

The Theories and Determinants of Teacher Attrition and Retention

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# **CHAPTER I**

## **INTRODUCTION**

Teachers represent a critical part of public education and there is compelling interest in retaining teachers, particularly for schools in dire needs. This has led researchers and policy makers to develop strategies to recruit and retain effective teachers, highlighting the importance of knowing the determinants of teacher attrition and retention. As such, this dissertation seeks to contribute to the scholarly understanding of the determinants of teacher attrition and retention in a series of three studies, demarcated as chapters II, III, and IV. The studies are strongly connected and each one informs the work of the other.

The first study, chapter II of the dissertation, develops a comprehensive conceptual framework of teacher attrition and retention. The two most cited and seminal works in the area of teacher attrition and retention are the Guarino, Santibanzas, and Daley (2006) and Borman and Dowling (2008) studies. While both studies present their own conceptual framework, the frameworks were constructed without much guidance from the employee turnover literature. Moreover, their frameworks are based solely on the factors that they found in their narrative review and meta-analysis. Last but not least, there has been substantial development in the area of teacher attrition and retention in the last twelve years since these two seminal works were published.

This study then makes several contributions to the study of teacher attrition and retention. Building on these two seminal works, I present a comprehensive conceptual framework of teacher attrition and retention, which is guided by broader employee turnover literature and supported by the empirical literature. Using updated systematic review methods, leveraging the broader employee turnover literature, and adding in more than ten additional years of research on

the determinants of teacher attrition and retention, particularly in light of the proliferation of “big data” and its use in providing new results and causal estimates, I categorized the determinants into nine subcategories grouped under three primary categories of personal correlates, school correlates, and external correlates. Personal correlates include teacher characteristics and teacher qualifications; school correlates include school organizational characteristics, school resources, student body characteristics, and relational demography; and external correlates include school improvement, work force, and accountability. For each category, I discuss the empirical results and their implications for attrition and retention and I also highlight the gaps in the empirical literature and the possible policy levers to positively influence the teacher work force. In short, through the systematic review and synthesis of the literature I created a framework that can be used to study and advance the field’s knowledge on teacher attrition and retention in addition to synthesizing the results of nearly forty years of research and providing guideposts for future research in this area of scholarly study.

The second study, chapter III of the dissertation, is a meta-analysis of teacher attrition and retention using the conceptual framework developed in the first study. I improve upon the Borman and Dowling (2008) study by expanding the search from 1980 to 2017, adding in more than a decade of research and development, which is particularly meaningful with the inclusion of studies involving teacher evaluation, teacher merit pay, NCLB, principal effectiveness, teacher-principal race/gender matching, teacher-student race matching, comprehensive school reform, and research-practice partnership. Moreover, the proliferation of longitudinal data systems has allowed researchers to empirically improve our understanding of the teacher labor market dynamics, which substantially advances the field’s knowledge of teacher attrition and retention in a meta-analysis. The study also makes methodological improvements using current

best meta-analytic practices, paying close attention to the grey literature search, publication bias, data analysis, presentation of results and robustness of findings. The updates and improvements proposed in this meta-analysis should enhance the scholarly understanding of what drives teacher attrition and retention and provide the most up-to-date comprehensive review of the field's empirical knowledge on teacher attrition and retention.

The third study, chapter IV of the dissertation, is a quantitative study of the determinants of teacher attrition and retention using over-time cross-sectional national data. In the current literature the factors determining retention and attrition come from a large number of studies that vary substantially from each other with respect to time period, location, sample, sampling strategy, and methodology. Empirically, each factor has been found to have an association with teacher retention and attrition, but no study has analyzed the extent to which these relationships hold when these factors are studied simultaneously. Another limitation is that the majority of the studies have analyzed the relationship between the factors and teacher retention and attrition in a given year or a single district or state. Consequently, there is substantial room for contribution to the research on the factors of teacher retention and attrition.

This study analyzes whether and how the relationships of these categories of factors and teacher retention and attrition hold true nationally and over time using four waves of the Schools and Staffing Survey (SASS) and its supplement, the Teacher Follow-Up Survey (TFS). Using these data, I make several contributions to the study of teacher attrition and retention. First, the use of longitudinal nationally representative data instead of short-term district- or state-level data to study teacher turnover provides a more thorough picture of turnover nationally and over time. Second, the data from SASS have detailed comprehensive information on teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body

characteristics, which is ideal in studying how these factors influence teacher turnover as it alleviates some concerns of omitted variable bias. Third, I am able to differentiate between movers and leavers, and I find that factors that influence movers may not influence leavers and vice versa, which substantially adds to the empirical knowledge of the factors of teacher attrition and retention. Fourth, I find that, while the influences of most factors remain stable through time, there are some variables whose influences have changed over the twelve-year time frame.

