States, provides accurate teacher and student counts. Finally, public school teacher projections 2000 to 2025 published in the Digest of Education Statistics allow for our model to estimate workforce trends a decade into the future.

To examine teacher production and the supply side of the labor market, this analysis uses universal data on teacher preparation programs collected by the U.S. Department of Education under Title II of the Higher Education Act—the most recent and complete national data on teacher preparation. To further investigate an individual's journey from teacher preparation to the classroom, we use the 2008:2012 Baccalaureate and Beyond (B&B), a longitudinal dataset that follows recent baccalaureates from 2008 until 2012, four years after their graduation, with a special focus on careers in education. This collection of data is used in tandem with the modeling techniques described below to provide the estimates and projections in this paper.

Teacher Demand

To model demand, we use the public school teacher projections from 2000 to 2025 produced by the NCES (Hussar & Bailey, 2014). These NCES teacher workforce projections were modeled based on pupil-teacher ratios predicted by current economic conditions and future student enrollment estimates. The NCES teacher projections are extended into the future by looking at total student enrollment and the pupil-teacher ratio projected over time. We refine these estimates using several additional nationally representative data sources that examine teachers and schools over time: the Schools and Staffing Survey (SASS) Teacher File 2011–12, the SASS Teacher Follow-Up Survey 2012–13, and Common Core of Data (CCD) years 1999–00 through 2012–13. Below we explain the factors that comprise demand and discuss the methodology we used to model demand in more detail.

The first component of the teacher labor market is teacher demand. Knowing how many teachers are needed is crucial to understanding labor market needs and thus ensuring that every community has access to a sufficient supply of well-qualified teachers.

Demand in the teacher labor market can be thought of in two ways. Total teacher demand represents the total number of teachers required to educate the nation's students. In 2015-16, the total teacher demand was roughly 3.1 million full-time-equivalent (FTE) public school teachers in classrooms across the United States (NCES, 2014a). Most of these positions are filled by teachers who remain in the workforce from the year before (NCES, 2004, 2008, 2012). However, on average between 2012–13 and 2015–16, about 250,000 positions (NCES, 2015b) must be filled due to some combination of the increase in student population, changing pupil-teacher ratios, and teachers who leave the profession (Haggstrom et al., 1988). This second way of considering teacher demand—the annual need for teachers to fill vacant positions—is what we focus on in this article.

One of the biggest challenges in estimating demand is navigating the difference between ideal demand and actual demand. Ideal demand requires defining the desired pupil-teacher ratio, geographic teacher distributions, and course requirements to determine the perfect number of teachers necessary each year. The actual demand represents reality—the need for teachers based on the number of teachers actually hired and employed. For example, in the Great Recession, actual

demand for teachers dropped as budgets were cut, and schools could not afford to hire new teachers or even keep the teachers they already had. In this case, actual demand dropped, but ideal demand did not. In an ideal sense, schools would like, at a minimum, to be able to maintain the number of teachers and return to the class sizes and course offerings they had in place before the recession.

The projections in this paper, while mindful of ideal demand, attempt to estimate actual demand using NCES projections of student enrollments, pupil-teacher ratios, and the teacher workforce. These estimates are just that—estimates. Using historical data and indications of future trends, these projections paint a potential picture of the workforce in the future. We first examine the factors that determine the quantity of teachers needed in the classroom. Next, we look at indicators that speak to current trends in demand. Finally, in order to further understand the teacher labor market and pressing policy needs, we use current data to model teacher demand 10 years into the future.

Demand Factors

Some elements of teacher demand, such as student enrollments, are predicted by trends not easily influenced by education policy. Others, such as pupil-teacher ratios and attrition rates, are very directly influenced by policy strategies. We discuss each of these in turn.

Student enrollment. Student enrollment directly influences teacher demand. An increase in the school-age population corresponds with an increase in the number of teachers needed in the education system, as long as pupil-teacher ratios remain constant. Future public school enrollment numbers can be estimated by looking at birth rates, public school attendance rates, and immigration and migration patterns (Haggstrom et al., 1988). These indicate how many school-age children will enter school. Once the number of students entering school is estimated, historical data can be used to model how many students will stay in school and for how long.

Public school enrollment increased substantially (by 26%) from 1986 to 2007, growing from 39 million students to 49 million students. From 2007 to 2015, student enrollment remained relatively flat, hovering around 49 million public school students (see Figure 1). NCES estimates a steady increase in public school student enrollment starting in 2016, growing from 50 million to 53 million by 2025 (Hussar & Bailey, 2014; see Figure 1). These estimates are based on historical data on grade progressions and enrollment data as well as U.S. Census Bureau's school-age population estimates to project total public school enrollment to 2025. Although NCES does not specify what will drive this increase, the enrollment rate of 5- to 17-year-olds has changed less than three percentage points over the last 30 years, suggesting the majority of this growth, if the enrollment rates continue to remain relatively constant, will come from an increase of school-age children due to population growth (higher birth rates and/or immigration), with teacher demand rising in response (NCES, n.d.).
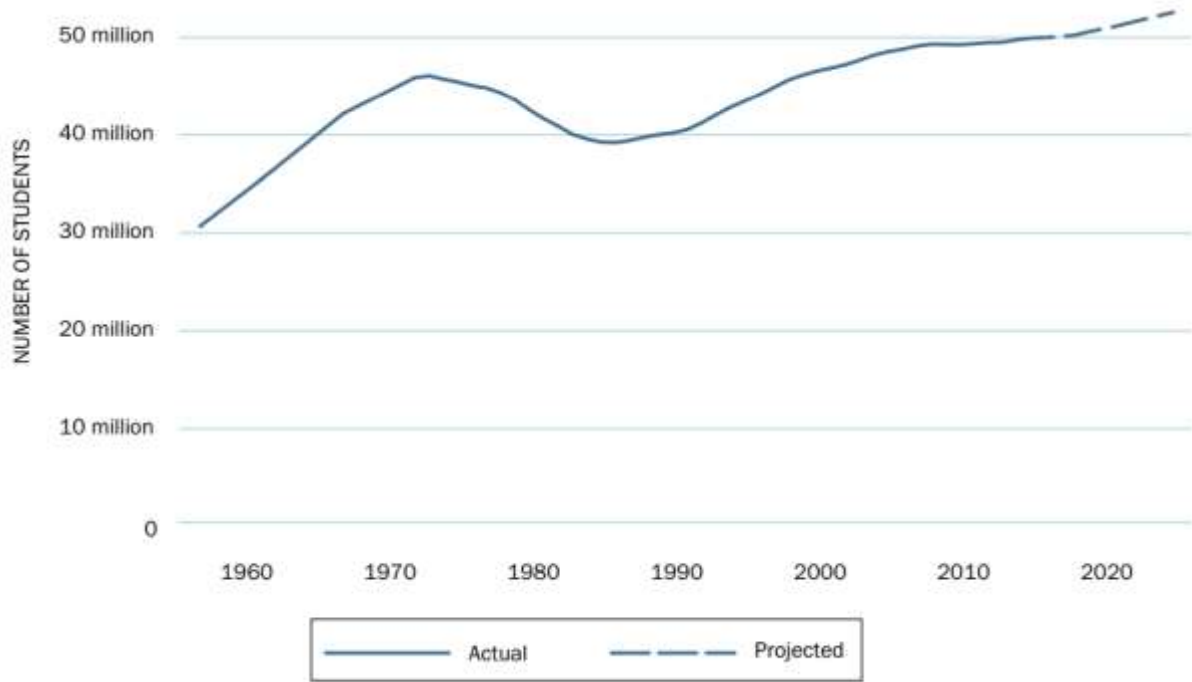
Figure 1. Student Enrollment in Public Schools 1955–56 to 2024–25
Source: (NCES 2015b)

     Pupil-teacher ratios. The pupil-teacher ratio is another component of teacher demand (Haggstrom et al., 1988). The number of additional teachers needed by a school district is dependent on the change in desired class size, as well as any adjustments in how schools are staffed and how staff are used. To estimate pupil-teacher ratios, researchers first look at school budgets and economic conditions influencing a district's ability to hire more teachers (Haggstrom et al., 1988). Second, state and local policies may influence pupil-teacher ratios by requiring certain class sizes.

     Currently, average public school pupil-teacher ratios are 16-to-1, an increase from its low point of 15.3 to 1 in 2008. Average pupil-teacher ratios trended downward from nearly 18-to-1 in 1986, remaining over 17 until there was a large push in the late 1990s and early 2000s for smaller class sizes and increased staffing for special education (Loeb & Beteille, 2009). When the Great Recession hit and education budgets were slashed, average pupil-teacher ratios quickly increased to 16-to-1, and have remained there for some time (see Figure 2). These ratios vary across states, from a high of 24-to-1 in California to a low of 11-to-1 in Vermont (NCES 2015d).

     NCES pupil-teacher ratio projections are produced by modeling both historical patterns and economic conditions, such as a teacher's relative wage compared to that of other workers and state education budgets, to determine the relationship between these factors, and current and future pupil-teacher ratios (Hussar & Bailey, 2014). The NCES projects that pupil-teacher ratios will slowly dip downward to the pre-Recession level of 15.3-to-1 by 2025 (see Figure 2). The effects of such a decrease on demand are significant: Reducing the pupil-teacher ratio from 16-to-1 to 15.3-to-1 would require hiring an additional 145,000 teachers in total (NCES, 2015b). Over a period of eight years, this reduction in the pupil-teacher ratio would increase annual demand by nearly 20,000 teachers a year. We incorporate this increase into our demand projections.
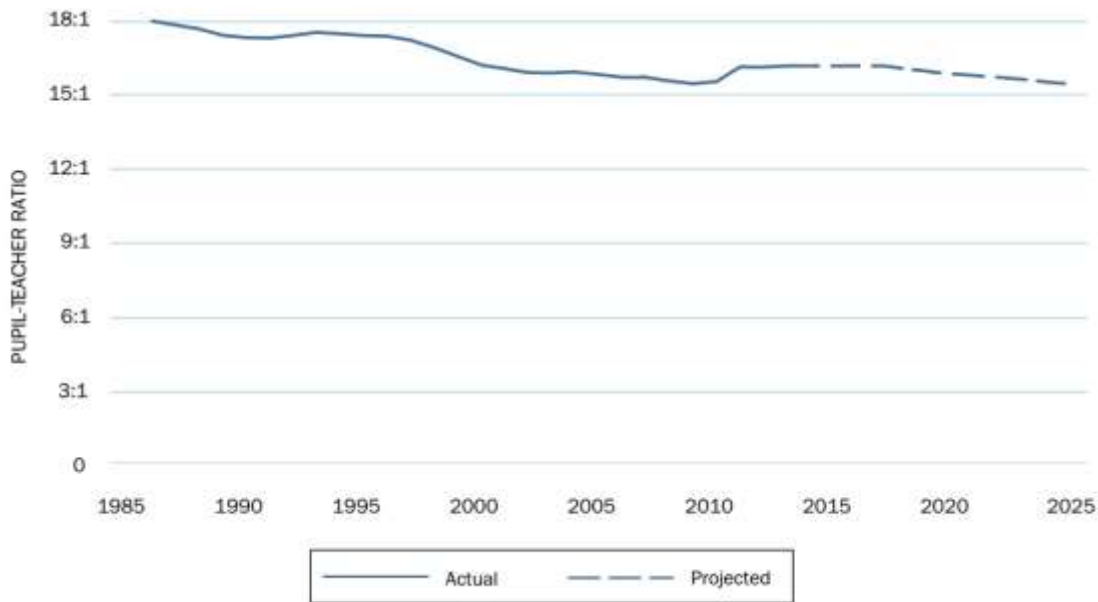
Figure 2: Public School Pupil-Teacher Ratios 1985–86 to 2024–25
Source: (NCES 2015b)

Attrition. The final component of demand for new hires is attrition. The number of new teachers demanded depends substantially on how many teachers leave the profession (Haggstrom et al., 1988). One form of departure is retirement. According to data from the Schools and Staffing Survey TFS 2004, 2008, and 2012, retirements on average account for about one-third of leavers. Preretirement attrition, due to school staffing decisions, life changes, or dissatisfactions with teaching, accounts for about two-thirds of all attrition and is estimated to have comprised around 66% of total new demand in the 2015–16 school year (see Figure 3). As we discuss in Section IV, policies that change attrition rates can greatly influence demand and the extent of shortages.

