Teacher Supply and Turnover

Paul Bruno
K-12 Schools
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Introduction

Teachers are central to the operation of schools. The size of the teacher supply – that is, the quantity of available teachers – matters because of the centrality of teacher labor in providing programming to students. And, more recently, there is evidence that the teaching profession has become less desirable, motivating widespread concerns about teacher "shortages".

Which individuals supply teacher labor is also important as there is significant evidence that teachers vary considerably in their effectiveness and in their impacts on students. This means that the composition and quality of the teacher supply matter over and above the quantity of available teachers.

In this chapter I present key facts and evidence about the teacher supply, including teacher turnover. Being a part of the teacher supply means that people are both willing and able to work (e.g., they satisfy state licensure requirements) in public elementary and secondary schools. The teacher supply depends on the number of people entering the teacher labor market for the first time; returning to the teacher labor market after an absence, such as a paternity leave; or leaving the school system, for example to retire or to work in a different profession. I also consider briefly some other aspects of teacher turnover, such as movement from school to school.

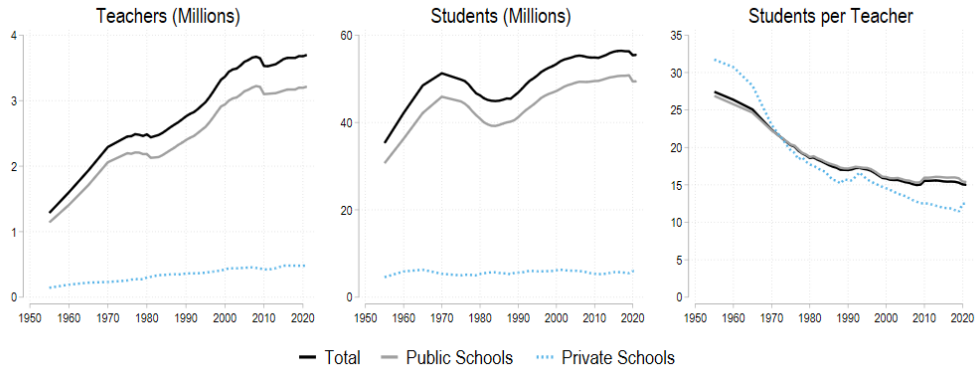
I then identify several issues that are important for understanding or improving the supply and turnover of teachers but for which the available evidence is limited or inconclusive. I focus on teachers in the United States, but many similar concerns and findings would likely apply internationally.[1] I also focus primarily on public schools because there is much less evidence on the teacher supply and teacher mobility in the private sector, though I note evidence on private schools when it is available.

Key findings

Key finding #1: *The number of teachers working in schools has increased substantially over time and much faster than the number of students.*

As shown in Figure 1, the number of teachers working in public or private elementary and secondary schools in the United States increased fairly steadily between 1955 and 2021, nearly tripling from about 1.3 million to about 3.7 million. During this time student enrollment increased by only 57%. Consequently, the number of students per teacher fell by almost half, from 27.4 to 15, and from 26.9 to 15.4 in public schools specifically. Hiring additional teachers does not have easily predictable effects on class sizes as teachers may be hired into positions that do not reduce class sizes very much, such as special education and non-classroom-teaching positions. Nationwide data on class sizes is relatively uncommon, but between the 1987-88 and 2011-12 school years average class sizes in public schools fell by 13% at the elementary level while increasing by 12% at the secondary level.

Figure 1. Elementary and secondary teachers, student enrollment, and student-to-teacher ratios over time. Teacher counts are full-time equivalent. Source: U.S. Department of Education data.[2]



Key finding #2: *The rate at which people pursue teaching licenses has declined from a peak around 2010.*

As indicated by the number of education degrees issued each year, interest in pursuing teaching has fluctuated substantially. In the early 1970s the number of education degrees issued rose to a high of approximately 300,000 before falling by almost half by the late 1980s. Education degree receipt then rose steadily, nearly returning to its previous peak around 2010. The number of teacher licenses issued by states also increased in the early 2000s and then decreased by about one third between 2006 and 2021, from 320,000 to 215,000. Teaching licenses issued also fell as a share of people completing bachelor's degrees. However, the extent to which these declines have impacted schools is unclear because they follow many years of increases that outpaced K-12 student enrollment growth; the declines may vary substantially across types of licenses; and because historically large fractions of newly licensed teachers have not been hired into schools in any case.

Key finding #3: *Teacher shortage rates are low on average but are disproportionately concentrated in certain schools and types of teaching positions*.

The rates at which teachers receive licenses affect the supply of teachers but do not directly indicate the extent of shortages, or gaps between the supply of and the demand for teachers. Studies that can estimate the rate at which teaching positions go unfilled tend to find overall vacancy rates between 1% and 4%, and many schools and districts report no unfilled teaching positions at all. These vacancy rates are generally lower than what is observed in jobs across the economy as a whole. At the same time, some types of teacher positions are consistently much harder to staff, such as special education teaching positions and positions in schools serving disadvantaged students (e.g., Black and low-income students).