In short, the first two studies provide a framework that can be used to study and advance the field's knowledge on teacher attrition and retention in addition to synthesizing the results of nearly forty years of research and providing guideposts for future research, while the third study examines whether and how factors of teacher retention and attrition hold true nationally and over time, and how factors that influence leavers may not influence movers in the same way. Taken together, the three studies in this dissertation add substantial breadth and depth to the study of and policy discourse on teacher attrition and retention.

## **CHAPTER II**

### **A CONCEPTUAL FRAMEWORK OF TEACHER ATTRITION AND RETENTION: A SYSTEMATIC REVIEW OF THE EMPIRICAL LITERATURE AND INSIGHTS FROM THE EMPLOYEE TURNOVER LITERATURE**

#### **Introduction**

Teacher labor markets and teacher shortages have strong implications for learning outcomes and equity for students. Teachers are the foundation of public education, an integral part of a democratic society. As such, the general public and educators care about issues of equity and productivity in schools, and policy makers have spent a considerable amount of time working to ensure that classrooms are staffed with qualified teachers (Hanushek, Kain, & Rivkin, 2004; Ingersoll & Smith, 2003; Loeb, Kalogrides, & Beteille, 2012). For instance, No Child Left Behind (NCLB) and Every Student Succeeds Act (ESSA) are two pieces of federal legislation that emphasize the importance of teachers and the placement of qualified teachers in every classroom. Substantial evidence indicates that an important facet of the large variations in quantity and quality of the teacher workforce among schools and districts is the teacher attrition rates in certain schools and districts, and scholars have concluded that we need to learn more about teacher labor markets so that we can better address the uneven distribution of quantity and quality of teachers (Feng & Sass, 2017a; Ingersoll, 2001; Guarino, Santibanez, & Daley, 2006; Lankford, Loeb, & Wyckoff, 2002).

Variations in teacher quantity and quality can be explained by multiple factors such as teacher preferences and district hiring practices (Engel & Cannata, 2015; Lankford, Loeb, & Wyckoff, 2002). These factors affect how teachers are sorted differentially across states, districts and schools, and substantial research has shown that the most disadvantaged schools, schools that need effective teachers the most, are often the hardest to staff and often face high teacher

turnover (Allensworth, Ponisciak & Mazzeo, 2009; Boyd et al., 2011; Ingersoll, 2001; Guarino, Santibañez, & Daley, 2006). In addition, high teacher turnover is also costly to schools and districts (Barnes, Crowe, & Schaefer, 2007). In short, teachers represent a critical part of public education and there is compelling interest in retaining quality teachers, particularly for disadvantaged schools. This has led researchers and policy makers to develop strategies to recruit and retain effective teachers, highlighting the importance of the determinants of teacher attrition and retention.

What can explain why teachers stay or go? There are few comprehensive conceptual frameworks based in both the employee turnover literature and empirical research in education that explain the determinants of teacher attrition and retention. Individual studies of teacher attrition and retention often present a tailored framework that focuses on the specific factors that are examined in that study. In terms of critical and systematic reviews of teacher attrition and retention, the two most cited and seminal works are the Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008) studies. While both studies made substantial contributions to the study of teacher attrition and retention with their reviews and conceptual frameworks, there are limitations to each study that can be addressed. In particular, while Guarino, Santibañez, and Daley (2006) presented a conceptual framework based on the economic labor market theory of supply and demand, this conceptual framework was fairly broad as it encompassed both the supply and demand sides. As such, their conceptual framework does not provide a detailed framework for studying teacher attrition and retention. Relatedly, the authors only dealt with several factors that influence attrition and retention.

On the other hand, based on their systematic search of the empirical literature on teacher attrition Borman and Dowling (2008) presented five categories of attrition and retention factors

with several factors under each category. However, these categories were grouped together without guidance from the prior literature, particularly the broader employee turnover literature. Moreover, both of these frameworks are based solely on the factors identified through their reviews without consideration of theoretical and not-yet-available factors that could drive attrition and retention, which is one area this study seeks to advance. Furthermore, a substantial amount of work on teacher attrition and retention has been conducted since these two seminal studies were published, particularly in the areas of evaluation, value-added measures, and merit pay. Relatedly, there have been significant methodological improvements in the field of systematic reviews that allow for more thorough and robust searches to find eligible studies. Moreover, the development and proliferation of large longitudinal data systems, “big data,” in the last ten years have allowed researchers to empirically advance our understanding of teacher attrition and retention, especially in terms of providing causal estimates. As such, these developments provide new insights and opportunities to create and develop a more comprehensive conceptual framework of teacher attrition and retention.

In sum, there is strong need for a comprehensive conceptual framework of teacher attrition and retention that is guided by employee turnover literature and supported by empirical evidence attending to recent development and insights. Thus, to advance the literature on teacher attrition and retention I develop a conceptual framework of teacher attrition and retention based on a systematic search of the empirical literature on teacher attrition and retention and guided by the existing literature on employee turnover of which teacher turnover is a subset. In particular, the research questions I address are:

- (1) What are the conceptual and empirical determinants of teacher attrition and retention?