Based on the Schools and Staffing Surveys (SASS) from 2011–12 and the corresponding Teacher Follow-Up Survey (TFS) from 2012–13, the overall public school teacher attrition rate is calculated to be 7.68% (NCES, 2013). To put this in perspective, of the 3.1 million FTE teachers in 2011, 238,310 teachers did not teach the following year. In 1989, the attrition rate was below 6%; however, this rate climbed to 8.4% in 2004 and has remained near 8% since. The difference between a 6% and 8% attrition rate might seem trivial, but in 2015–16 alone, a 6% attrition rate would have cut demand by nearly 25%, eliminating the need to replace approximately 63,000 teachers.

Each year, different factors contribute varying amounts to teacher demand. For example, in some years, student enrollment growth is responsible for a noticeable portion of increased demand, while in other years, demand is driven almost entirely by attrition. Figure 3 shows the estimated breakdown of the different components comprising demand in 2012, 2016, and 2020. In each of these years, the largest portion of demand is driven by preretirement attrition.
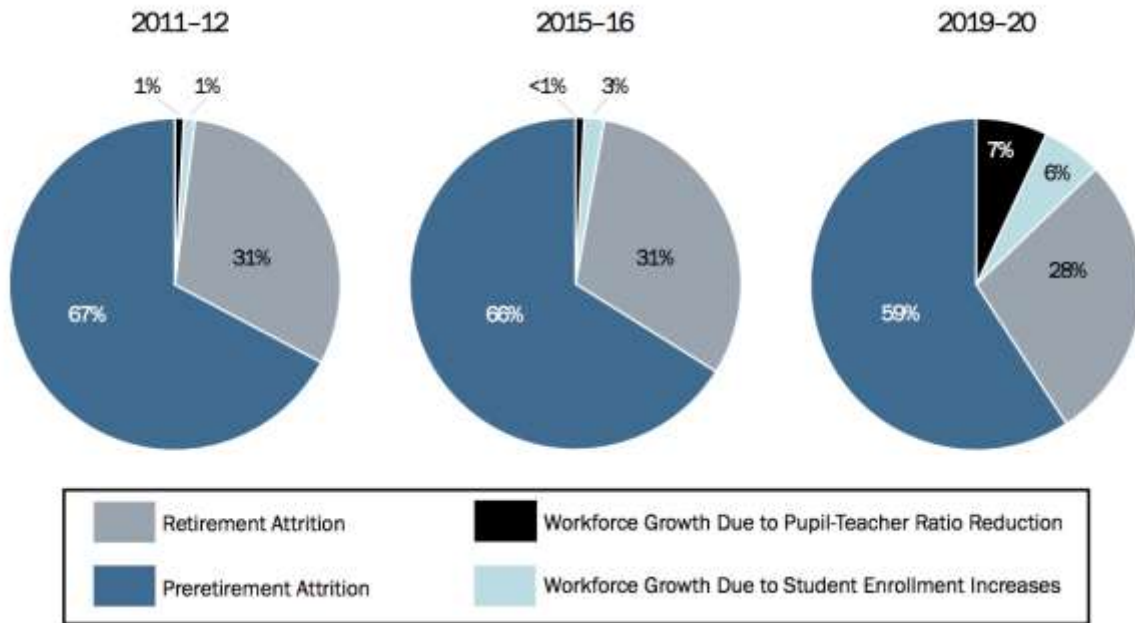
Figure 3: Components of Teacher Demand
Source: (NCES, 2004, 2005, 2008, 2009, 2012a, 2013 2014b, 2015b)

Modeling Teacher Demand

Since 2013-14, all of the above mentioned factors have played a role in boosting teacher demand. Student enrollment is on the rise, and if economic conditions hold firm, class sizes are predicted to decrease as districts move toward pre-recession class offerings and teacher workloads. Furthermore, attrition remains at relatively high rates with little indication of any change to come in the near future. Our overall methodological approach comprises four steps:

(1) Estimate the increase or decrease in the necessary number of public school teachers to educate all students between 2011–12 and 2012–13, using the NCES workforce projections. It is worth noting these estimates account for only student enrollment, pupil-teacher ratio, and the subsidiary factors that are used to calculate those figures, such as birthrates, migration, immigration, and current school budget—all assumed to continue with similar trends in the projected period. They do not account for exogenous shocks that could take place in the future, such as a sudden recession or a shift in education policy that funds smaller class sizes. In all, these projections are assuming the continuation of conditions in the current period.

(2) Estimate the number of teachers who left the classroom between 2011–12 and 2012–13— vacancies created due to attrition. In order to better estimate the number of teachers who left in a given year, it is important to differentiate teachers by shared characteristics, because a first-year teacher will not leave at the same rate as a teacher in her or his 10th year. This paper assumes that teachers with similar levels of experience will exit the teaching workforce at similar rates.

(3) Combine the change in total teachers demanded in step 1 with the number of teachers who left the classroom and need to be replaced in step 2 to calculate the demanded hires in 2012–13. In this step, because another school year has passed, teachers must advance by one year in the experience distribution. Each teacher is moved up one experience category, with teachers with 40 years of experience being moved to the over 40 years of experience category. By shifting these teachers' experience by one year, there are no new teachers. It would be easy to fill this empty value

if all new hires were first-year teachers; however, many new hires are actually re-entrants and have prior teaching experience. In order to appropriately account for the different experience levels of new hires, using the SASS 2011–12 public school teacher data file, the experience distribution of new teachers is applied to the estimated new teacher hires from the prior year.

(4) Repeat for years 2014 to 2025, assuming trends affecting public school enrollment (e.g., birthrates, immigration, and grade progression rates), teacher wages and education revenue, teacher experience-based continuation rates, the experience distribution for newly hired teachers, and general economic and political conditions remain similar during the projected period. Experience-based continuation rates are exponentially smoothed into the future to appropriately weight each year of observed data. The most recent data are weighed most heavily, with exponentially diminishing value given to the older observed data from the SASS 2008–09 TFS and SASS 2004–05 TFS. This process yields projected teacher demand estimates to 2024–25. The main limitation of the aforementioned methodology, which is used in most forecasting, is that the model heavily relies on one year of data—data collected from the SASS 2011–12. Although using exponential smoothing for continuation rates helps incorporate older data, most of the data and assumptions are derived from the 2011–12 school year, during the Recession era.

In Figure 4, the solid line represents observed demand, while the dashed line represents projected demand. The impact of the Great Recession is evident by the sharp decrease in demand between 2008 and 2012 as a result of budget cuts and layoffs that occurred during these times of austerity. Teacher demand shows a sharp increase after 2012, leveling off at around 260,000 teacher hires by 2014. In 2017–18, there is a large projected increase, which brings annual demanded teacher hires to 300,000 a year. This model projects the largest demand increases are yet to come, eventually requiring over 300,000 public school teacher hires a year, the largest number of annual teacher hires in the last decade.
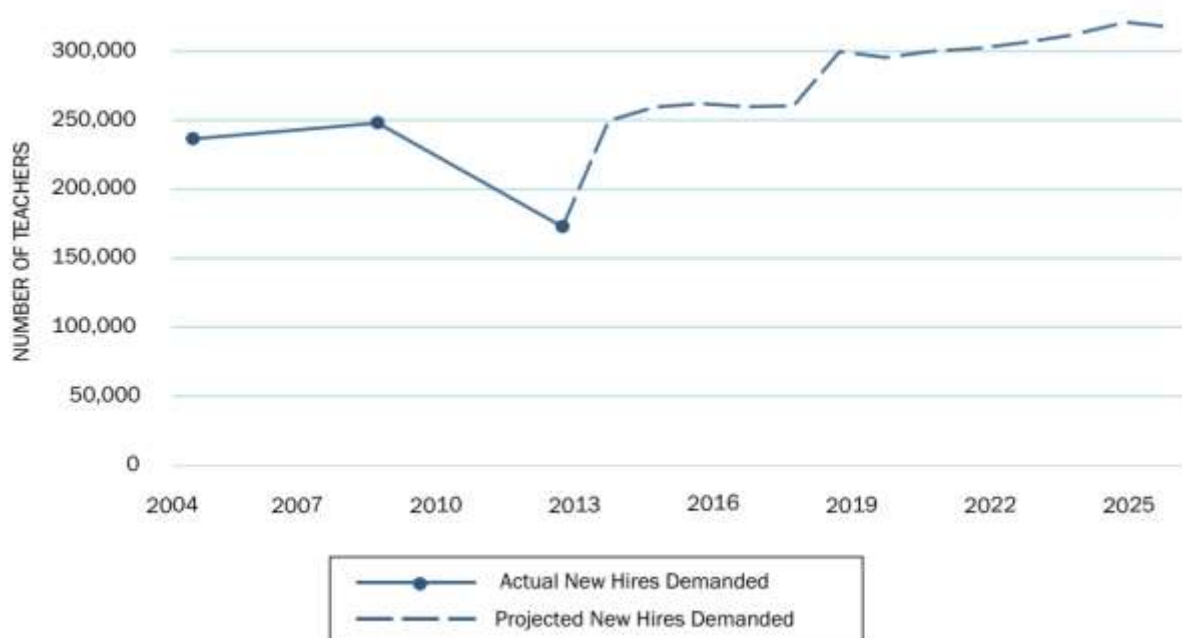
Figure 4: Estimated New Teacher Hires Demanded
Note: Data for teachers are expressed in full-time equivalents
Source: (NCES, 2004, 2005, 2008, 2009, 2012a, 2013, 2014b, 2015b)

This large increase in demand is not inherently a cause for alarm. After a period of austerity, it is no surprise that schools are attempting to return to pre-recession conditions. In fact, the downturn in the teacher workforce during the Great Recession was relatively modest compared to its considerable growth in the years before. Between the late 1980s and 2008, the teacher workforce grew at more than twice the rate of student enrollment growth, driven not only by declines in pupil-teacher ratios, but also by programmatic changes that called for more mathematics and science teachers when high school standards were raised, as well as more special education and bilingual/ESL teachers when services were expanded (Ingersoll, Merrill, & Stuckey, 2014). Other changes, like expansions of kindergartens from part- to full-day and increases in graduation rates that kept more high school students in school, also influenced the need for teachers (Chapman, Laird, & KewalRamani, 2010; Kena et al., 2016).

In the years ahead, a sizable demand is projected: New hires are expected to fill positions that were lost during the Great Recession, as well as positions that are created to keep up with increased student enrollment and smaller pupil-teacher ratios. The question is, as demand rapidly rises, can teacher supply expand to keep pace and provide all classrooms with well-qualified teachers? Alternatively, can we reduce attrition sufficiently to make the supply of teachers more adequate?

Teacher Supply

The second component of the teacher labor market is teacher supply. To model supply we use both enrollment and completer data from the Title II data collection, data from national databases such as the Baccalaureate and Beyond, and prior research on teacher re-entry. Below we describe the various components of supply, and discuss our methodology in more detail.

States and districts need accurate information about production and availability of future teachers to assess and plan for their workforce needs. To evaluate the current condition of teacher supply, we first identify indicators of teacher preparation program enrollments and completions. Next, we take a more complex methodological approach to model teacher supply over the last decade and to project supply into the next decade. These analyses reveal a significant reduction in teacher supply over the years from 2009 to 2014, and shortages continuing over the next decade, if current teacher preparation enrollment trends continue. Given these sharp decreases, it is critical to understand the policy levers surrounding recruitment and retention that could support a high-quality, sustainable teacher workforce.

Like teacher demand, there are several different ways to think about teacher supply. One way to analyze supply-side dynamics is total teacher supply. Total activated teacher supply could be conceptualized as the entire teacher workforce: For example, in 2015-16, the 3.1 million FTE public school teachers in classrooms across the United States (NCES, 2014a). The majority of these teachers remain in the workforce the following year; however, a substantial number of positions vacate and must be filled.