Key finding #4: *Typically, 5-8% of teachers leave the profession each year.*

Exit rates tend to be higher for the most novice teachers and then to fall among more experienced teachers before rising again for the most veteran teachers. This is similar to turnover rates in plausibly similar occupations like nursing and accounting. However, teaching appears to have a relatively high rate of early retirements, perhaps driven in part by the prevalence and design of

retirement benefits like pensions. Teachers have been more likely to leave when overall unemployment rates are low. Teacher turnover fell in the first year or two of the COVID-19 pandemic before rising back to, or slightly above, pre-pandemic levels. This again appears to be similar to turnover patterns for other workers during the pandemic.

Key finding #5: *Teacher turnover disrupts school operations and harms student outcomes.*

Part of this is related to the fact that when teachers leave a position, they are often replaced by more junior teachers, who are often less effective. But turnover appears to have negative effects beyond what would be expected due to changes in the composition of teachers in schools. In particular, turnover seems to be harmful due to the disruption of relationships between teachers and between teachers and their students. Moreover, these types of negative effects extend beyond the classrooms that are experiencing turnover. That disruption is counterbalanced by potential benefits from turnover of less effective teachers.

Key finding #6: *Higher compensation tends to increase teacher recruitment and retention.*

Targeted increases in compensation have been shown to be effective at recruiting and retaining teachers into "hard-to-staff" positions, teachers with National Board Certification, and more effective teachers. Indeed, much of the evidence that teacher compensation matters comes from policy experiments in which policymakers target financial incentives at "hard-to-staff" teaching positions. This suggests that strategically differentiating compensation for the hardest-to-staff positions can be an effective lever for addressing teacher supply problems and improving student achievement. There is some evidence that changes in compensation matter more to teachers with less experience.

Topics where more research is needed

While we have strong evidence about many aspects of the teacher supply, we have little evidence about:

a. what rates of teacher entrance, exit, or shortage would be "good enough" to achieve specific educational objectives;
b. how to characterize the quality of the teacher supply or about potential tradeoffs between the quantity of the teacher supply and the quality of the teacher supply;
c. what interventions would reliably increase the quality of the teacher supply;
d. the earliest stages of the teacher pipeline;
e. how to reliably increase the diversity of the teacher supply; and
f. how to intervene to improve working conditions that might matter for attracting and retaining teachers, or about tradeoffs between teacher compensation and teacher working conditions.

Evidence underlying key findings

Key finding #1: *The number of teachers working in schools has increased substantially over time and much faster than the number of students.*

The most comprehensive evidence on the size of the teacher workforce comes from the National Center for Education Statistics (NCES), a federal agency that collects education data from nearly all schools in the United States.[3] As shown in Figure 1, NCES data indicate that the number of teachers working in schools has increased fairly steadily since the 1950s. In 1955 there were about 1.3 million elementary and secondary teachers in U.S. public and private schools. By 2021 that number had increased to about 3.7 million. This 188% increase in the number of teachers was almost identical

to the growth in the number of all nonfarm workers in the country.[4] In public schools specifically, the teacher workforce grew from 1.1 million to 3.2 million, an increase of 182%, much faster than the rate by which public school student enrollment increased (61%). This has resulted in a drop in the student-to-teacher ratio in public schools, from 26.9 to 15.4. These patterns were qualitatively similar in the relatively small private school sector.

Declines in student-to-teacher ratios since the 1950s do not necessarily imply similar declines in class sizes. This is because teachers may have increasingly been hired into positions that do little to decrease average class sizes, such as special education teaching or non-instructional (e.g., coaching) roles.[5] Credible nationwide class size estimates are not available consistently over time or prior to the 1980s, but NCES estimates suggest that between the 1987-1988 and 2011-2012 school years, average class sizes in public schools fell from 24.5 to 21.2 at the elementary level and increased from 23.9 to 26.8 at the secondary level.[6] Changes in average class size therefore likely cannot fully explain the decline in student-to-teacher ratios.

As discussed below, there is no clear way to quantify how many teachers are "enough" in aggregate, and such issues are necessarily at least partially subjective. Nevertheless, steady growth in the teaching force suggests that the overall supply of teachers is relatively robust, at least in terms of quantity.

Common dimensions along which the composition of the teacher supply is evaluated are its racial and gender diversity, as this is thought to matter for students. For example, recent studies have credibly identified benefits for students of having a same-race[7] or same-gender[8] teacher.

The best data on teacher demographics again come from the NCES. NCES data indicate increasing racial diversity among public school teachers, but only among some racial groups.[9] For instance, between the 1987-1988 and 2020-2021 school years the share of public school teachers who were White fell from 87% to 80% as the share of teachers who were Hispanic increased from 3% to 9%. However, the share of teachers who were Black fell, from 8% to 6%. Additionally, racial diversification among teachers has been much slower than among students. This has left the public school teaching force substantially less racially diverse than the public school student population, which is about 45% White, compared to about 70% in 1986.[10] Similarly, the teacher workforce continues to be disproportionately female. In fact, the share of public school teachers who were female was higher in 2020-2021 (77%) than in 1987-1988 (71%).[11]

Key finding #2: *The rate at which people pursue teaching licenses has declined from a peak around 2010.*

The most nationally comprehensive data on the production of new teachers come from the U.S. Department of Education, which compiles annual data from institutions of higher education and institutions that license teachers. A recent analysis of these data finds that since 1970 the number of individuals earning a degree in education has fluctuated substantially. In the early 1970s the number of education degrees issued rose to a high of approximately 300,000 before falling by almost half by the late 1980s. Education degree receipt then rose steadily, nearly returning to its previous peak around 2010. The subsequent decade saw another decline that appears to have slowed and then reversed in the most recent years for which data are available. This was also a period of rising college attainment, so between the early 1970s and 2020 the share of new degrees that were in education fell mostly steadily, from about 25% to about 8%.