(2) Are there gaps in the empirical research on teacher attrition and retention? If so, what are they?

(3) What are some policy levers that can be used to affect teacher attrition and retention?

In reviewing and synthesizing the literature on teacher attrition and retention, I follow the recommended processes of Hallinger (2014), Moher et al. (2009), and Murphy (2008). As such, the rest of the paper is structured as follows. First, I discuss previous conceptual frameworks of teacher attrition and retention as well as the employee turnover literature that guides my construction of a comprehensive conceptual framework of teacher attrition and retention. Then I describe the procedures used to conduct my systematic review of this extensive body of empirical and theoretical scholarship. Based on this systematic review, I discuss the findings of my search in light of my conceptual framework, which contains three primary categories of personal correlates, school correlates, and external correlates. In the discussion section I highlight the new areas of development and empirical gaps in the literature on teacher attrition and retention as well as promising policy levers that may be able to positively impact the composition of the teacher work force.

### **Examining Prior Conceptual Frameworks**

Guarino, Santibañez, and Daley (2006), one of the most cited works in the area of teacher attrition and retention, provided a conceptual framework based on the economic labor market theory of supply and demand. With this broad frame in mind, they examined the literature related to teacher entry, mobility and attrition and summarize the prominent themes in these areas. For instance, in terms of the characteristics of individuals who enter teaching, they found that gender, race/ethnicity, ability, and psychological and family-related factors all contribute to the

composition of who enters the profession. Relatedly, they found that age, experience, gender, race/ethnicity, ability, field or specialization, qualifications, and psychological factors influence teacher decisions to leave teaching. In particular, they found teacher attrition is high for teachers in their first few years of teaching, that minority teachers tend to have lower attrition rates than White teachers, teachers in math and science are more likely to leave than teachers in other fields, and teachers with higher measured academic ability and female teachers are also more likely to leave. Furthermore, they discussed the characteristics of districts and schools that successfully recruit and retain teachers, and they concluded that schools with higher proportions of minority, low-income and low-performing students tend to have higher attrition rates. Lastly, they categorized and examined policy levers (compensation policies, pre-service policies, and in-service policies) that may be able to positively affect the composition of the teacher work force. For instance, they found that teachers respond positively to higher salaries and that attrition rates are lower in schools that provide mentoring and induction programs. In short, using the broad framing of economic labor market theory of supply and demand Guarino, Santibañez, and Daley (2006) summarized some of the driving forces of teacher attrition and retention.

Building on Guarino, Santibañez, and Daley (2006), Borman and Dowling (2008) conducted a meta-analysis and narrative review of the research on teacher attrition and retention. Across 34 studies, they found over 60 factors that are empirically associated with teacher attrition and retention. They organized these factors into five categories: teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics. Teacher demographic variables facilitate our understanding of how teacher background characteristics such as age, gender, race/ethnicity, and marital status, influence attrition and retention. Teacher qualifications include teacher training, certification, teaching

experience, teacher ability, and field or specialty area. School organizational characteristics are the characteristics of the school such as the urbanicity, size, secondary versus elementary level, and work environment. School resources drill down further to include characteristics such as average class size and teaching materials. Lastly, student body characteristics describe the composition of the student body, which includes broad areas such as the school's socioeconomic composition, student achievement level, and the racial/ethnic composition of the school. For each of these five categories, Borman and Dowling (2008) presented their meta-analytic results. This study included a more thorough examination of the factors that may influence attrition and retention than the work by Guarino, Santibañez, and Daley (2006). However, Borman and Dowling (2008) constructed these five categories based on how they seem to group together and without guidance from the broader employee turnover literature. The five categories certainly are reasonable categories but they do not provide a conceptual framework that situates their findings and that could be used to point to gaps in the literature. Consequently, I build upon these two seminal studies by conducting a systematic search of the empirical literature on teacher attrition and retention, and by developing a classification scheme for identified determinants of teacher attrition and retention that is guided by existing literature on employee turnover at large. More specifically, I focus on the factors that influence whether teachers exit the system, i.e., leave teaching or leave the state or the data set where they taught, not on whether teachers switch schools.<sup>1</sup> In addition to updating the field's knowledge of the determinants of teacher attrition and retention with more than ten years of additional research since Borman and Dowling (2008)<sup>2</sup> and Guarino, Santibañez, and Daley (2006), I provide a conceptual framework that organizes

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<sup>1</sup> For ease of reading, I also use leave teaching when referring to teachers exiting the system as many studies do.

<sup>2</sup> The study was published in 2008 but the literature search ended in 2005.

prior findings with insights from the broader employee turnover literature, which I describe below.