Examining the pool of teachers who will potentially be available to fill empty classrooms is a second way of looking at teacher supply and is most relevant to labor force analysis. This teacher supply can be thought of as the number of potential teacher entrants who were not teaching in the previous year, who are either new entrants to the profession or re-entrants who have stepped out from teaching for a period of time. At the local or state level, individuals who may be recruited from other schools or states are also considered a source of supply. The teacher supply that has the potential to meet the number of newly demanded employees is adjusted by two main influences: new entrants and re-entrants (Haggstrom et al., 1988). Individuals who hold valid teaching credentials, whether or not they are currently in the workforce, are thought of as the supply pool.

Some of these individuals may enter or re-enter teaching under the right conditions. Understanding these conditions is important for policymakers, particularly in times when shortages emerge.

Supply Factors

New entrants. In most years, new entrants comprise over half of the annual teacher supply (NCES, 2004; 2008; 2012). The potential supply of new entrants is often estimated as the number of recent fully credentialed teachers who have not yet taught. When fully credentialed teachers cannot be found, sometimes teachers are hired who are not fully prepared for the subjects they teach. State laws generally indicate that underprepared teachers cannot be hired when fully credentialed teachers are available. Thus, when underprepared teachers are hired, it typically indicates evidence of a shortage. Estimating the number of new entrants into the workforce in a given year can be tricky. Universal data collected by the federal government on teacher preparation programs can be used to help deduce the number of candidates who enroll in and complete teacher preparation programs.

However, these data do not reveal how many and how soon recent completers end up teaching in the classroom. Longitudinal studies conducted by institutions of higher education that follow college graduates in their educational and occupational pursuits can provide estimates of when and how many college graduates enter teaching. These sample sizes are relatively small and non- representative of all teachers. The federal government periodically conducts some surveys, like the Baccalaureate and Beyond survey, that follow college graduates into their careers, which can provide some information as well. A combination of these types of data—individuals who have completed teacher preparation programs and individuals who have accepted teaching jobs—is necessary to properly investigate patterns of entry into the teacher labor market.

Past estimates in the literature generally find between 70% and 90% of newly minted teachers end up in the classroom in the year following their teacher preparation, with higher rates of entry from postbaccalaureate programs than from undergraduate programs (Darling-Hammond, 2000). Historically, new teachers often came straight from undergraduate teacher preparation programs (Haggstrom et al., 1988). Today, it is increasingly common to obtain a teacher credential through a postgraduate program. Some states (CT and NY, for example) have required that teachers achieve a master's degree in order to receive professional certification; in California, nearly all teaching credentials are issued in postbaccalaureate teacher education programs. In addition, federal incentives for alternative certification have created postbaccalaureate pathways in many states (Darling-Hammond & Sykes, 2003; U.S. Department of Education Office of Postsecondary Education, 2013). One survey in 2011 found that about one-third (34%) of respondents had entered the profession through a postbaccalaureate program (Feistritzer, 2011).

While some education graduates select occupations other than teaching, others enter teaching after a delay. The nature of this delay from preparation to practice adds delayed entrants as a sub- category of teachers that must be accounted for when examining new entrants.

Estimates of completer-to-teacher entrant rates are tied to labor market conditions. For instance, the comparative wage a teacher is paid relative to other jobs in the economy can affect the decision of a newly qualified teacher to enter the classroom (Loeb & Beteille, 2009). Furthermore, the relative availability of teaching positions alters the likelihood that a newly qualified teacher who wants to enter the profession finds a job. In times of high demand, when there are more job openings, the percentage of hires coming straight from a teacher preparation program increases (Darling-Hammond & Sykes, 2003).

Some evidence suggests delayed entry also varies by subject area. High rates of delayed entry are evident in some fields such as physical education and elementary education, but a recent study using national data found that almost all newly prepared mathematics and science teachers entered teaching within a year of graduating if they entered teaching at all (Ingersoll, 2011).

We used survey responses from the 2008:2012 Baccalaureate and Beyond (B&B), a longitudinal study that follows college graduates after they receive their BA degree, to determine the percentage of students who were prepared to teach but did not end up in the classroom in a four-year period. The data provide an estimate that 75% of newly minted teachers ended up teaching within four years. It is possible some of these teachers end up teaching in private school, but, as private school enrollments are less than 10% of total school enrollments, the percentage would likely be similarly small. It is worth noting that the B&B sample includes only recent BA graduates; therefore, this estimate does incorporate many teachers coming from graduate-level pathways or nontraditional routes, which typically have higher entry rates.

The four-year average has the benefit of accounting for many delayed entrants. However, the years sampled were during the Great Recession in precisely the years that many beginning teachers were being laid off, and fewer new teachers were able to get teaching jobs than would normally be the case. Thus, we think of this as a lower-bound estimate of entry rates into the profession. For this reason, our analysis used a lower bound of 75% and an upper bound of 90% to model the flow of recruits from teacher preparation to the classroom.

Re-entrants. Re-entrants make up the other component of teacher supply. A proportion of teachers each year leave the occupation for personal and professional reasons (Shields, Esch, Humphrey, & Young, 1999). These exits create a reserve pool of teachers who have a teaching credential and experience but are not currently teaching (Haggstrom et al., 1988). Some of these individuals come back to teaching at a later date as re-entrants. The size and willingness of candidates in the reserve pool to re-enter is difficult to estimate, but existing data allow us to examine the share of annual hires who come from this pool. Recent estimates from the 2011–12 SASS survey find that approximately 49% of teachers entering the teaching workforce are re-entrants. A re-entrant is defined as a new hire (someone who was not teaching in public schools the previous year) who has prior experience teaching in public schools. We note that labor market conditions in 2011–12 were unusual in that year, because many districts were laying off teachers, especially beginners, and hiring very few new teachers. Proportions of re-entrants as a share of total hires likely vary with labor market and economic conditions as alternate employment opportunities fluctuate (Haggstrom et al., 1988). For example, the 2011–12 estimate of 49% is likely elevated because after the Great Recession, as the workforce began to expand, schools rehired many teachers who had been laid off just a few years prior as re-entrants. In 2003–04 and 2007–08, the proportion of new hires that were re-entrants was lower, at 41% and 37%, respectively (NCES 2004; 2008; 2012).

Research suggests that many re-entrants left with the intention of returning, including teachers who stepped out for child-rearing or other personal reasons (Grissom & Reininger, 2012). Estimates suggest that just under a third (between 28% and 32.3%) of teachers who leave teaching come back to the classroom within five years (Grissom & Reininger 2012; Murnane, Singer, Willett, Kemple, & Olsen, 2009). On average, teachers who are female and who have more teaching experience (controlling for age) are more likely to re-enter teaching, as are those who receive higher salaries (Grissom & Reininger, 2012). Most teachers who choose to re-enter teaching do so after just one or two years out of the classroom. The more time a teacher spends away from the classroom, the less likely he or she is to return to the profession (Grissom & Reininger, 2012; see also Haggstrom et al., 1988).

Understanding that the proportion and rate of re-entrants can vary, in our analysis we estimate an upper and lower bound for the rate at which teachers who leave return to the classroom within five years of leaving. Grissom and Reininger (2012) found that 38% of teachers who leave the classroom return at some point. However, using their time to re-entry estimates by year, we know

within the first five years, 85% of teachers return; therefore, 32.3% of all teachers who left, returned within five years. (Grissom & Reininger, 2012). We use the upper-bound rate of 32.3% and the lower bound of 28% (Murnane et al., 2009), which are based on the range of estimates found in high-quality studies on teacher re-entrance.

Modeling Teacher Supply

Currently, key indicators point to a significant decrease in the supply of teachers. Enrollments in teacher preparation programs across the country have decreased steadily in recent years. Between 2009 and 2014, the most recent years of data available at the time of our analysis, there was a 35% reduction in undergraduate and postbaccalaureate teacher preparation enrollments, which amounts to a decrease of almost 240,000 fewer professionals working their way toward the classroom in 2014 as compared to 2009. Another way of looking at the future teacher supply is by observing the number of prospective candidates who attend a teacher preparation program and complete the requirements for a credential. The number of completers decreased by over 23% from 2009 to 2014 (U.S. Department of Education, n.d.). Together, these decreases indicate significantly reduced teacher supply (see Figure 5).
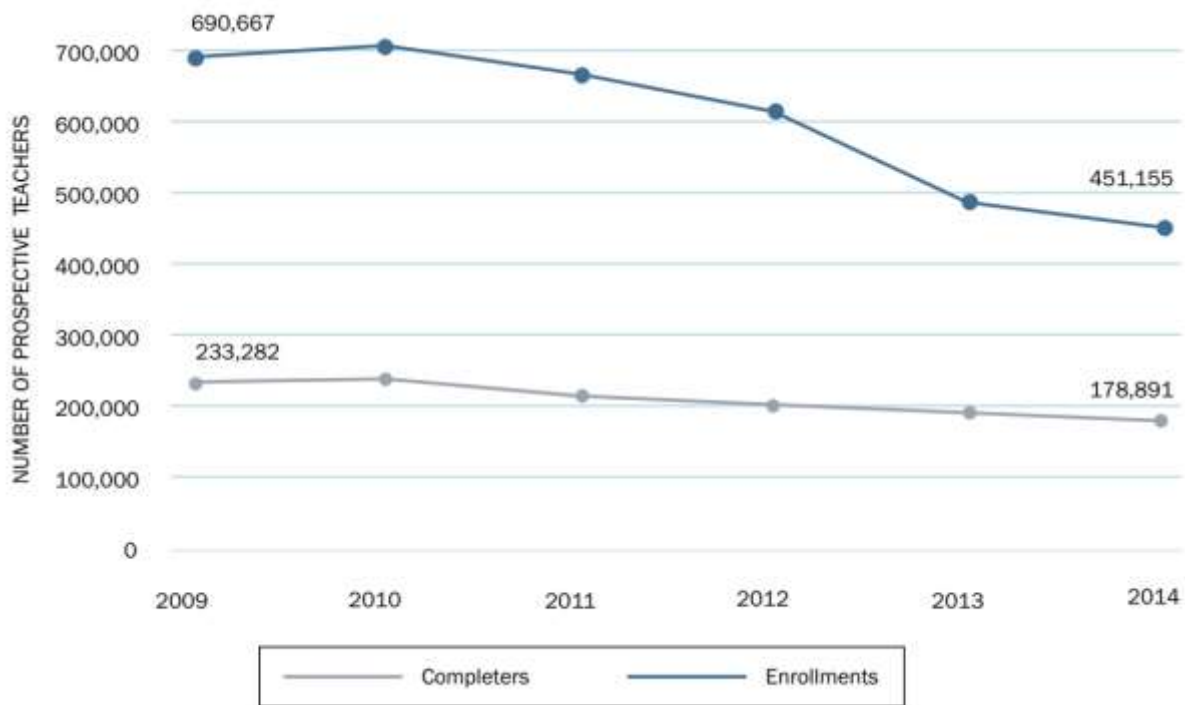
Figure 5: National Teacher Preparation Program Enrollment and Completers
Note: Data include prospective teachers from both traditional and alternative teacher education programs.
Source: (U.S. Department of Education, n.d.)

A common hypothesis for the dramatic downturn in supply is that the highly publicized teacher layoffs during the Great Recession left a mark on the public psyche, including individuals who might have been considering a teaching career. In addition to the fact that there were few jobs available, budget cuts resulted in frozen salaries and deteriorated teaching conditions as resource limitations led to increased class sizes, and fewer materials and instructional supports.

One sign of the cumulative impact of these factors is that only 5% of the students in a recent survey of those taking the ACT college entrance exam were interested in pursuing a career in education, a decrease of 29% between 2010 and 2014 (ACT, 2014). In an annual national survey of college freshmen, only 4.2% of students indicated their probable field of study would be education. This is fewer than half the share who expressed interest in 2007, when 9.2% of students intended to major in education, and the lowest proportion of students considering teaching in the last 45 years (Cooperative Institutional Research Program, UCLA Higher Education Research Institute, 2016).