Receiving a degree in education does not necessarily indicate that an individual is licensed to teach, for example because an individual may complete the relevant coursework but not take or pass requisite licensure exams. The U.S. Department of Education also provides data on teaching licenses issued in recent decades, providing a somewhat more direct measure of new teacher production.

After increasing in the early 2000s, the number of teacher licenses issued by states decreased by about one third between 2006 and 2021, from 320,000 to 215,000, though this decline too appears to have slowed or stopped. Teaching licenses issued also fell as a share of people completing bachelor's degrees, from about 22% to about 10%.[12]

This period has also seen substantial changes in the routes through which teachers become licensed. New teaching licenses are more likely than in the past to be issued through so-called "alternative" licensure programs that do not have all of the same certification requirements of more "traditional" licensure programs.

Drawing inferences about the overall teacher supply from the aggregate number of people pursuing education degrees or teaching licenses is difficult for two reasons. First, the number of new teaching licenses issued does not necessarily correspond to the number of individuals entering the teacher supply. For instance, some individuals who earn new licenses may already be teachers (e.g., if they are licensed in some other subject area). Even individuals who earn their first teaching license may choose to pursue non-teaching professional options.

The supply of licensed and willing teachers may also not be equal to the demand for teachers, either overall or in specific positions. For instance, there is suggestive evidence that newly licensed individuals are often limited in their ability to become teachers by the number of teaching positions available.[13]

Whatever the reason, research shows that many newly prepared teachers are not hired into teaching positions. For example, one analysis compared the number of individuals completing teacher education programs to the number of new teachers hired in schools between 1987 and 2011 using the Schools and Staffing Survey. In that analysis, the number of teachers new to the profession in schools was generally less than half of the number of newly prepared teachers.[14] Another more recent analysis follows a cohort of newly licensed teachers in Washington state and finds that about one third were never public school teachers in the 5-year period after licensure.[15] In sum, the rate at which new teachers are produced has often exceeded the demand for new teachers in aggregate. If many individuals are being prepared - but not hired - as teachers, declines in the rate at which people pursue teacher education or licensure may not necessarily lead to serious staffing problems in schools.

Second, the rate at which people are entering teaching is probably less important than the specific types of position those people are being licensed to fill and choosing to pursue in the labor market. For example, one analysis of special education teacher preparation documented that changes in special education teacher preparation rates have varied substantially across states and cannot be explained in terms of changing student disability rates.[16] Another analysis documents how some subject areas have seen much smaller decreases than others in the rate at which individuals complete teacher preparation programs in recent years, with some subjects even seeing increases.[17] This variation across places and subject areas makes it complicated to predict how, if at all, declines in the aggregate supply of new teachers will affect any particular teacher labor market.

The evidence on the evolving quality of new teachers is even less clear than the evidence on the rate at which individuals are entering teaching. There is evidence that the academic qualifications of new teachers have improved in recent decades, for example when looking at SAT scores or the possession of at least a master's degree.[18] However, such indicators are only at best indirect signals of teacher effectiveness. Conversely, there is credible evidence that economic downturns have tended to lead more instructionally effective individuals to enter teaching (as measured by student test score growth), perhaps due to the reduced availability of other job prospects,[19] but whether this has led to a cumulative increase in teacher quality over time is not clear.

Key finding #3: *Teacher shortage rates are low on average but are disproportionately concentrated in certain schools and types of teaching positions*.

There is no definitive study quantifying nationwide teacher shortages; indeed there is no agreed upon definition as to what constitutes a shortage. However, several recent studies consider the rate at which teaching positions go unfilled as a measure of shortages. This is plausibly the most direct and intuitive measure of shortages though, as discussed below, some studies have used other measures. Studies of unfilled positions consider different data sources and contexts, but overall provide strong evidence that vacancy rates for public school teaching positions are low.

A recent study conducted a state-by-state analysis, combining news reports, government data releases, and correspondence with state departments of education to quantify teacher vacancy rates nationwide.[20] This analysis finds that in aggregate across the states for which they were able to find data, 1.8% of teaching positions were vacant. However, these data were also limited and hard to interpret, coming from different sources and years, and in approximately one quarter of states no vacancy data were obtained at all.