A classic study that has influenced the scholarly study of employee turnover is a meta-analysis and review by Cotton and Tuttle (1986). In this study, Cotton and Tuttle (1986) analyzed the determinants of employee turnover and organize them into three large categories, or correlates, of turnover: (1) personal correlates, (2) work-related correlates, and (3) external correlates. Personal correlates are variables and characteristics of the employees and their relationship with turnover such as age, gender, education, marital status, number of dependents, and ability. Work-related correlates include variables that are associated with the work place such as job satisfaction, salary satisfaction, and organizational commitment. External correlates include factors that are outside the individual or the work place such as the unemployment rate and union presence.

Similar to Cotton and Tuttle (1986), Griffeth, Hom, & Gaertner (2000) conducted a meta-analysis of the determinants of employee turnover. In their work, they organize the determinants into six categories: (1) personal characteristics, (2) satisfaction with overall job and job facets, (3) other dimensions of work experience, (4) external environment factors, (5) behavioral predictors, and (6) cognitions and behaviors about the withdrawal process. The authors also found that, like Cotton and Tuttle (1986), these factors do indeed predict turnover, and with more studies and variables available, they organized them into more detailed categories.

The most recent systematic review or meta-analysis study on the employee turnover literature was conducted by Rubenstein, Eberly, Lee, and Mitchell (2017). Building on the prior literature, Rubenstein and colleagues conducted a meta-analysis of the determinants of employee turnover. Following prior work, they categorized their findings into nine categories: (1)

individual attributes, (2) aspects of the job, (3) job attitudes, (4) newer personal conditions, (5) organizational context, (6) person-context, (7) external job market, (8) attitudinal withdrawal, and (9) employee behaviors.

Looking across these three studies and others (e.g., Maertz, Griffeth, Campbell, & Allen, 2007; Ongori, 2007; Porter & Steers, 1973), there seem to be three large categories and smaller subcategories that influence general employee turnover. First, the individual characteristics of employees such as age, gender, race/ethnicity, and qualifications are highly associated with turnover. Second, the interactions between the individual employees and the work place also matter. In this construct, we observe that variables like the physical conditions of the work place and support and collaboration among employees play a significant role in whether people leave their job. Third, there are external events or factors outside the individual and the work place, such as the external job market, that influence whether people stay or leave their job.

Adapting the findings from these prior works in employee turnover literature to teacher attrition and retention literature, I argue there are three primary categories that influence teacher attrition and retention: (1) personal correlates, (2) school correlates, and (3) external correlates. Under personal correlates, we have teacher characteristics and teacher qualifications categories. School correlates contains factors that describe the schools and conditions in which the teachers work, including school organizational characteristics, school resources, student body characteristics, and relational demography categories. Lastly, under external correlates, are factors that come from federal, state, or district policies and economic factors surrounding employment such as accountability, school improvement, and work force categories. Figure 1 is the visual representation of my conceptual framework of teacher attrition and retention and Table 1 lists the specific factors under each category. Five of the nine categories are based on Borman

and Dowling (2008), while four categories, relational demography, accountability, school improvement, and work force, are proposed categories that have clear theoretical reasons or empirical evidence that may influence teacher attrition and retention, which I briefly describe below.