Enrollment and completion rates reveal important information about the current teacher labor market. Modeling teacher supply using these data in tandem with longitudinal analysis of college graduates and teacher re-entry allows a more powerful analysis.

Figure 6 estimates new teacher entrants over the past decade using universal data on teacher preparation programs collected by the U.S. Department of Education under Title II of the Higher Education Act—the most recent and complete national data on teacher preparation. We use the average ratio of completers to enrollments (.303) to project current enrollments into future completers. We then obtain a range of new teacher estimates by multiplying the number of completers by a lower and upper bound (75% and 90%) for the rate at which completers are expected to end up in the classroom.

We estimate total teacher supply using the average annual attrition rate reported by the National Center for Education Statistics (7.88%) (NCES, 2015c), the upper (32.3%) and lower (28%) bounds of re-entry rates, and estimates of the timing of return for these re-entrants by Grissom and Reininger (2012). To estimate supply into the future, we exponentially smooth new teacher entrants through 2025 following the same methods as described above to produce total teacher supply. Assuming supply holds constant, meaning new entrants and re-entrants remain constant at 2016 levels, these projections illustrate future supply.

Figure 6 shows a steady decline in the teacher supply starting in 2009. According to our model, we estimate 2016 to have the lowest number of available new entrants in over 10 years, at around 113,000 first-time teachers. This estimate is calculated by finding the mid-point between the upper and lower bound of new entrants. The upper and lower bounds in brackets indicate where total supply will lie based on variation in re-entrants and the entry rate. In 2015–16, the overall teacher supply (new entrants and re-entrants) was estimated to be between 180,000 and 212,000 teachers, while the demand is approximately 260,000.

Depending on economic conditions and changes in the desirability of teaching, teacher supply will vary. Assuming that new entrants and re-entrants remain at 2016 levels, this model estimates that supply will decrease through 2017 and remain near that low level through 2021. Constant supply is unlikely given the reactive nature of supply and demand; however, projecting current trends into the future illuminates the extent of the labor market gap if nothing is done to alter current trends.

Since the analysis was completed, new Title II data revealed that declining enrollments continued through 2015 until there was a slight uptick in 2016. However, education preparation enrollments are still below the 2014 levels (recent lows), shown in the Figure 5. (U.S. Department of Education, n.d.). Although this uptick is promising, absolute enrollment counts remain at recent lows.
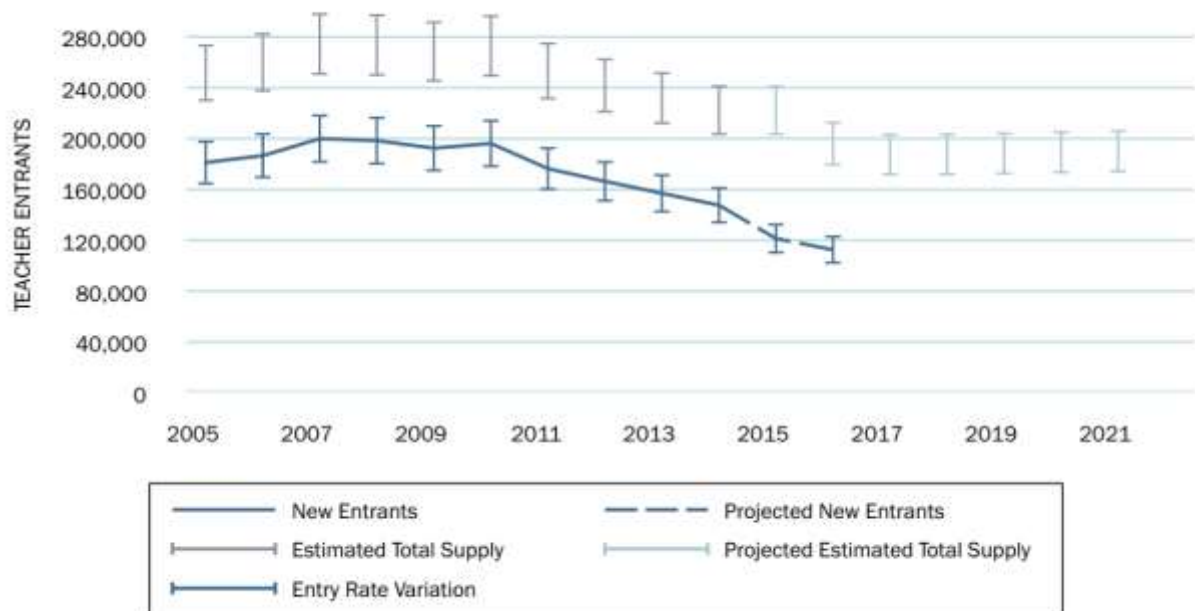
Figure 6: Estimate Teacher Supply
Note: Error bars represent high and low projections for total teacher supply to account for varying economic conditions that affect the entry and re-entry rates.
Source: (U.S. Department of Education, n.d.; NCES, 2012b)

It is also important to remember, even as enrollments could be increasing, candidates do not necessarily choose the fields and subject areas in which there are large numbers of vacancies, nor do they choose to teach in the hard-to-staff locations where the shortages are most pronounced. In fact, candidates are often less likely to go to these higher-need schools when there are more vacancies in well-heeled districts that tend to have easier working conditions and better salaries. Policymakers must ensure not only that there are enough teachers to meet demand, but also that there is an adequate supply of teachers for the fields and locations where they are needed most.

Results

For each component of the labor market, we have examined the contributing factors and the current outlook, and we have modeled estimates of current and future trends. Looking at these components separately allowed us to investigate each in a degree of detail necessary to later understand how supply and demand interact together in a policy context. Now, combining supply and demand together allows us to investigate the teacher labor market as a whole.

Figure 7 shows the size of the predicted teacher shortage. In the early 2000s, demand fell roughly within the brackets of total teacher supply, suggesting relative balance in the teacher labor market. In 2010, 2011, and 2012, supply was greater than demand. This finding matches with reality; during the Great Recession, teachers were being laid off, and it was difficult to find work. In other words, there was a surplus of teachers. In 2013, however, as the economy recovered, demand rose steeply, while supply continued to remain low and declined further in 2014 and 2015. During this period, the teacher labor market moved into a shortage condition.

Based on our 2015 estimates, there were not enough qualified teachers to meet the demand. The shortage in the 2015–16 school year was estimated to be between 47,000 and 80,000 teachers.

We estimated that, if supply trends were to persist at these lows, in 2017-18, as demand increases again, supply would be around 112,000 teachers short of demand. We can expect some increase in the number of individuals entering teaching in response to greater demand. Nonetheless, even if supply increases to pre-recession levels of 260,000 teachers a year, demand would still be outstripping supply by approximately 40,000 teachers. Furthermore, the perennial areas of acute shortages (special education, mathematics, and science) thus far show little sign of response to labor market demand with states reporting continued shortages in these fields (U.S. Department of Education Office of Postsecondary Education, 2017).
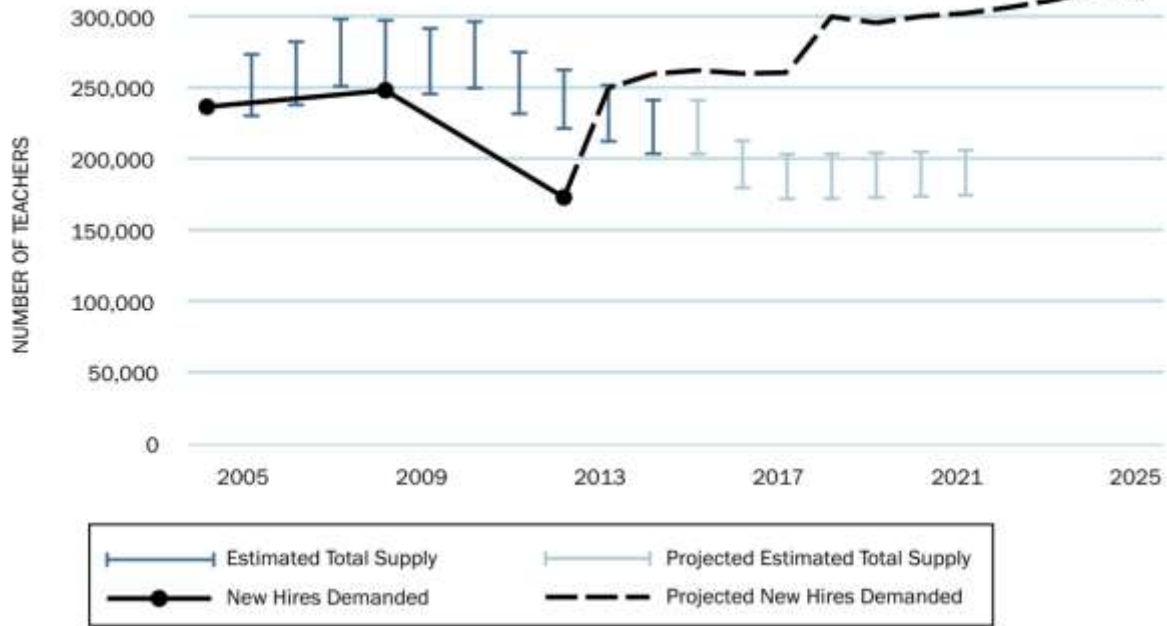
Figure 7: Projected Teacher Supply and Demand
Source: (NCES, NCES, 2005, 2008, 2009, 2012a, 2013, 2014b, 2015b, 2012b; U.S. Department of Education, n.d.)

Figure 7 suggests that the United States is in the midst of a teacher shortage that, if current trends continue, would worsen further. This estimate appears close to current reality. In fact, as discussed earlier, a review of state teacher workforce reports from 2016 and 2017 revealed that nationally, approximately 109,000 individuals were uncertified for their teaching position, very close to our estimated shortfall (Learning Policy Institute, n.d.).

The effects are likely to be felt in some subject areas, states, and communities more than others, as we describe below. Examining the distribution of teacher preparation programs, starting salaries, and working conditions, as we do below, helps us understand the variability in teacher labor markets by state, and how those differences could have an impact on teacher supply and demand.

Factors That Influence Variation in Supply, Demand, and Shortages

Availability of new teachers. States vary in the number and size of preparation programs they sponsor, and their yield in relation to state hiring demands (U.S. Department of Education, n.d.). Because of this variation some states are net importers of teachers and others that are net exporters. For example, according to our analysis of Department of Education data, Wyoming, Alaska, and North Dakota—net importers—issued 72%, 75%, and 100%, respectively, of their

initial teaching credentials to out-of-state prepared candidates in 2013–14. On the other hand, in the same year, New Jersey and New York—net exporters—issued effectively no initial teaching credentials to individuals who prepared out of state. This analysis excludes New Mexico, which did not report these data (U.S. Department of Education, n.d.).

Teachers do move around the country; one analysis found about one-quarter of all applicants for teaching positions across the country were from out of state (Ingersoll & Perda, 2010). At the same time, states that prepare a great many teachers, relative to their needs, have at least two advantages. First, many teachers prefer to teach near where they grew up or went to school (Boyd, Lankford, Loeb, & Wyckoff, 2005), and some will have job offers from the districts where they student taught. In addition, teachers earn state-specific credentials while they are preparing, and candidates sometimes encounter a variety of barriers in trying to transfer credentials to other states, creating steep transaction costs for moving. States that prepare fewer teachers must attract out-of-state candidates to fill their vacancies, which can be even more difficult in times of shortage. Thus, the concentration of teacher preparation providers and number of candidates completing these programs is likely one reason for the variation in labor markets by state.

Salaries. State differences in starting teacher salaries can also contribute to the variability in teacher labor markets. Salaries can affect the attractiveness of teaching jobs in ways that impact both recruitment and retention (Adamson & Darling-Hammond, 2012). According to data from the National Education Association, the average starting teacher salary in the United States in 2016-17 was $30,249, but the range was very wide. In 2013, the District of Columbia had the highest starting salary at $55,209, and Montana had the lowest starting salary at $31,418, unadjusted for cost of living differentials (National Education Association, n.d.).