Potentially more valid and reliable measures of teacher shortages come from studies of a small number of states that collect official data on unfilled positions in their K-12 school systems. For example, Illinois has integrated school-level unfilled position reporting into its annual staff-related data collections from local education agencies. Analyses of these data indicate that in October of 2022 2.6% of teacher positions were unfilled and just over half of school districts reported no unfilled teacher positions at all.[21] In Virginia the reported statewide teacher vacancy rate in that month was 3.8% and 40% of schools had no vacancies.[22]

When statewide administrative data have not been available, researchers have sometimes relied on surveys asking administrators about their unfilled teacher positions. For example, in one study that was able to obtain responses from two thirds of school administrators in Tennessee, respondents collectively reported that 1.4% of teaching positions were unfilled at the start of the 2019-2020 school year.[23]

To understand whether the above vacancy rates are large or small, it is useful to compare teaching to other labor markets. Government estimates show that unfilled vacancies economy-wide in the U.S. were approximately 4-5% of total nonfarm employment in the years leading up to the COVID-19 pandemic. That figure spiked to as high as about 8% in March of 2022.[24] Hence, teaching positions go unfilled at low rates relative to the labor market as a whole. Indeed, low teacher vacancy rates are found even when, as noted elsewhere in this chapter, the number of teachers being employed in schools has grown substantially over time, and much faster than student enrollment.

Unfilled teacher positions are in some sense the most direct measure of teacher shortages since they correspond to a gap between supply and demand and an unfilled position plausibly indicates some diminishment in the services provided to students. I therefore prioritize them here to characterize the magnitude of teacher shortages.

At the same time, credible unfilled position data have not been widely available until recently, are not available in all contexts, and may not allow for projections into the future or capture all aspects of shortages. For example, even a large teacher candidate pool may be weak or pessimistic administrators may choose not to open a position in the first place.

Consequently, some studies have used alternative approaches to quantify the extent of teacher shortages or to capture other aspects of teacher supply problems. For example, one common approach to measuring teacher shortages has been to look at widely collected data on the rate at which teachers are fully licensed for their positions. These studies find that teaching positions are

filled by less-than-fully licensed teachers at higher rates than those positions go unfilled. For example, the aforementioned study estimating a nationwide teacher vacancy rate of less than 2% estimates that a little more than 9% of teachers lack full licensure.[25] Such evidence may indicate limitations in the teacher supply not fully captured by evidence on unfilled positions. However, administrators may not always prioritize licensure during the hiring process, teacher licensure requirements vary over time and between states and positions, and teacher licensure is only weakly correlated with teacher quality. This complicates the interpretation of licensure as an indicator of shortages.

Other studies have used surveys to assess administrators' perceptions of the difficulty of hiring teachers to understand the state of the teacher labor market. For instance, one survey in Illinois in the fall of 2022 found that 79% of responding district administrators reported they had "minor to serious problems" with teacher shortages.[26] For comparison, this was approximately the same period in which the administrative data in Illinois (discussed above) indicated that about half of districts had no unfilled teacher positions.[27] While these kinds of surveys may be useful for gauging administrators' perspectives about the teacher labor market, they are hard to use to understand teacher shortages since it is not clear how administrators' stated perceptions are related to actual labor market conditions or service provision in schools.

Other work on teacher shortages has attempted to model the likely extent of teacher shortages in the future based on data such as student enrollment projections, teacher turnover rates, and enrollment in teacher preparation programs. Such modeling has produced very large estimates of looming teacher shortages.[28] At the same time, these estimates are hard to interpret because they can be sensitive to modeling assumptions about both the teacher supply (e.g., about the proportion of teacher candidates wishing to enter teaching) and demand for teachers (e.g., about policy choices like the imposition of maximum class sizes). Additionally, actual impacts of projected shortages on students and schools depend on a variety of additional assumptions (e.g., whether declines in teacher preparation are concentrated in licensure or geographic areas that currently have teacher surpluses).[29]

These alternative approaches to characterizing teacher shortages all tend to indicate that existing shortages are more severe than is indicated by staffing levels and vacancy rates. This has likely contributed to persistent narratives about serious, or even catastrophic, teacher shortages in news media and even in the research literature. While all of these measures have potential value for understanding aspects of the teacher labor market, it is notable that more recent work documenting schools' abilities to fill teaching positions indicates that teacher shortages are in general much less severe than those narratives suggest, both in absolute terms and relative to other occupations.

Regardless of how teacher shortages have been defined, estimated, and measured, a highly consistent finding in the empirical literature is that while overall or average teacher shortage rates may be low, shortages also vary substantially between schools and types of teacher position. There appears to be substantial variation between states in the rates at which teaching positions go unfilled[30] and there is approximately as much, or even more, variation in vacancy rates between schools within school districts as there is between school districts.[31]

While this variation has not been thoroughly explained by previous research, there are some systematic patterns. Some variation in shortages is regional (e.g., between counties or across urbanicities).[32] This may reflect the fact that teacher preparation programs are unevenly distributed geographically, teachers often stay relatively "close to home", and teachers are particularly unlikely to move to a school in a different state.[33] These geographic teacher production and mobility patterns may prevent teachers from moving to areas of high demand, leaving regional variation in shortages unresolved. This also motivates the recent proliferation of "grow your own" teacher programs, in which school districts prepare their own teacher candidates by drawing on their own student and staff populations.