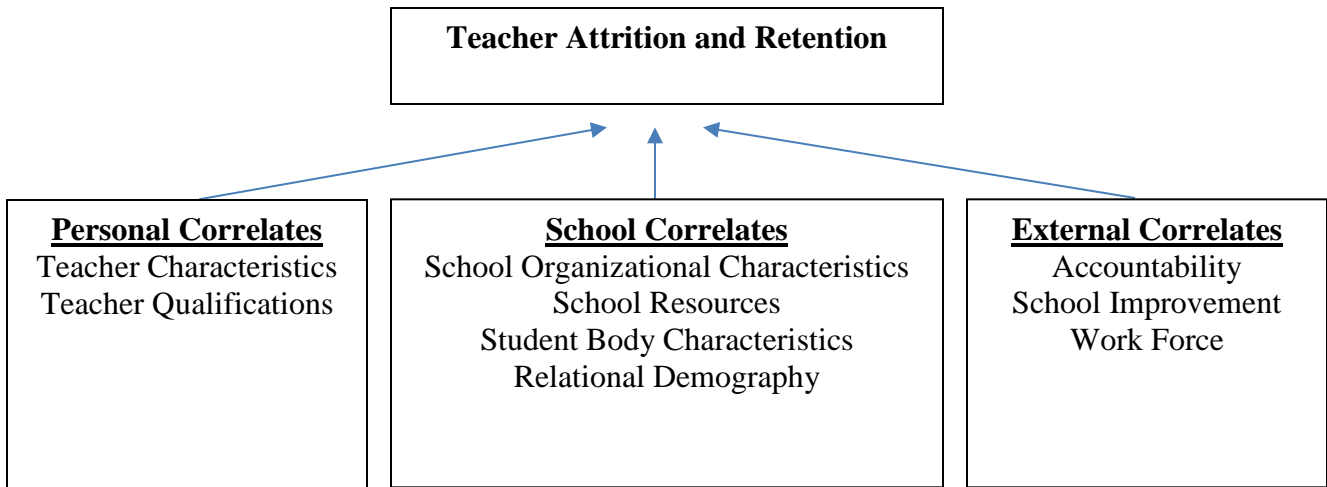


Figure 1. Conceptual Framework of Teacher Attrition and Retention

Table 1: Categories and determinants of teacher attrition and retention

Personal correlates		School correlates				External correlates		
Teacher characteristics	Teacher qualifications	School org characteristics	School resources	Student body characteristics	Relational demography	Accountability	School improvement	Work force
Age	Ability (test scores)	School size	Expenditure	Student achievement	Tch-princ race/gender match	Assessment impact	Mandated school reform	Employment rate
Gender	Education selectivity	Urbanicity	Class size	Percent minority	Tch-tch race match	Teacher effectiveness	Research-practice partnership	Accession rate
Race/ethnicity	Graduate Degree	Sec. vs elem. level	Classroom assistants	Poverty	Tch-student race match	Merit pay		Late hiring
Marital status	Certification	Private, public, charter	Teaching materials	Percent IEP/LEP		Federal policies (NCLB/ESSA)		Salary
Children	Highly qualified (NCLB/ESSA)	Work environment				Principal effectiveness		Retention bonus
Satisfaction	Internship	Administrative support						Non-teacher salary
Full time Teaching	Specialty area (STEM, SPED)	Teacher collaborations						Union
Distance to school	Experience	Teacher leadership						Tenure
	Prior non-teaching career experience	Professional development						
		Induction mentoring						
		Classroom autonomy						
		Stay ratio						

Note. The first five categories are adapted and expanded based on Borman & Dowling (2008). Stay ratio is the teacher retention rate at the school. Internship includes field placement. Teacher leadership includes teacher influence at the school level. Assessment impact includes evaluation used for school-level decision-making. In comparison, teacher effectiveness score is measured by a composite evaluation score or value-added score.

**Relational demography.** A new area of development in the literature on teacher attrition and retention comes from the relational demography, and relatedly representative bureaucracy, literature (Fairchild et al., 2012; Grissom, Kern, & Rodriguez, 2015; Sohn, 2009). The thrust of the theory of relational demography is that people are influenced by the composition of other people around them. In other words, the degree of similarity between a person and others with whom they have regular contact would influence their attitudes and behaviors (Tsui & O'Reilly, 1989). The literature in this area suggests that there are positive outcomes for teachers and students when there is race or gender congruence between the teachers and the principals, between teachers and teachers, and between teachers and students. For instance, Grissom and Keiser (2011) found there is higher job satisfaction when there is teacher-principal race congruency. Elsewhere, others have found that teacher-principal gender congruence is also associated with teacher satisfaction and turnover (Grissom, Nicholson-Crotty, & Keiser, 2012). Likewise, teacher-student race matching has also been found to influence teacher satisfaction, a strong predictor of teacher turnover (Engel, Jacob, & Curran, 2014; Fairchild et al., 2012; Renzulli, Parrott, & Beattie, 2011; Stearns, Banerjee, Mickelson, & Moller, 2014). For instance, Fairchild et al. (2012) found that teacher-student race congruence is a positive and significant predictor of teacher satisfaction. In short, recent research in relational demography suggests that teacher-principal race/gender matching and teacher-student race matching can influence teacher attrition.

**Accountability.** In terms of external programs from the district or the state that rely or call upon accountability at the teacher or school level, there has been much development in state and federal programs and initiatives that aim to make changes to the teacher labor markets to attract qualified teachers and retain qualified and effective teachers. An additional part of the



logic model of accountability is that some attrition is probably good –in particular, attrition among low-performing teachers. Murnane and Steele (2007) noted some proposed policies, such as the use of teacher evaluation and teacher merit pay, to increase the supply of effective teachers and how they can be distributed more equitably. However, many of these policies were newly enacted, and they varied widely in terms of implementation and management. Moreover, their effectiveness was still being assessed and debated by 2006 (Murnane & Steele, 2007). Recent work has highlighted how schools and school personnel respond differently to teacher evaluation, how evaluation is framed differently depending on the contexts, and that teacher evaluation can have a direct impact on teacher satisfaction, commitment, and retention (Marsh et al., 2011; Murphy, Hallinger, & Heck, 2013; Peterson, 2000; Weiss, 1999).