Within states, school district funding often varies, with strong consequences for salary levels. Great inequalities in salaries across districts typically cause shortages in those that are not able to offer a competitive wage (Adamson & Darling-Hammond, 2011). Some of this variation can be explained by cost-of-living differences, but even in higher-paying states, such as California, there can be wide variations in wages that are not associated with cost-of-living differentials, leaving many teachers struggling with the higher cost of living and lower purchasing power. One analysis of California teacher salaries found a 2 to 1 ratio of wages for similarly experienced and educated teachers across the state, which actually grew to a 3 to 1 differential when cost of living differentials were taken into account. These differences were closely associated with teacher shortages in low-wage districts (Adamson & Darling-Hammond, 2011) These variations in salaries are another reason why states experience teacher shortages differently.

The competitiveness of teachers' wages to those of non-teaching occupations requiring similar levels of education can be just as important as teacher salaries themselves, as these are an influential factor in teachers' decisions to enter the profession (Loeb & Beteille, 2009). Wage competitiveness also varies from state to state. After controlling for age, education level, hours worked per week, and weeks worked per year, teachers in Wyoming earned 94% of what non-teachers in the state earned in 2012. The ratio in Alaska and Iowa was 85%. Conversely, teachers in Arizona and Virginia earned only 62% and 63%, respectively, of what this group of non-teachers earned (Baker, Farrie, & Sciarra, 2016). It is important to remember there are two moving parts in these ratios—teacher wages and non-teacher wages. So a high-wage competitiveness ratio could represent high teacher wages and average non-teacher wages, or average teacher wages and low non-teacher wages, or any combinations in between.

Working conditions. Working conditions that teachers report as important to their decisions to stay, leave, or return to the classroom vary by state. One working condition important to teachers is the average number of students they teach: their class sizes or pupil loads. Although

class size is always a higher number than average pupil-teacher ratios, the two are correlated, and widely varying across the country. In 2014, when the national average pupil-teacher ratio was 16-to-1, California's ratio was 24-to-1, while Vermont's was 11-to-1 (NCES 2015d).

Other conditions found to be related to teachers' decisions to stay in or leave a school—such as competent and supportive leadership, a school's testing and accountability environment, and teacher autonomy in making key classroom decisions—also vary substantially.

For instance, according to data from the 2011–12 SASS, more than twice as many teachers in Arkansas strongly agreed that their administration was supportive as did teachers in the District of Columbia (58% vs. 24%) (NCES, 2012a). More than 10 times as many teachers in Indiana and Florida strongly agreed their job security was impacted by the performance of their students or school on state or local tests as in Vermont and North Dakota (25–26% vs. 2%) (NCES, 2012a). Whereas roughly 88% of teachers in Montana, North Dakota, and Vermont agreed they have decision-making autonomy in the classroom, fewer than 60% felt this way in Delaware, Florida, and Maryland (NCES, 2012a). We measured teacher autonomy in the classroom using a Cronbach Alpha generated construct of classroom control derived from six components: Control over textbooks and materials, content and skills to be taught, teaching techniques, evaluating students, discipline, and homework. All of these differences are associated with differences in teachers' plans to leave teaching across these states.

Attrition rates. It should be no surprise, then, that teachers' estimates of how long they will stay in the profession also differ by state. Teachers in Washington, DC, are more than five times as likely to report they plan to leave the classroom as soon as possible as are teachers in South Dakota. Teachers are most likely to say they plan to leave teaching in Arizona, Nevada, and Washington, DC, and least likely to report plans to leave in Illinois, Rhode Island, and South Dakota (NCES, 2012a). Indeed, federal data show that close to one in four teachers moves schools or leaves the profession annually in Arizona and Washington, DC, more than three times the rate in Rhode Island, for example (NCES, 2012a). Not surprisingly, states with more teachers who plan to leave teaching tend to be the same states with a smaller percentage of teachers planning to teach as long as possible or until they are eligible for retirement benefits.

Sources of Shortages

In order to respond effectively, it is important to understand what factors are driving these shortages and what can be done to shift teacher supply and demand to bring the teacher labor market to equilibrium. Based on the evidence available, the emerging teacher shortage appears to be driven by four main factors: 1. Decline in teacher preparation enrollments; 2. An effort to return to pre-recession course offerings and class sizes resulting in lower pupil-teacher ratios; 3. Increasing student enrollment; and 4. High teacher attrition.

We identify the first three factors because these have shown the largest changes at the same time teacher shortages have increased. For example, between 2009 and 2014, there was a 35% decrease in teacher preparation program enrollment. Meanwhile, the teacher workforce has been increasing, and student enrollment has begun to increase and is projected to grow by 3 million students.

While these factors have been changing, a more constant factor—and by far the largest component of annual demand—is the high rate of teacher attrition in U.S. schools. As we discuss below, this rate is much higher than in many other countries that offer more competitive wages for teachers and more uniformly supportive working conditions. Reducing attrition would actually make a greater difference in balancing supply and demand than any other intervention. Given the large impact that attrition has on teacher demand and on the adequacy of supply, we examine its

characteristics and effects before turning to a broader discussion of policy drivers and potential solutions.

The Role of Teacher Attrition

Using workforce estimates, student enrollment, and attrition data from the SASS 1988–89 to 2011–12, Figure 8 shows the relative contribution of different factors to teacher demand. Estimates vary from actual demand for the years 1989 to 2012 because the model does not perfectly predict demand, especially in unusual circumstances that stray from averages, like the Great Recession.

Figure 8 highlights two main points: First, although the number of teachers who leave the profession has not dramatically changed in recent years, it constitutes the lion's share of demand, representing anywhere from two-thirds to nearly 100% of the demand for teachers in any given year. Thus, the most important driving factor of teacher shortages is high teacher attrition. Second, while workforce growth due to student enrollment increases and reductions in pupil-teacher ratios will play a bigger role in demand from 2018 to 2025 than they have in recent years, attrition still swamps these variables as a driver of teacher demand.
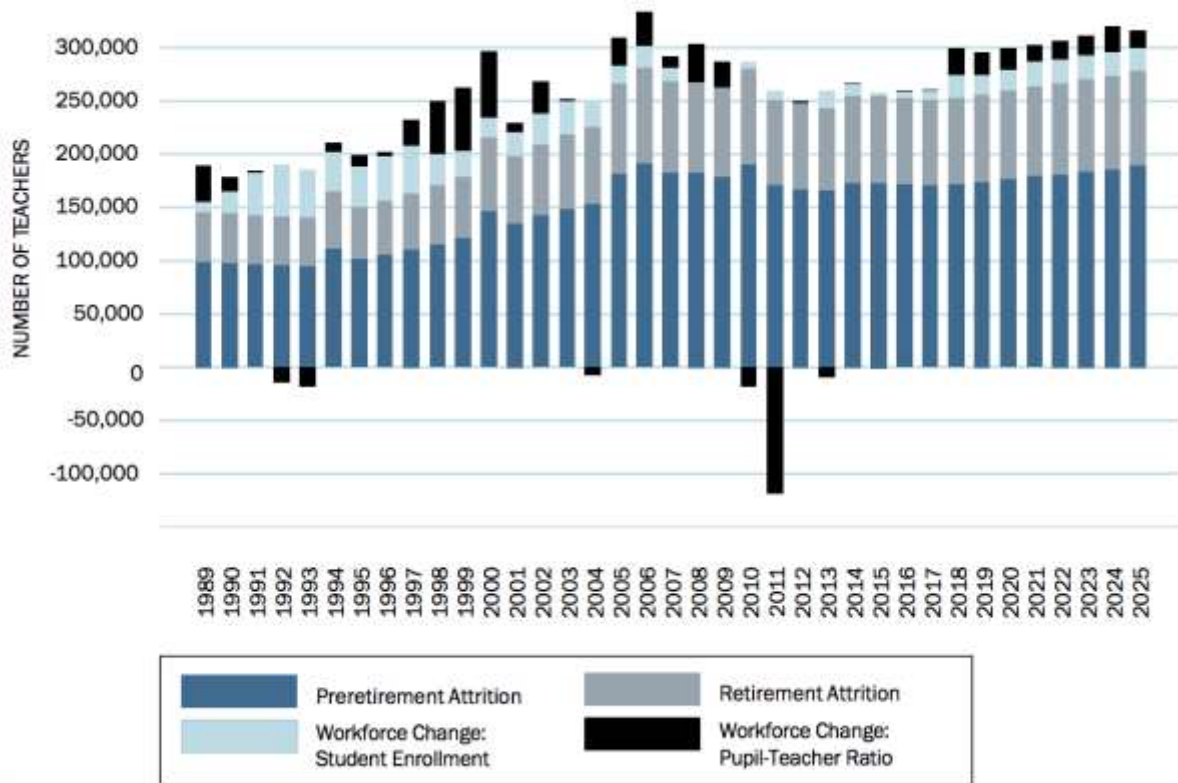
Figure 8: Teacher Demand Factors Over Time
Note: Negative number of teachers represents a decrease in the total number of teachers.
Source: (NCES, 2004, 2005, 2008, 2009, 2012a, 2013, 2014b, 2015b)

Attrition has not always been such a dominant factor in demand. In the late 1980s and early 1990s, attrition was less than 6%, and demand was, consequently, lower, as fewer teachers had to be replaced each year (NCES, 2015c). The higher attrition rates of recent years have had a very large impact on demand. Between 1989 and 2005, attrition rates increased by 50%, and they have stayed

high since then. Consequently, compared to 25 years ago, attrition is now responsible for a larger number of teachers demanded each year.

In times of shortages, policymakers often focus attention, understandably, on how to get more teachers into the profession. However, it is equally important to focus on how to keep effective teachers in the workforce. In fact, as we show below, reducing attrition could virtually eliminate overall shortages, with the exception of distributional imbalances across fields and locations that may require specific incentives.

Compared to high-achieving nations like Finland, Singapore, and Ontario, Canada—where only about 3% to 4% of teachers leave in a given year (Darling-Hammond & Rothman, 2011) — U.S. attrition rates are quite high: hovering near 8% over the last decade, and much higher for new teachers and teachers in high-poverty schools and districts (Loeb, Darling-Hammond, & Luczak, 2005).

The Cost of Attrition

Figure 9 displays the teacher labor market under different assumptions of teacher attrition. Relatively small differences in the attrition rate have huge implications for the teacher labor market. The attrition rate during the projection period (black dashed line) is 8%. If the annual attrition rate could be reduced from the current projection of 8% to 6%—slightly higher than the U.S. teacher attrition rate in 1989—hiring needs would decrease by at least 60,000 teachers annually. This modest decrease in the attrition rate would reduce the demand for teachers in each year to about 200,000 teachers instead of 260,000 (NCES, 2015b).
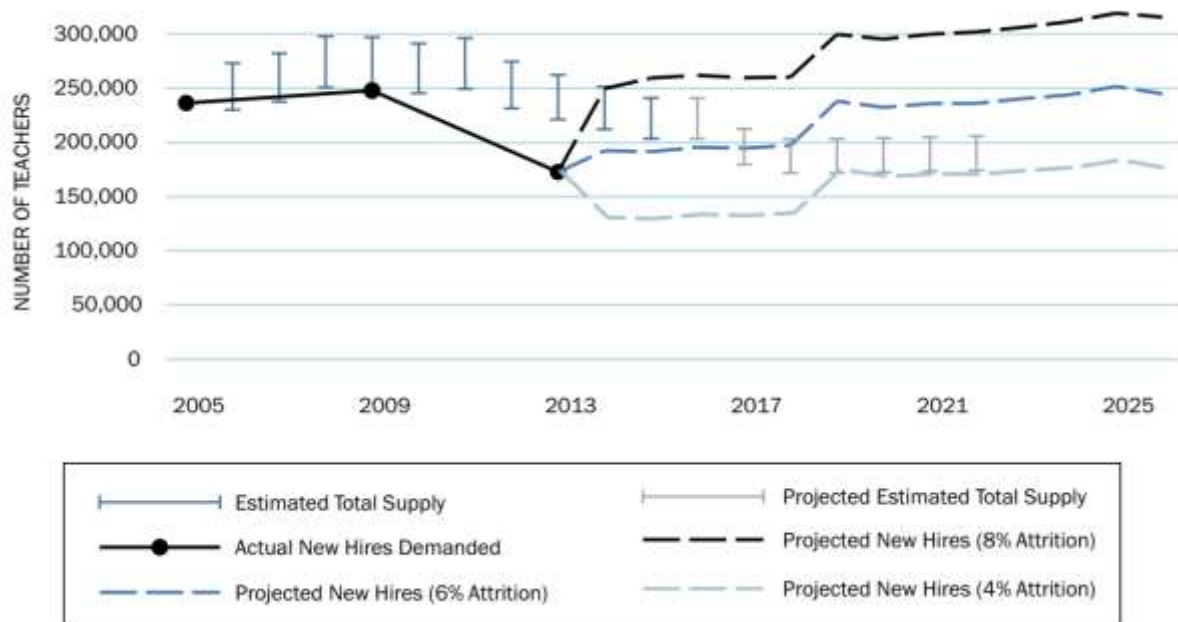
Figure 9: Projected Supply and Demand with Varying Attrition Rates
Source: (NCES, 2004, 2005, 2008, 2009, 2012a, 2012b ,2013, 2014b. 2015b; U.S. Department of Education, n.d.)