The empirical evidence consistently indicates that teacher shortages are more severe in contexts with more educationally disadvantaged students. For instance, English learners and low-income, lower-achieving, Black, Hispanic, and Native American students experience more severe teacher shortages than their peers.[34]

Additionally, some types of teacher positions are consistently much harder to staff. Among the positions most consistently found to have the most severe shortages are math, special education, science, foreign language, English as a second language (or similar), and Career Technical Education positions.[35]

Key finding #4: *Typically, 5-8% of teachers leave the profession each year.*

Studies of teacher turnover often distinguish several kinds of teacher mobility. For instance, teachers may leave their positions to take a similar position in a different school or district or to take a non-teaching role (e.g., as an administrator). For present purposes, I focus primarily on the type of teacher mobility that matters most directly for the overall teacher supply: the rate at which teachers leave the teaching profession. However, as discussed elsewhere in this chapter, other forms of teacher mobility can matter as well, particularly for the specific schools and students experiencing the highest rates of teacher turnover.

The best nationwide historical data on teacher turnover rates come from periodic, nationally representative surveys of schools through the Schools and Staffing Survey (SASS) and its successor, the National Teacher and Principal Survey (NTPS). These surveys ask public school teachers about their mobility between one school year and the next, including whether they left teaching. In seven administrations of the SASS/NTPS between the 1987-1988 and 2021-2022 school years, the rate at which public school teachers reported leaving teaching ranged from 5.6% to 8.4%. For teachers with 11 to 25 years of experience, exit rates were only 3.5% to 6.6%. Conversely, exit rates tend to be relatively high for teachers with little experience and even more so for teachers with more than 25 years of experience (i.e., as teachers approach retirement).[36]

While SASS/NTPS surveys produce results that are nationally representative, they are administered only periodically. Additional useful information on teacher exit rates comes from analyses of longitudinal administrative data on public school teachers in Washington and other states. These analyses find that between the 1984-1985 and 2020-2021 school years, between 5% and 12% of teachers exited the state's teaching workforce each year. This is roughly in line with estimates from SASS/NTPS, albeit with somewhat higher turnover in years with relatively good economies. A substantial minority of leavers remain in the education workforce in a non-teaching capacity, and exit rates are moderately inversely correlated with state unemployment rates.[37] While teacher surveys are often cited as evidence of teacher mobility, teachers' stated intentions to leave the profession are weak predictors of, and substantially overstate, actual exit rates.[38]

What impact teacher exit rates have on the teacher supply depends in part on whether teachers who leave the profession eventually return. The most recent evidence on the rate at which teachers re-enter teaching after exiting uses a nationally representative survey of individuals born between 1980 and 1984.[39] Among teachers exiting teaching between 2000 and 2019, approximately one-fifth are ever observed teaching again subsequently. This is a lower rate than what was estimated in earlier years[40] and suggests that the large majority of teacher exits are permanent, though this study also relies on a relatively small sample of teachers. Additionally, it is not clear the extent to which the rate at which teachers re-enter the profession reflects teacher or school preferences or might vary with labor market conditions.

The implications of teacher exit for the quality of the teacher workforce depend on the relationship between teacher effectiveness and teacher exit probability. For example, if lower-quality teachers are more likely to leave the profession than higher-quality teachers, then teacher exits would tend to increase the quality of the teacher supply on average. Indeed, there is evidence that inducing exit among less effective teachers can be useful as a component of strategic efforts to improve schools.[41]

In general, the evidence suggests that less effective teachers are more likely than more effective teachers to leave the profession, and that this is particularly true among the least effective teachers. At the same time, these patterns are unlikely to have large effects on the quality of the teacher workforce on average. For example, one study of teachers in North Carolina in which students could be linked to teachers to estimate teacher effectiveness (in the form of impacts on student test scores) found that teachers in the bottom fifth of effectiveness were about 60% more likely than other teachers to leave the workforce. However, exit probabilities did not vary much among the remaining 80% of teachers; the most effective teachers were about as likely to exit as teachers in the middle three quintiles. A similar study in Florida found that teachers in the bottom quartile of effectiveness are more likely to leave the workforce than average teachers, but so are teachers in the top quartile.[42] These non-linear, or even U-shaped, relationships between effectiveness and turnover suggest that the average effects of teacher turnover on teacher quality are modest under current conditions. The impact of teacher exit on the teacher workforce may also be limited by the fact that school- and district-level teacher hiring do not appear to be highly sensitive to teacher quality.[43] This may limit the extent to which departing teachers are replaced with high-quality hires.

The rate at which teachers exit the profession appears to be roughly comparable to what is observed for plausibly similar workers in plausibly similar occupations. This was illustrated in a study using nationally representative survey data from the Census Bureau.[44] The authors first corroborate teacher exit rates estimated by SASS, and then compare profession changes between survey respondents initially reporting working in professions with similar demographic compositions, education levels, or licensure requirements: nurses, social workers, and accountants. They find that teachers overall leave their profession at about the same rate as nurses or accountants, and at a much lower rate than social workers. These patterns persist after accounting for individual, job, and labor market characteristics. They do find evidence that teacher exit rates increase and diverge from those of other professions among older workers. They interpret this as early retirement for teachers driven by the structure of common teacher pension benefits that allow teachers to replace a relatively large portion of their income at a relatively young retirement age. Numerous other studies document that teachers often respond to the incentives created by their retirement benefit plans.[45] See the chapter on teacher compensation for additional information.