Relatedly, there are policies and programs that link teacher evaluation, most often via student performance, with consequences and rewards. A couple of examples of these new programs are the Teacher Advancement Program and the Teacher Incentive Fund. The Teacher Advancement Program was established in 1999, but there was not an evaluation of its effect on the teacher labor market until after 2005 (e.g. Glazerman et al., 2013; Glazerman & Seifullah, 2012; Springer, Ballou, & Peng, 2014). The Teacher Incentive Fund, initially a \$600 million federal grant established by Congress in 2006, was expanded and supported as part of the American Recovery and Reinvestment Act (ARRA) in 2009. At least two studies assessing the effectiveness of the TIF funds have been published recently (Slotnik et al., 2013; Wellington et al., 2016). Moreover, there are other state merit pay programs have been implemented and evaluated in the last 10 years (Pham, Nguyen, & Springer, 2017).

Additionally, there has also been evidence that federal programs and initiatives may influence the teacher labor market, especially teacher retention decisions (Brownell, Bishop, &

Sindelar, 2005; Harrell et al., 2004; Hill & Barth 2004). Lastly, recent works have found accountability of school administrators, most often the principals, can also influence teacher satisfaction, commitment, and attrition (Boyd et al., 2011; Grissom, 2011; Stockard & Lehman, 2004). Recently, using longitudinal administrative data, Grissom and Bartenan (2017) have found plausibly causal estimates of principal effectiveness on teacher turnover. In sum, teacher evaluation, teacher merit pay, federal policies such as NCLB, and principal effectiveness must be considered in how teacher retention and attrition is conceptualized.

**School improvement.** There is a long history of school reform efforts and over the last several years there has been a swell of new approaches and evaluations of school improvement efforts, including comprehensive school reforms and research-practice partnerships, that have a strong focus on teacher development and leadership (Borman, Hewes, Overman, & Brown, 2003; Bryk, Gomez, Grunow, & Lemahieu, 2015; Coburn & Penuel, 2016; Cohen-Vogel, Cannata, Rutledge, & Socol, 2016; Datnow & Castellano, 2001; Rowan, Correnti, Miller, & Camburn, 2009). These school improvement developments aim to increase teacher buy-in and develop teacher capacity as teachers and leaders (Nguyen & Hunter, 2018; Rubin, Nguyen, & Cannata, 2017), which theoretically and empirically can incentivize teachers to stay in their schools (Guarino, Santibañez, & Daley, 2006; Macdonald, 1999; Shaw, 2016). However, even though school reforms have been around for decades, there has not been any rigorous analysis of the effects of school improvement efforts on teacher attrition and retention until very recently (Heissel & Ladd, 2017; Sun, Penner, & Loeb, 2017). The recent implementations and evaluations of school reforms and research-practice partnerships may affect the teacher labor market and should contribute to the scholarly understanding of teacher attrition and retention.

**Work force.** Work force is a category of determinants that comes mostly from the employee turnover literature (Cotton & Tuttle, 1986; Griffeth, Hom, & Gaertner, 2000; Rubenstein, Eberly, Lee, & Mitchell, 2017). These determinants are factors that reflect the employment opportunities inside and outside of teaching and policies that can influence attrition and retention at the district or state levels but not related to accountability or school improvement efforts. They include employment rate, accession rate, teacher salary, non-teacher salary, late hiring, retention bonus, union and tenure. The employee turnover literature indicates that the overall employment rate and existence of alternative job opportunities generally influences whether people stay or leave their current occupation (Griffeth, Hom, & Gaertner, 2000), and these determinants can logically be extended to teacher attrition and retention (Barbieri, Rossetti, & Sestito, 2011; Clotfelter, Ladd, & Vigdor, 2011). Relatedly, the accession rate or the percent of new employees added during a hiring period, usually one year, could also affect attrition decisions (Cotton & Tuttle, 1986). Late hiring is also another factor that may relate to teacher attrition (Cotton & Tuttle, 1986; Jones, 2011). In terms of monetary incentives, non-teacher salary, teacher salary<sup>3</sup> and teacher retention bonuses could incentivize or disincentivize teachers from leaving the profession (Griffeth, Hom, & Gaertner, 2000; Rubenstein, Eberly, Lee, & Mitchell, 2017). Lastly, tenure reform is expected to affect teacher attrition and retention (Goldhaber, Hansen, & Walch, 2016).

In sum, there are clear theoretical reasons or empirical evidence that these recently developed categories, relational demography, accountability, school improvement, and work force, may influence teacher attrition and retention. All together, these nine subcategories grouped under personal, school, and external correlates form my conceptual framework of

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<sup>3</sup> Salary was moved to the work force category instead of school resources since salary is mostly set at the district level and principals have only minor influence on salary via additional job duties.

teacher attrition and retention. This current study extends and improves the seminal studies by Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008) by using improved methodological systematic search, and expanding the search from 1980-2005 to 1980-2017, adding in more than a decade of research and development, particularly in light of recent advances in new categories of determinants of attrition and retention as well as the proliferation of longitudinal data systems. The updates to the findings and to the conceptual framework, guided by theories and supported by empirical evidence, should enhance the scholarly understanding of what influences attrition and retention and provide the most up-to-date comprehensive review of the field's knowledge on teacher attrition and retention. In the next section I discuss my systematic review process of the empirical literature on teacher attrition and retention and how the data are evaluated.