If the attrition rate could be reduced to 4%, closer to where it is in some other countries, U.S. hiring needs would be reduced by roughly 130,000 teachers annually, cutting annual demand by nearly half. This large reduction in demand would not only largely eliminate current teacher shortages, but also allow for increased selectivity, boosting the quality of our nation's teachers.

Some object to this comparison to other countries, arguing that there are major cultural differences that would make these kinds of attrition rates impossible to achieve in the United States. However, several American states, including Massachusetts and other New England states, have attrition rates well below 5%. It is not surprising that, like the countries we noted, these states also have policies and conditions associated with increased retention, such as competitive compensation, high-quality training, few entrants through low-quality backdoor routes, and positive working conditions (Carver-Thomas & Darling-Hammond, 2017b). Evidence from abroad, from some U.S. states today, and from the United States in past years shows that lower attrition rates are possible.

Beyond those who leave the profession, teachers who move from one school to another are an equally important component of teacher turnover. We use the term "turnover" to denote the rate at which teachers leave a school, whether to teach elsewhere (movers) or to leave the profession entirely (leavers). At the school level, teachers who leave for a different school have the same impact as teachers who leave the profession—a vacancy that must be filled, along with both fiscal and academic costs associated with the turnover. Nationally, in 2012-13, close to 16% of teachers left the school at which they taught the prior year. These rates are higher in some schools than others, based on conditions in the school, which we discuss further below.

Hard-to-staff schools with high turnover rates typically end up with a disproportionate number of relatively inexperienced teachers, which can both create greater churn, if they leave rapidly as many beginning teachers do, and undermine student achievement as a function of both teacher inexperience and overall instability (Kini & Podolsky, 2016). High teacher turnover rates have been found to negatively affect the achievement of all students in a school, not just students in a new teacher's classroom (Ronfeldt, Loeb, & Wyckoff, 2013). As a principal in a poorly resourced, high-turnover school in California explained:

> (H)aving that many new teachers on the staff at any given time meant that there was less of a knowledge base. It meant that it was harder for families to be connected to the school because, you know, their child might get a new teacher every year. It meant there was less cohesion on the staff. It meant that every year, we had to re-cover ground in professional development that had already been covered and try to catch people up to sort of where the school was heading (Carroll, Reichardt, & Guarino, 2000).

Such schools must continually pour money into recruitment efforts and professional support for new teachers, many of them untrained, without reaping dividends from these investments. Other teachers, including the few who could serve as mentors, are stretched thin and often feel overburdened by the needs of their colleagues as well as their students. Scarce resources are squandered trying to reteach the basics each year to teachers who come in with few tools and leave before they become skilled (Darling-Hammond, 2003).

Each time a teacher leaves a district, it not only increases demand but also imposes replacement costs on districts. A decade ago, replacement costs for teachers were estimated to range from around $4,400 in a small rural district to nearly $18,000 in a large urban district for every teacher who leaves—a national price tag of over $7 billion a year (Carroll, 2007). With inflation, those costs would be more than $8 billion today. A comprehensive approach to reducing attrition would effectively both lessen the demand for teacher hiring and save money that could be better spent on mentoring and other evidence-based approaches to supporting teacher development. Attrition is one of the most important aspects of demand to focus on, both because it is such a large component of demand and because it is policy malleable.

Furthermore, research shows that stability, coupled with shared planning and collaboration, helps teachers to improve their effectiveness (Jackson & Bruegmann, 2009), and that teachers

improve more rapidly in supportive and collegial working environments (Kraft & Papay, 2014). High teacher turnover undermines these benefits, which arise through shared knowledge and collaboration among colleagues.

Reasons for Attrition

Of teachers who responded to the SASS survey and who left in the year after 2013, only 13% said the *most* important factor for their departure was retirement. Fifty-five percent reported areas of dissatisfaction as important reasons for leaving. These range from teaching conditions, such as class sizes and salaries, to unhappiness with administrative practices (such as lack of support, classroom autonomy, or input on school decisions) to policy issues, such as the effects of testing and accountability. Accountability pressures related to test preparation and sanctions for low performance comprised the most frequently cited area of dissatisfaction, listed by 25% of teachers who left (NCES, 2013). (For a more in-depth analysis, see Carver-Thomas & Darling-Hammond, this issue.)

Reducing attrition from the current 8% to about 4%—the norm in high-achieving nations like Finland, Singapore, and Ontario, Canada, and a few states—could virtually eliminate overall teacher shortages. Because most attrition is voluntary, pre-retirement attrition policy can have a big impact on reducing the number of people who leave the classroom and on increasing the number of those who have left but who later return. In the next section, we discuss policy responses that research suggests can help resolve shortages and create a stable, long-term, high-quality teaching force.

Discussion

While policymakers often focus on how to recruit more teachers when there are shortages, our findings suggest it is equally important to recognize policies that decrease teacher attrition. Cutting teacher attrition in half—and hence reducing teacher demand— would make our current supply adequate on a national scale, although localized shortages could persist.

No single policy can solve emerging teaching shortages. What is needed is a comprehensive set of strategies at the federal, state, and local levels that are focused on increasing the number of well-prepared entrants to the field of teaching, directing them to the fields and locations where they are needed, and plugging the leaky bucket of teacher attrition, which has high costs for both district budgets and student achievement.

Without policy interventions, it is likely that even if more new candidates—heartened by reports of greater hiring—consider teaching, they will fail to choose the fields in which there are shortages or go to the high-poverty communities where they are more sorely needed. Furthermore, a status quo approach will not leverage better preparation that supports student achievement or stem turnover where it is currently high (Podolsky, Kini, Bishop, & Darling-Hammond, 2016).

Based on the analysis in the article and what is known from other research on teacher recruitment and retention, productive policies could focus on both enhancing the supply of qualified teachers targeted to high-need fields and locations through training subsidies and high-retention pathways, and improving teacher retention, especially in hard-to-staff schools, through more effective mentoring, induction, working conditions, and career development (see Podolsky, Kini, Bishop, & Darling-Hammond, this issue.)

Enhancing a Stable Supply of Teachers

In addition to the importance of salaries for recruiting and retaining qualified teachers (Adamson & Darling-Hammond, 2012), it is important to enable teachers to afford a high-quality

preparation for teaching. A growing body of evidence indicates that attrition is unusually high for those who lack preparation for teaching (Ingersoll, Merrill, & May, 2014; Marinell, Buckley, Scallon, & Tanner, 2013). Several studies have found that teachers who receive little or no pedagogical training are two to three times more likely to leave teaching after their first year than teachers who had received a comprehensive preparation (Gray, Taie, & O'Rear, 2015; Ingersoll et al., 2014).

A key issue, however, is how candidates can afford adequate preparation—especially when they may have had to go into debt to prepare to enter a profession that earns less than others. Research shows that the more debt college students incur, the less likely they are to choose to work in a lower wage profession like teaching. The influence of debt on job choice is "most notable on the propensity to work in the education industry" (Rothstein & Rouse, 2011). Research shows that service scholarships and forgivable loans that underwrite the cost of preparation in exchange for several years of service result in higher entry rates to high-need fields and locations, and stronger retention (Podolsky & Kini, 2016).

Supporting Teacher Retention

Mentoring and induction. Along with comprehensive preparation, well-designed mentoring programs improve retention rates for new teachers, as well as their attitudes, feelings of efficacy, and instructional skills (California Commission on Teacher Credentialing, 2015; Hanke, Chen, Geis, & Knepper, 2000; Headden, 2014; Ingersoll & Strong, 2011). The keys to success include having a mentor teacher in the same subject area, common planning time with teachers in the same subject, and regularly scheduled collaboration with other teachers. Beginning teachers' practice is enhanced further when their mentors also receive formal training and are released from some of their own classroom duties to provide one-to-one observation and coaching in the classroom, so they can demonstrate effective methods and help new teachers solve problems of practice (Bartell, 1995; Olebe, 2001; Smith & Ingersoll, 2004; Wang, Odell & Schwille, 2008).

Improved teaching conditions. While salaries matter for retention as well as recruitment, working conditions are typically found to matter at least as much. Surveys of teachers have long shown that teaching conditions play a major role in teachers' decisions to change schools or leave the profession. The relatively poor teaching conditions in many high-poverty schools are a major reason why teachers in these schools are more than twice as likely to leave due to dissatisfaction as those in low-poverty schools (Darling-Hammond, 2005; Ingersoll, 2001). In addition to teaching loads and resources, teachers' plans to stay in teaching and their reasons for actually having left are strongly associated with how they feel about administrative support, collegial opportunities, and teacher input into decision-making. When these elements are present, retaining teachers is easier.

Conclusion

Current data and projections reveal teacher shortages across many states, communities, and subject areas in the United States that could worsen, if trends continue without policy intervention. These shortages exacerbate the inequitable distribution of qualified teachers to schools serving concentrations of low-income students and students of color. Concerns currently rising to the attention of policymakers could provide an opportunity for the United States to take a long-term approach to establishing a comprehensive and systematic set of strategies to build a stronger, more stable profession.

References

Achinstein, B., Ogawa, R. T., Sexton, D., & Freitas, C. (2010). Retaining teachers of color: A pressing problem and a potential strategy for "hard-to-staff" schools. *Review of Educational Research, 80*(1), 71–107. https://doi.org/10.3102/0034654309355994

ACT. (2014). *The condition of future educators 2014*. Iowa City, IA: ACT. Retrieved from http://www.act.org/newsroom/ data/2014/states/pdf/FutureEducators.pdf

Adamson, F., & Darling-Hammond, L. (2011). *Speaking of salaries: What it will take to get qualified, effective teachers in all communities*. Washington, DC: Center for American Progress.

Adamson, F., & Darling-Hammond, L. (2012). Funding disparities and the inequitable distribution of teachers: Evaluating sources and solutions. *Education Policy Analysis Archives, 20*(7), 1–46. https://doi.org/10.14507/epaa.v20n37.2012

Aldeman, C. (September 9th, 2016). There's a huge flaw in the 'teacher shortage' data. *EducationNext*. http://educationnext.org/theres-a-huge-flaw-in-the-teacher-shortage-data/.

American Association for Employment in Education. (2017). *Educator supply and demand report 2016–17*. Slippery Rock, PA: American Association for Employment in Education.

Antonucci, M. (September 20th, 2016). Analysis: New warnings of teacher shortage sound like déjà vu all over again. *The74. https://www.the74million.org/ article/analysis-new-warnings-of-teacher-shortage-sound-like-deja-vu-all-over-again/*

Arizona Department of Education, Educator Recruitment & Retention Task Force. (2015). *Educator retention and recruitment report*. Phoenix, AZ: Arizona Department of Education.

Arizona School Personnel Administrators Association. (2016). *ASPAA teacher shortage survey results*. Glendale, AZ: Author. Retrieved from http://www.arizonaea.org/assets/document/AZ/ASPAA_SurveyResults_TeacherShortage09-06-16.pdf.