An important consideration when interpreting these results is that the data are now decades old. On the one hand, turnover rates between teachers and other workers may have diverged in more recent years. On the other hand, the evidence discussed above suggests that the variation over time in teacher exit rates is modest and substantially explicable in terms of macroeconomic conditions. This might suggest largely parallel trends for exit rates in teaching and other occupations.

Of particular interest in recent years is whether teacher turnover has been impacted by the COVID-19 pandemic. Evidence from many large-scale studies in a variety of states finds that teacher turnover fell in the first year or two of the pandemic before subsequently increasing to levels at or above pre-pandemic years.[46] This is qualitatively consistent with what was observed for non-farm workers generally.[47]

Overall rates of teacher exit mask considerable variation between schools. A consistent finding in many credible studies is that teacher turnover is worse in schools enrolling more educationally disadvantaged students. For example, SASS data indicate that between the 2011-2012 and 2012-2013 school years, 84.3% of public school teachers nationwide remained teaching in the same

school. Over the same period, the figure was 80.5% in schools enrolling mostly students of color and 77.9% in schools where at least three quarters of students were low-income.[48] These differences in teacher attrition rates likely help to explain why, as discussed elsewhere in this chapter, teacher vacancy rates tend to be higher in schools serving disadvantaged students at higher rates.

Key finding #5: Teacher turnover disrupts school operations and harms student outcomes.

There are good reasons to believe that the disruption associated with teacher turnover is harmful to student achievement, but until recently there was only limited causal research examining this issue. This is in large part because it is difficult to distinguish the effects of turnover from the effects of other factors that may impact both turnover and student outcomes (e.g., student poverty and poor teacher working conditions). Consequently, research on this topic should necessarily be viewed with some degree of caution. However, several studies collectively present strong evidence that teacher turnover tends to be harmful to students and to their schools more generally.

A seminal study on the effects of teacher turnover on student outcomes compared student achievement outcomes among fourth- and fifth-grade students in New York City.[49] The authors use longitudinal data to account for important differences between students (e.g., prior achievement) and measure turnover rates in multiple ways. They also take two approaches to account for other contextual factors that might impact student outcomes. In one approach, they compare different cohorts of students in the same grade in the same school, but who experienced different rates of teacher turnover because they were enrolled in different years. In the second approach, they compare students in the same school in the same year, but who experience different turnover rates because they are in different grade levels. Despite relying on somewhat different assumptions, the various approaches point in the same direction: the turnover of the entire teaching staff in a given grade level reduces student achievement in that grade level by 0.08-0.10 standard deviations (s.d.) in math and by 0.05-0.08 s.d. in English/language arts. For perspective, these are approximately the additional achievement gains we would expect teachers to be able to produce as they gain effectiveness over the first five years of their careers.[50] These estimated impacts of turnover are mostly similar in schools of different sizes and ages, and larger in magnitude in schools with more Black or lower-achieving students.

A key contribution of this study was its analysis of why teacher turnover was detrimental to student outcomes. The authors find that some, but not all, of the negative effects of turnover can be explained by that turnover leading students to be assigned to teachers who are less experienced and less effective. Additionally, they show that even students whose teachers do not leave have lower test scores when other teachers in the grade level turn over. That not all of the negative effects of turnover are accounted for by the changing composition of teachers in a school suggests that some of the negative effects of turnover spill over in some fashion to the teachers who remain (and their students), though the researchers cannot demonstrate the precise mechanism by which this occurs.

This approach to identifying the effects of teacher turnover is not perfect, because it cannot eliminate the possibility that turnover is associated with other unobserved factors affecting student achievement growth within or between grade levels (even within schools). This motivates subsequent work that attempts to further mitigate potential omitted variable bias with additional controls. However, the inclusion of these additional controls produces a qualitatively similar pattern of results, including the results that the achievement impacts of turnover are larger in lower-achieving schools and can be substantially – though not entirely – explained by changes in the distribution of teacher experience.[51]

Other work has explored how the effects of teacher mobility depend on who is assigned to fill an open position.[52] The authors again use longitudinal data from New York City but extend previous work by allowing the effect of having a new teacher to vary depending on whether the teacher is newly reassigned within-school, new to the school, new to the city, or new to the profession altogether. The results are consistent with teacher transitions being more disruptive to learning when those transitions involve greater degrees of change for the new teacher. Student achievement suffers most when teachers are entirely new to the profession rather than simply new to the school or district, though even within-school reassignments are associated with small decreases in student achievement. These apparent decrements to teacher effectiveness fade in ways consistent with teachers adapting to their new assignments, but do not switch direction as might be expected if teacher switching improves teacher-assignment matches overall. This helps to explain why teacher turnover has negative effects on average: however effective replacement teachers are, their effectiveness is at least temporarily depressed in their new assignment.