### **Data and Methods**

This study is designed to examine the determinants of teacher retention and attrition, or the factors that have been found to explain why teachers persist or why they leave the teaching profession. To define the eligibility criteria, literature search, data analysis, and reporting conventions, I follow the Preferred Reporting Items for Systematic Reviews and Meta-Analysis standards as defined by Moher et al. (2009).

**Eligibility Criteria.** Following Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008) and expanding on their inclusion criteria, the primary studies eligible for inclusion in this systematic review need to meet the following criteria: (a) the sample is comprised of teachers in K-12 education; and includes (b) characteristics of individuals who leave or remain in the teaching profession; (c) characteristics of schools and districts related to

teacher attrition and retention; (d) compensation policies such as teacher merit pay programs that may affect teacher retention and attrition; (e) pre-service and in-service policies that affect teacher retention; or (f) other characteristics or factors that are related to teacher retention and attrition. As noted previously, this study endeavors to include studies that employ long-term longitudinal data that can capture the dynamic teacher career trajectories and studies that evaluate state and federal programs and initiatives that aim to change the teacher labor markets. Additionally, this study focuses on the determinants that influence whether teachers stay or leave the teaching profession and not on whether they switch schools.

**Literature Search.** I obtained primary studies from searching commonly used economic and general social science databases, including ERIC, WorldCat, ProQuest, JSTOR, NBER and EconLit. Through an iterative process, I created the following search string: teacher AND (attrition OR turnover OR retention OR leav\* OR suppl\* OR career OR attitudes OR mobility OR commit\* OR persist\*). I also searched for “grey” literature using Dissertation and Thesis Repositories in WorldCat and ProQuest as well as a general Google search for evaluation reports of well-known merit pay programs such as the Teacher Advancement Program (TAP), the Teacher Incentive Fund (TIF), and the Texas District Awards for Teacher Excellence Program (DATE).<sup>4</sup> In addition to searching databases, my literature search included an examination of reference lists and previous reviews of the teacher retention and attrition literature (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006; Johnson, Berg, & Donaldson, 2005; Wilson, Floden, & Ferrini-Mundi, 2001).

**Studies Meeting Eligibility Criteria.** Starting with the results returned from my search of databases and previous reviews, I used a two-phase process to screen for primary studies that meet all eligibility criteria as illustrated in Figure 1. First, I read the title, abstract, and

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<sup>4</sup> The search on merit pay program is supplemented by prior research (Pham, Nguyen, & Springer, 2017).

introduction for all studies obtained in my original search. I retained a study if the title, abstract or introduction mentioned that the study contained empirical results pertaining to teacher retention and attrition. Search results can be found in Table 2. In total, I screened 23,187 studies.

Table 2: Results by database

Database	Results
ERIC	5,233
WorldCat	4,445
NBER	4,270
ProQuest	3,895
DOAJ	2,614
JSTOR	1,111
Google scholar	1,000
Taylor and Francis online	619
Total	23,187

Search string: Teacher AND (attrition OR turnover OR retention OR leav\* OR suppl\* OR career OR attitudes OR mobility OR commit\* OR persist\*)

In phase two, I was left with 286 studies for full text reading where I assessed whether each study fits the eligibility criteria outlined above. From these studies, I excluded studies due to lack of relevant teacher outcomes, non-empirical results, and duplicate reports. For multiple reports from the same study (e.g., a dissertation and corresponding journal article or reports from multiple years for the same evaluation), I kept only the most current publication. After screening, I was left with a sample of 152 studies that met all eligibility criteria.

**Coding Reports.** A second coder and I coded relevant information for each of the 132 eligible studies using an improved taxonomy based on Borman and Dowling (2008) to include new factors that have been found to relate to teacher retention and attrition such as teacher-principal race match. The coding schema and descriptions are provided in Appendix Table 1. Any discrepancy was resolved by consensus between the two coders.

## Results

I present the results of my systematic review of the literature here for each category for personal, school, and external correlates. In comparison to Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008), the numbers of studies for each category have increased substantially and in many cases, I am able to provide a more nuanced picture than was previously possible.

### Personal Correlates

**Teacher Characteristics.** Across more than a dozen studies, when age is operationalized as a continuous measure, older teachers are generally less likely to exit the system than younger teachers (Donaldson & Johnson, 2010; Kukla-Acevedo, 2009; Nah, 2015; Rees, 1991; Sass et al., 2012). Relatedly, when age is operationalized as a binary comparison of those who are 30 years of age or younger compared to those who are older than 30 years, I observe that older teachers are less likely to leave (Clotfelter, Ladd, & Vigdor, 2011; Gritz & Theobald, 1996; Imazeki, 2005; Ingersoll, 2001; Ingersoll & May, 2012). The findings are comparable when age is operationalized as a binary of 28 years of age or younger (e.g., Boe et al., 1998). Taken together, these results suggest that many young teachers leave the system within a few years of entry into the profession. In terms of gender, in contrast to the two previous systematic reviews, I find that the female teachers are not more likely to leave the system, particularly with the newer studies and studies with longitudinal data (Barbieri, Rossetti, & Sestito, 2011; Boyd et al., 2011; Grissom, Nicholson-Crotty, & Keiser, 2012). Across these new studies, researchers find that female teachers are just as likely to leave as male teachers. It may be that how gender influences attrition has changed over the last ten years, or that studies with longitudinal and more recent

data are able to provide a more accurate representation of the influence of gender on attrition than prior works.