Barshay, J. (2016, April 25). Cries about national teacher shortages might be overblown. *The Hechinger Report*. Retrieved from http://hechingerreport.org/national_teacher_shortages_overblown/

Baker, B., Farrie, D., & Sciarra, D. G. (2016). *Mind the gap: 20 years of progress and retrenchment in school funding and achievement gaps*. Princeton, NJ: Educational Testing Service.

Bartell, C. A. (1995). Shaping teacher induction policy in California. *Teacher Education Quarterly, 22*(4), 27–43.

Berg-Jacobson, A., & Levin, J. (2015). *Oklahoma study of educator supply and demand trends and projections*. Washington, DC: American Institutes for Research.

Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2005). The draw of home: How teachers' preferences for proximity disadvantage urban schools. *Journal of Policy Analysis and Management, 24*(1), 113–132. https://doi.org/10.1002/pam.20072

Brown, E. (2015, December 4). High-poverty schools often staffed by rotating cast of substitutes. *The Washington Post*. Retrieved from https://www.washingtonpost.com/local/education/how-can-students-learn- without-teachers-high-poverty-schools-often-staffed-by-rotating-cast-of-substitutes/2015/12/04/be41579a-92c6-11e5-b5e4-279b4501e8a6_story.html

California Commission on Teacher Credentialing. (2015). *Report on New Teacher Induction*. Sacramento, CA: California Commission on Teacher Credentialing.

California Legislative Analysts Office (2016, February). *2016-17 Budget Analysis: Proposition 98 Education Analysis*. Sacramento: Author. https://lao.ca.gov/Publications/Report/3355

California Teachers Association. (2009). *Pink Friday takes on a life of its own as throngs engage in pink slip protests statewide* [Press release]. Retrieved from https://www.cta.org/en/About-CTA/News-Room/Press-Releases.aspx

California Teachers Association. (2010). *Budget hearing held as 21,000 teachers receive "pink slips"* [Press release]. Retrieved from https://www.cta.org/en/About-CTA/News-Room/Press-Releases.aspx

California Teachers Association. (2011). *Governor's budget, revenue extensions needed to protect schools as nearly 19,000 educator pink slips issued* [Press release]. Retrieved from https://www.cta.org/en/About-CTA/News-Room/Press-Releases.aspx

California Teachers Association. (2012). *Nearly 20,000 teacher pink slips statewide show drastic need for more education funding* [Press release]. Retrieved from https://www.cta.org/en/About-CTA/News-Room/Press-Releases.aspx

Carroll, T. G. (2007). *The high cost of teacher turnover* [Policy brief]. Washington, DC: National Commission on Teaching and America's Future. Retrieved from https://nctaf.org/wp-content/uploads/NCTAFCostofTeacherTurnoverpolicybrief.pdf

Carroll, S., Reichardt, R., & Guarino, C. M. (2000). *The distribution of teachers among California's school districts and schools.* Santa Monica, CA: RAND Corporation. Retrieved from http://www.dtic.mil/dtic/tr/fulltext/u2/ a384997.pdf

Carver-Thomas, D. & Darling-Hammond, L. (2017a). *Addressing California's growing teacher shortage: 2017 update.* Palo Alto, CA: Learning Policy Institute.

Carver-Thomas, D. & Darling-Hammond, L. (2017b). *Teacher turnover: Why it matters and what we can do about it.* Palo Alto, CA: Learning Policy Institute.

Chapman, C., Laird, J., and KewalRamani, A. (2010). *Trends in high school dropout and completion rates in the United States: 1972–2008.* Washington, DC: U.S. Department of Education.

Cooperative Institutional Research Program, UCLA Higher Education Research Institute. (2016). *Backgrounds and Beliefs of College Freshmen.* (2016). Los Angeles, CA: University of California. Available from The Chronicle of Higher Education. http://chronicle.com/interactives/freshmen-survey

Darling-Hammond, L. (2000). *Solving the dilemmas of teacher supply, demand, and standards: How we can ensure a competent, caring, and qualified teacher for every child.* Kutztown, PA: National Commission on Teaching and America's Future. Retrieved from http://nctaf.org/wp-content/uploads/2012/01/supply-demand-standards.pdf

Darling-Hammond, L. (2003). Keeping good teachers: Why it matters, what leaders can do. *Educational Leadership, 60*(8), 6–13.

Darling-Hammond, L. (2010a). *The flat world and Education: How America's commitment to equity will determine our future.* New York, NY: Teachers College Press.

Darling-Hammond, L. (2010b). *Evaluating teacher effectiveness: How teacher performance assessments can measure and improve teaching.* Washington DC: Center for American Progress.

Darling-Hammond, L. (2010c). Recruiting and retaining teachers: Turning around the race to the bottom in high-need schools. *Journal of Curriculum and Instruction*, 4(1), 16-32. https://doi.org/10.3776/joci.2010.v4n1p16-32

Darling-Hammond, L., Burns, D, Campbell, C., Goodwin, A. L., Hammerness, K., Low, E.L., … Zeichner, K. (2017, in press). *Empowered educators: Teaching quality around the world.* San Francisco, CA: Jossey-Bass.

Darling-Hammond, L., Chung, R., & Frelow, F. (2002). Variation in teacher preparation: How well do different pathways prepare teachers to teach? *Journal of Teacher Education, 53*(4), 286–302. https://doi.org/10.1177/0022487102053004002

Darling-Hammond, L., Furger, R., Shields, P. M., & Sutcher, L. (2016). *Addressing California's emerging teacher shortage: An analysis of sources and solutions.* Palo Alto, CA: Learning Policy Institute.

Darling-Hammond, L., Guha, R., & Hyler, M. (2016). *Teacher residencies: An innovative model for preparing teachers.* Palo Alto, CA: Learning Policy Institute.

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., & Heilig, J. V. (2005). Does teacher preparation matter? Evidence about teacher certification, Teach for America, and teacher effectiveness. *Education Policy Analysis Archives, 13*(42), 51. https://doi.org/10.14507/epaa.v13n42.2005

Darling-Hammond, L., LaPointe, M., Meyerson, D., Orr, M. T., & Cohen, C. (2007). *Preparing school leaders for a changing world: Lessons from exemplary leadership development programs.* Stanford, CA: Stanford University, Stanford Educational Leadership Institute. Retrieved from http://www.wallacefoundation.org/knowledge- center/Documents/Preparing-School-Leaders.pdf

Darling-Hammond, L., & Orphanos, S. (2007). *Leadership development in California.* Stanford, CA: Stanford University, Institute for Research on Education Policy & Practice. Retrieved from https://edpolicy.stanford.edu/sites/default/files/publications/ leadership-development-california.pdf

Darling-Hammond, L., & Rothman, R. (2011). *Teacher and leader effectiveness in high-performing education systems.* Washington, DC: Alliance for Excellent Education; Stanford, CA: SCOPE. Retrieved from http://eric.ed.gov/ ERICWebPortal/recordDetail?accno=ED517673.

Darling-Hammond, L., & Sykes, G. (2003). Wanted: A national teacher supply policy for education: The right way to meet the "highly qualified teacher" challenge. *Education Policy Analysis Archives, 11*(33), 1–55. https://doi.org/10.14507/epaa.v11n33.2003

DeVise, D. (1999, November 5). A+ plan prompts teacher exodus in Broward County. *Miami Herald.*

Dolton, P., Tremayne, A., & Chung, T. P. (2003). *The economic cycle and teacher supply.* Paris: OCED.

Esch, C. E., Chang-Ross, C. M., Guha, R., Humphrey, D. C., Shields, P. M., Tiffany-Morales, J. D., …Woodworth, K. R. (2005). *The status of the teaching profession 2005.* Santa Cruz, CA: The Center for the Future of Teaching and Learning.

Feistritzer, C. E. (2011). *Profile of teachers in the US.* Washington, DC: National Center for Education Information.

Gantert, T. (2015, January 19). Looming "teacher shortage" appears largely mythical. *Capcon.* Retrieved from http://www. michigancapitolconfidential.com/21831

Gardner, D. P. (1983). *A nation at risk.* Washington, DC: The National Commission on Excellence in Education, US Department of Education.

Gray, L., Taie, S., & O'Rear, I. (2015). *Public school teacher attrition and mobility in the first five years: Results from the first through fifth waves of the 2007–2008 Beginning Teacher Longitudinal Study.* Washington, DC: U.S. Department of Education.

Grissom, J. A., & Reininger, M. (2012). Who comes back? A longitudinal analysis of the reentry behavior of exiting teachers. *Education Finance and Policy, 7*(4), 425–454. https://doi.org/10.1162/EDFP_a_00075

Grissom, J. A., Viano, S. L., & Selin, J. L. (2015). Understanding employee turnover in the public sector: Insights from research on teacher mobility. *Public Administration Review, 76*(2), 241-251. https://doi.org/10.1111/puar.12435

Haggstrom, G. W., Darling-Hammond, L., & Grissmer, D. W. (1988*). Assessing teacher supply and demand.* Santa Monica, CA: RAND Corporation.

Hale, L. (2015, November 9). Behind the shortage of special ed teachers: Long hours, crushing paperwork. *NPR.* Retrieved from

http://www.npr.org/sections/ed/2015/11/09/436588372/behind-the-shortage-of-special-ed-teachers-long-hours-crushing-paperwork

Headden, S. (2014). *Beginners in the classroom*. Stanford, CA: Carnegie Foundation for the Advancement of Teaching.

Hussar, W. J., & Bailey, T. M. (2014). *Projections of education statistics to 2022*. Washington, DC: National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2014/2014051.pdf

Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal, 38*(3), 499–534. https://doi.org/10.3102/00028312038003499

Ingersoll, R. M. (2011). Do we produce enough mathematics and science teachers? *Kappan Magazine, 92*(6), 37–41. https://doi.org/10.1177/003172171109200608

Ingersoll, R. M., & May, H. (2011a). The minority teacher shortage: Fact or fable? *Kappan Magazine, 93*(1), 62–65. https://doi.org/10.1177/003172171109300111

Ingersoll, R. M., & May, H. (2011b). *Recruitment, retention and the minority teacher shortage*. Philadelphia, PA: Consortium for Policy Research in Education. https://doi.org/10.12698/cpre.2011.rr69

Ingersoll, R. M., & May, H. (2012). The magnitude, destinations, and determinants of mathematics and science teacher turnover. *Educational Evaluation and Policy Analysis, 34*(4), 1–64. https://doi.org/10.3102/0162373712454326

Ingersoll, R. M., Merrill, L., & May, H. (2014). *What are the effects of teacher education and preparation on beginning teacher retention?* Philadelphia, PA: Consortium for Policy Research in Education.

Ingersoll, R. M., Merrill, L., & Stuckey, D. (2014). *Seven trends: The transformation of the teaching force*. Philadelphia, PA: Consortium for Policy Research in Education. Retrieved from http://www.cpre.org/7trends

Ingersoll, R. M., & Perda, D. (2010). Is the supply of mathematics and science teachers sufficient? *American Educational Research Journal, 47*(3), 563–594. https://doi.org/10.3102/0002831210370711

Ingersoll, R. M., & Strong, M. (2011). The impact of induction and mentoring programs for beginning teachers: A critical review of the research. *Review of Educational Research, 81*(2), 201–233. https://doi.org/10.3102/0034654311403323

Jackson, C. K., & Bruegmann, E. (2009). Teaching students and teaching each other: The importance of peer learning for teachers. *American Economic Journal: Applied Economics, 1*(4), 85–108. https://doi.org/10.3386/w15202

Kena, G., Hussar, W., McFarland, J., de Brey, C., Musu-Gillette, L., Wang, X., … Dunlop Velez, E. (2016). *The condition of education 2016*. Washington, DC: U.S. Department of Education.

Kini, T., & Podolsky, A. (2016). *Does teaching experience increase teacher effectiveness?* Palo Alto, CA: Learning Policy Institute.