But, while turnover appears to generally have negative impacts on student achievement, this is not always the case. In particular, there is evidence that strategic efforts to improve workforce quality can mitigate the disruptive effects of turnover when they selectively induce turnover among less effective teachers or induce greater improvements among teachers who remain. Some of the most credible studies of this possibility consider teacher turnover in the Washington, D.C. public school system (DCPS). DCPS adopted a new teacher evaluation system in 2009 that was intended to better identify teacher effectiveness by incorporating both classroom observations and measures of student learning. Moreover, DCPS increased professional development supports for teachers linked to classroom observations, and increased the stakes of evaluation through a combination of credible dismissal threats and substantial amounts of performance pay.

Studies of this reform found that the threat of dismissal induced some low-performing teachers to leave and others to improve their performance. Additionally, teachers potentially in line for a performance bonus increased their effectiveness, and there is suggestive evidence that they were also more likely to stay in their jobs.[53] Subsequent studies find net positive impacts of this reform-induced turnover on both the composition of teacher quality and student achievement.[54] So while teacher turnover currently appears to be harmful on average, it does not follow that all cases of teacher turnover are harmful or that strategic interventions cannot use teacher turnover as part of a school improvement strategy.

Key finding #6: Higher compensation tends to increase teacher recruitment and retention.

Numerous studies have estimated the effects of compensation on the teacher supply. They collectively suggest that higher compensation can improve the teacher supply through improvements to teacher recruitment, retention, and quality.

The most credible studies on this topic take advantage of natural experiments in which changes in policy change the compensation available to some teachers but not others. For example, Florida implemented statewide programs to recruit and retain early career teachers through student loan forgiveness and retention bonuses for teachers in “hard-to-staff” subject areas and grade levels. By comparing teachers eligible for those incentives based on their teaching assignments to those who were ineligible, researchers found that an annual loan forgiveness payment representing 3-4% of pay reduced the chances that math, science, foreign language, English as a second language, and, in some cases, special/gifted education teachers left the workforce by at least 9%. Retention bonuses of a similar magnitude had larger retention effects, at least in the short term.[55]

Conceptually similar approaches have found similar results across a wide range of compensation incentives and contexts. For instance, California’s $20,000 incentives for novice teachers to work in low-performing schools increased the probability that they would do so by 28 percentage points.[56] In Washington, the state’s policy offering National Board Certified (NBC) teachers $5,000 per year

to work in low-income schools increased the rate at which teachers in those schools were NBC by about 1.2 percentage points per year.[57] In Hawaii, a statewide $10,000 salary incentive for special education teachers reduced the vacancy rate for special education teaching positions by about one third, primarily by inducing general education teachers to move into special education teaching positions.[58] Strategically targeted compensation also appears to hold promise for improving student outcomes by improving the teacher supply. In Dallas, Texas, stipends of $6,000-10,000 for effective teachers working in low-achieving schools substantially and rapidly improved student achievement. Similarly, when stipends were eliminated teacher effectiveness and achievement fell in targeted schools.[59] There is also randomized experimental evidence that payments of $20,000 over two years offered to the most effective teachers in a district successfully induced those teachers to transfer to classrooms in low-performing schools.[60]

There is moderately strong evidence that the supply effects of compensation are greater for more novice teachers, though the strongest studies on this topic are smaller in number and more contradictory. For instance, a pair of studies of teachers in Texas finds that compensation matters more for novices. One of these studies takes advantage of the fact that over time school districts change their teacher salaries by different amounts for teachers of different experience levels, and by different amounts than other districts. The author compares changes in teacher turnover between teachers of different experience levels over time in a school district to analogous turnover changes in other school districts to estimate the effects of those salary changes. Overall, a 1% increase in salary is estimated to increase teacher retention by 0.16 percentage points. However, when allowed to vary with teacher experience, the effects are as much as 50% larger in magnitude for the least experienced teachers and become smaller, approaching zero and losing statistical significance, for more experienced teachers.[61] A second study takes advantage of changes to the statewide minimum teacher salary schedule in Texas that affected teacher salaries differently at different experience levels depending on how the district was previously paying teachers. When these changes induced a 1% increase in salaries offered to teachers at a given experience level, relative to other experience levels in the district, the proportion of all new hires who came in at that experience level increased by 0.04-0.08 percentage points. Again, the effects were substantially larger for more novice teachers and smaller for veterans.[62] However, some contrary evidence comes from a program in North Carolina providing annual bonuses worth approximately 4-5% of base salary to math, science, and special education teachers in low-income or low-achieving secondary schools. These bonuses reduced turnover by 17% among those teachers overall. However, effects were generally larger, in some cases almost double, among more experienced teachers.[63]

Compensation reforms do not always work as well as intended. For example, one study examines the impact of a performance bonus offered to teachers in low-performing schools in Tennessee.[64] The authors compare the retention of teachers whose performance ratings are just high enough to receive the bonus to teachers whose ratings are slightly too low (and who should otherwise have similar outcomes if not for the bonus). They find that for teachers in tested subjects and grades, the bonuses increased the probability of staying in their school. However, for other teachers there was virtually no effect. The authors attribute this to the incentive structure of the bonus policy: teacher performance ratings were based substantially on school performance measures that teachers of untested subjects and grades would have relatively little control over. This illustrates both the promise of compensation reforms for improving the teacher supply and the importance of designing policy strategically to achieve its intended goals.

Understudied or unsettled issues

Many important aspects of the teacher supply remain poorly understood. I will not catalogue them exhaustively, and some issues about which there is important uncertainty are noted above. Here I note several other issues that stand out as particularly important.

We do not know what rates of teacher entrance, exit, or shortage would be "good enough" to achieve specific educational objectives.

Many conversations about the teacher supply are complicated by the fact that even when some descriptive or causal realities are well understood, such as several of those discussed above, it is not clear what patterns of teacher supply and retention we should be satisfied with. In part, this is because what educational outcomes we should aim for is a necessarily normative question. Yet even when there is agreement about educational goals, there is no clear evidence or consensus about what would constitute satisfactory rates of teacher entrance into the profession, mobility, or "shortage" for achieving those goals. For example, while we now have good evidence about the extent of teacher shortages, the impacts of these shortages on students are not well understood. To see how this can be, consider that typical measures of teacher shortages like those discussed above may indicate growing shortages even as – and perhaps because – schools are employing larger numbers of teachers. This makes shortage levels and trends difficult to understand in terms of their implications for students.

We do not know very much about how to characterize the quality of the teacher supply or about potential tradeoffs between the quantity of the teacher supply and the quality of the teacher supply.

We have a much better understanding of the size of the teacher supply than we do of the quality of the teacher supply, or of how the size of the teacher supply is related to the quality of the teacher workforce. For example, there is some evidence about the relative rates at which more and less effective teachers enter or exit teaching, but characterizing the overall quality level of the teacher supply is hard to do. There may also be important tradeoffs between increasing the size of the teacher supply and increasing its quality (e.g., because preparing and hiring more teachers means that they are each prepared less rigorously or compensated less generously). Moreover, it is not clear the extent to which improvements in the quality of the teacher supply translate into improvements in the quality of the teachers working in schools (e.g., because schools may not hire the most effective teachers or because the highest-quality teachers may concentrate in certain schools or classrooms).

We do not know very much about what interventions would reliably increase the quality of the teacher supply.

Relatedly, we do not know much about how to increase the quality of the teacher supply. As noted above, some local efforts appear to have been successful in this regard, such as the teacher evaluation and compensation reforms in Washington, D.C. Public Schools. And there is promising statewide evidence from Wisconsin and a 2011 policy allowing school districts to depart from step-and-lane salary schedules, giving them flexibility to differentiate compensation between similarly educated and experienced teachers. Districts that did so increased pay for higher-quality teachers and improved both teacher quality and student achievement.[65] More generally, however, common approaches to improving teacher quality have met more mixed or limited success, such as efforts to implement pay-for-performance schemes or to reform teacher evaluation. Some approaches may even backfire or have unintended consequences, such as in cases where teacher licensure requirements have limited relationship to teacher quality but disproportionately exclude teachers of color from the profession.[66]

We do not know very much about the earliest stages of the teacher pipeline.

Most of the "key findings" discussed above relate to teachers being hired into or already holding teaching positions. While we have some information about the pathways of teachers and potential teachers prior to entering the labor market, even our national data on teacher preparation are

somewhat messy and difficult to interpret.[67] We also know relatively little about why some individuals choose to pursue or complete teacher preparation programs at the undergraduate or graduate levels or about how this varies across types of teaching roles (e.g., elementary vs. secondary vs. special education).

We do not know very much about how to reliably increase the diversity of the teacher supply.

As discussed above, the teacher supply has diversified only slowly, if at all, over the last several decades in terms of race and gender. This is despite persistent interest in diversifying teaching as a profession and mounting evidence that a diverse teaching force can have important benefits. This may be a reason to improve our understanding of the earliest stages of the teacher pipeline as there is evidence that choices about what professions to pursue may be more important to this problem than other factors (e.g., college graduation rates or retention in teaching).[68]

We do not know very much about how to intervene to improve working conditions that might matter for attracting and retaining teachers.

There is evidence that working conditions matter to teachers and to the teacher supply,[69] but it is mostly not clear how to intervene on working conditions to improve the teacher supply. This in part reflects that strong causal evidence on the effects of specific teacher working conditions is scarce. Additionally, some aspects of the working conditions that seem to matter for teachers are hard to operationalize in practice or are otherwise hard to deliberately and consistently improve. For instance, the quality of school leadership appears to be important to teachers, but it is not entirely clear what constitutes "good leadership" or how to reliably improve leadership quality in schools. Moreover, even in cases where working conditions can be operationalized and improved, this often requires tradeoffs that we have limited information about how to navigate. For example, we understand in principle how to reduce class sizes and this may reduce teachers' workloads and improve their job satisfaction, but using the same resources to instead increase teacher compensation might have bigger effects on teacher recruitment and retention.

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