Kraft, M. A., & Papay, J. P. (2014). Can professional environments in schools promote teacher development? Explaining heterogeneity in returns to teaching experience. *Educational Evaluation and Policy Analysis, 36*(4), 476–500. https://doi.org/10.3102/0162373713519496

KRQE Media. (2018, June 25). New Mexico faces teacher shortages. *Author*. https://www.krqe.com/news/education/new-mexico-faces-teacher-shortage/1261836517

Learning Policy Institute. (2017). *Uncertified teachers and teacher vacancies by state*. Palo Alto, CA: Author. Retrieved from https://learningpolicyinstitute.org/uncertified-teachers-and-teacher-vacancies-state.

Learning Policy Institute. (n.d.). *Understanding teacher shortages*. Palo Alto, CA: Author. Retrieved from https://learningpolicyinstitute.org/product/understanding-teacher-shortages-interactive.

Levin, J., Berg-Jacobson, A., Atchison, D., Lee, K., & Vontsolos, E. (2015). *Massachusetts study of teacher supply and demand trends and projections.* Washington, DC: American Institutes for Research.

Loeb, S. & Beteille, T. (2009). Teacher quality and teacher labor markets. In G. Sykes, B. Schneider & D. N. Plank (Eds.). *Handbook of Education Policy Research* (pp. 596-612). Florence, KY: Routledge.

Loeb, S., Darling-Hammond, L., & Luczak, J. (2005). How teaching conditions predict teacher turnover. *Peabody Journal of Education, 80*(3), 44–70. https://doi.org/10.1207/s15327930pje8003_4

Marinell, W. H., Coca, V. M., Arum, R., Goldstein, J., Kemple, J., Pallas, A., … Tanner, B. (2013). *Who stays and who leaves? Findings from a three-part study of teacher turnover in NYC middle schools.* New York, NY: Research Alliance for New York Schools.

Murnane, R. J., Singer, J. D., & Willett, J. B. (1989). The influences of salaries and "opportunity costs" on teachers' career choices: Evidence from North Carolina. *Harvard Educational Review, 59*(3), 325–347. https://doi.org/10.17763/haer.59.3.040r1583036775um

Murnane, R., Singer, J. D., Willett, J. B., Kemple, J., & Olsen, R. (2009). *Who will teach? Policies that matter.* Cambridge, MA: Harvard University Press.

Murphy, P., DeArmond, M., & Guin, K. (July 31, 2003). A national crisis or localized problems? Getting perspective on the scope and scale of the teacher shortage. *Education Policy Analysis Archives, 11*(23). https://doi.org/10.14507/epaa.v11n23.2003

National Center for Education Statistics. (2004). Public school teacher file, from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2005). Teacher Follow-Up Survey (TFS), from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2008). Public school teacher file, from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2009). Teacher Follow-Up Survey (TFS), from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2012a). Public school teacher file, from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2012b). N2Derived Data File, from the Baccalaureate and Beyond (B&B). Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2013). Teacher Follow-Up Survey (TFS), from the Schools and Staffing Survey. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (n.d.). *Digest of education statistics: 2014.* Washington, DC: U.S. Department of Education. Retrieved from https://nces.ed.gov/ programs/digest/d14/

National Center for Education Statistics. (2014a). Digest of education statistics. *Public and private elementary and secondary teachers, enrollment, pupil-teacher ratios, and new teacher hires: Selected years, fall 1955 through fall 2024.* Washington, DC: U.S. Department of Education. Retrieved from https://nces.ed.gov/ programs/digest/

National Center for Education Statistics. (2014b). Common Core of Data. *State Universe Survey, 2004-2014.* Washington, DC: U.S. Department of Education. Retrieved from https://nces.ed.gov/ccd/

National Center for Education Statistics. (2014c). Civil Rights Data Collection. *Public-Use Data File 2013-14.* Washington, DC: U.S. Department of Education. Retrieved from https://www2.ed.gov/about/offices/list/ocr/docs/crdc-2013-14.html

National Center for Education Statistics. (2015a). Digest of education statistics. *Enrollment and percentage distribution of enrollment in public elementary and secondary schools, by race/ethnicity and region:*

Selected years, fall 1995 through fall 2024. Washington, DC: U.S. Department of Education. Retrieved from http://nces.ed.gov/programs/digest/d15/tables/dt15_203.50.asp

National Center for Education Statistics. (2015b). Digest of education statistics. *Public and private elementary and secondary teachers, enrollment, pupil-teacher ratios, and new teacher hires: Selected years, fall 1955 through fall 2024*. Retrieved from https://nces.ed.gov/programs/digest/

National Center for Education Statistics. (2015c). Digest of education statistics. *Mobility of public elementary and secondary teachers, by selected teacher and school characteristics: Selected years, 1987–88 through 2012–13*. Washington, DC: U.S. Department of Education. Retrieved from https://nces.ed.gov/programs/ digest/

National Center for Education Statistics. (2015d). Digest of education statistics. *Public elementary and secondary teachers, enrollment, and pupil-teacher ratios, by state or jurisdiction: Selected years, fall 2000 through fall 2013*. Washington, DC: U.S. Department of Education. Retrieved from https://nces.ed.gov/programs/digest/

National Education Association. (n.d.). *2017-18 Average starting teacher salaries by state*. Retrieved from http://www.nea.org/home/2017-2018-average-starting-teacher-salary.html

Nix, N. (2015, December 1). Why Oklahoma is racing to put nearly 1,000 uncertified teachers in its classrooms. *The 74*. Retrieved from https://www.the74million.org/article/why-oklahoma-is-racing-to-put-nearly-1000-uncertified-teachers-in-its-classrooms

Olebe, M. (2001). A decade of policy support for California's new teachers: The beginning teacher support and assessment program. *Teacher Education Quarterly, 28*(1), 71–84.

Podolsky, A., & Kini, T. (2016). *How effective are loan forgiveness and service scholarships for recruiting teachers?* Palo Alto, CA: Learning Policy Institute.

Podolsky, A., & Sutcher, L. (2016). *California teacher shortages: A persistent problem* (Brief). Palo Alto, CA: Learning Policy Institute.

Ronfeldt, M., Loeb, S., & Wyckoff, J. (2013). How teacher turnover harms student achievement. *American Educational Research Journal, 50*(1), 4–36. https://doi.org/10.3102/0002831212463813

Rothstein, J., & Rouse, C. E. (2011). Constrained after college: Student loans and early-career occupational choices. *Journal of Public Economics, 95*(1–2), 149–163. https://doi.org/10.1016/j.jpubeco.2010.09.015

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

Shields, P. M., Esch, C. E., Humphrey, D. C., & Young, V. M. (1999). *The supply of and demand for teachers in California public schools.* Santa Cruz, CA: Center for the Future of Teaching and Learning.

Shields, P. M., Humphrey, D. C., Wechsler, M. E., Riehl, L. M., Tiffany-Morales, J., Woodworth, K., … Price, T. (2001). *Teaching and California's future: The status of the teaching profession 2001.* Santa Cruz, CA: The Center for the Future of Teaching and Learning.

Simon, N. S., & Johnson, S. M. (2015). Teacher turnover in high-poverty schools: What we know and can do. *Teachers College Record, 117*(3), 1–36. Retrieved from http://isites.harvard.edu/fs/docs/icb.topic1231814.files/Teacher Turnover in High-Poverty Schools.pdf

Simon, N., Johnson, S. M., & Reinhorn, S. K. (2015). *The challenge of recruiting and hiring teachers of color: Lessons from six high-performing, high-poverty, urban schools* [Working paper]. The Project on the Next Generation of Teachers, Harvard Graduate School of Education. Retrieved from http://robobees. seas.harvard.edu/files/gse-projectngt/files/the_challenge_of_recruiting_and_hiring_teachers_of_color_diversity_july_2015.pdf

Smith, T. M., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal, 41*(3), 681–714. https://doi.org/10.3102/00028312041003681

Stockard, J., & Lehman, M. B. (2004). Influences on the satisfaction and retention of 1st-year teachers: The importance of effective school management. *Educational Administration Quarterly, 40*(5), 742–771. https://doi.org/10.1177/0013161X04268844

Strauss, V. (2017, August 28). Teacher shortages affecting every state as the 2017-18 school year begins. *Washington Post.* https://www.washingtonpost.com/news/answer-sheet/wp/2017/08/28/teacher-shortages-affecting-every-state-as-2017-18-school-year-begins/?utm_term=.afb4d87a991f

U.S. Department of Education Office of Postsecondary Education. (2013). *Preparing and credentialing America's teachers: The secretary's ninth report on teacher quality*. Washington, DC: U.S. Department of Education. Retrieved from https://title2.ed.gov/Public/ TitleIIReport13.pdf

U.S. Department of Education Office of Postsecondary Education. (2017). *Teacher shortage areas nationwide listings 1990–1991 through 2017–18*. Washington, DC: U.S. Department of Education.

U.S. Department of Education. (n.d.). *Title II Data Collection, 2009–2014*. Available from https://title2.ed.gov/Public/Home.aspx

Villegas, A. M., & Irvine, J. J. (2010). Diversifying the teaching force: An examination of major arguments. *Urban Review, 42*(3), 175–192. https://doi.org/10.1007/s11256-010-0150-1

Wang, J., Odell, S. J., & Schwille, S. A. (2008). Effects of teacher induction on beginning teachers' teaching: A critical review of the literature. *Journal of Teacher Education, 59*(2), 132–152. https://doi.org/10.1177/0022487107314002

Whitaker, I. (2015, November 27). Nevada needs teachers, and it's shelling out $5 million to get them. *The Las Vegas Sun*. Retrieved from https://lasvegassun.com/news/2015/nov/27/nevada-needs-teachers-and-its-shelling-out-5-milli/

Williams, W. II, Adrien, R., Murthy, C., & Pietryka, D. (2015). *Equitable Access to Excellent Educators*. Washington, DC: U.S. Department of Education. Retrieved from http://www2.ed.gov/ programs/titleiparta/resources.html

About the Authors

Leib Sutcher
Learning Policy Institute
lsutcher@learningpolicyinstitute.org
Leib Sutcher is a Research Associate on LPI's Educator Quality Team. His current work focuses on teacher labor market issues, including recruitment and retention, the inequitable distribution of unqualified and inexperienced educators, and teacher shortages.

Linda Darling-Hammond
Learning Policy Institute
ldh@learningpolicyinstitute.org
Linda Darling-Hammond is President of the Learning Policy Institute and Charles E. Ducommun Professor of Education Emeritus at Stanford University. She was principal investigator for the team that designed the federal Schools and Staffing Surveys and has conducted extensive research on issues of educator supply, demand, and quality. Among her award-winning publications in this area

are the 1996 report of the National Commission on Teaching and America's Future, *What Matters Most: Teaching for America's Future*; *Teaching as the Learning Profession*; and *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do.*

Desiree Carver-Thomas
Learning Policy Institute
dcarverthomas@learningpolicyinstitute.org
Desiree Carver-Thomas is a Research and Policy Associate on LPI's Educator Quality Team. She is the lead author of *Addressing California's Growing Teacher Shortage: 2017 Update* and *Teacher Turnover: Why it Matters and What we can Do about It.* Previously, she taught in New York City public schools, and consulted on strategies for diverting recidivism and implementing a full-service community schools initiative.

About the Guest Editors

Linda Darling-Hammond
Learning Policy Institute
ldh@learningpolicyinstitute.org
Dr. Linda Darling-Hammond is President of the Learning Policy Institute and Charles E. Ducommun Professor of Education Emeritus at Stanford University. She has conducted extensive research on issues of educator supply, demand, and quality. Among her award-winning publications in this area are *What Matters Most: Teaching for America's Future; Teaching as the Learning Profession; Powerful Teacher Education;* and *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able to Do.*

Anne Podolsky
Learning Policy Institute
apodolsky@learningpolicyinstitute.org
Anne Podolsky is a Researcher and Policy Analyst at the Learning Policy Institute. Her research focuses on improving educational opportunities and outcomes, especially for students from underserved communities.

education policy analysis archives

Please send errata notes to Audrey Amrein-Beardsley at audrey.beardsley@asu.edu

Join EPAA's Facebook community at https://www.facebook.com/EPAAAAPE and **Twitter feed** @epaa_aape.