In terms of race, new data have allowed me to compare the likelihood of leaving the profession for minority teachers as a whole, and Black teachers and Hispanic teachers individually compared to White teachers. While previous reviews have found that all minority teachers are less likely to leave teaching (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006), I find that minority teachers, broadly defined as non-White teachers, and Black teachers are not more likely to leave than White teachers, particularly with results from more recent studies (Clotfelter et al., 2008; Djonko-Moore, 2016; Goldhaber, Gross, & Player, 2011; Harrell et al., 2004; Kelly & Northrop, 2015; Smith & Ingersoll, 2004). However, across many studies, Hispanic teachers are less likely to leave teaching than White teachers (Adams, 1996; Kukla-Acevedo, 2009; Moore, 2011; Newton, Rivero, Fuller, & Dauter, 2011; Sass et al., 2012; Dagli, 2012). These results indicate that retention rates are similar across most racial groups, although Hispanic teachers are more likely to stay in teaching than other groups.

In regards to marital status, married teachers are not more or less likely to leave teaching than non-married teachers (Harrell et al., 2004; Kukla-Acevedo, 2009; Rees, 1991; Stinebrickner, 2002). Contrary to popular belief, teachers with young children are not more likely to leave teaching (Arnold, Choy, & Bobbitt 1993; Boe et al., 1998; Harrell et al., 2004; Stinebrickner, 1998, 1999, 2002). The last few determinants in teacher characteristics are related to the school. We find full-time teachers are significantly less likely to leave teaching compared to part-time teachers (Arnold, 1993; Beaudin, 1993; Jones, Maier, & Grogan, 2011; Smith, 2006; Smith & Ingersoll, 2004). Moreover, the more satisfied the teachers are with their teaching career, the less likely they are to leave the profession (Cannady, 2011; Kelly & Northrop, 2015;



Renzulli, Parrott, & Beattie, 2011; Dagli, 2012). Lastly, as the distance between where teachers live and where they teach increases, the more likely they are to leave the profession, although there are only two studies on which to base these conclusions (Barbieri, Rossetti, & Sestito, 2011; Steele, Pepper, Springer, & Lockwood, 2015).

**Teacher Qualifications.** Teacher qualifications is one of the most well studied areas of teacher attrition. First, teachers with more academic abilities as measured by GPA or test scores such as the SAT or the ACT are slightly more likely to leave than teachers with less academic abilities (e.g., Clotfelter, Ladd, & Vigdor, 2011; Goldhaber, Gross, & Player, 2011; Perda, 2013). Similarly, teachers who come from more competitive or most competitive colleges, as defined by Barron's, are more likely to leave teaching than those from less competitive colleges (Boyd et al., 2011; Clotfelter, Ladd, & Vigdor, 2011; Erickson, 2007), but there are some mixed findings (Rickman & Parker, 1990; Kelly & Northrop, 2015). In other words, most studies find that teachers with more academic abilities as measured by test scores or the college they attended are more likely to leave than those with less academic abilities. In terms of graduate degrees, there are many mixed and insignificant findings for teachers with graduate degrees compared to those with only undergraduate degrees or without any degrees (Djonko-Moore, 2016; Harrell et al., 2004; Imazeki, 2005; Kelly & Northrop, 2015; Newton et al., 2011; Ondrich, Pas, & Yinger, 2008). A study on National Board certification provides causal estimates that teachers with National Board certification in North Carolina are more likely to leave the state than teachers without the certification, which the author attributed to leaving the state but remaining in the profession elsewhere (Goldhaber & Hansen, 2009); conditional on remaining in the state, Goldhaber and Hansen find teachers with the certification tend to move from schools with high levels of minority students to schools with lower levels. Similarly, there are mixed findings about

the effect of being highly qualified as defined by NCLB and having internship experience (Connelly & Graham, 2009; Goldhaber, Krieg, & Theobald, 2016; Luke, 2014; Moore, 2011).

However, across several studies teachers who have regular or standard certifications are much less likely to leave teaching than those who do not (e.g., Harris-Mcintyre, 2013; Helms-Lorenz, van de Grift, & Maulana, 2016; Ingle, 2009; Johnson & Birkeland, 2003; Kelly, 2004; Luke, 2014; Newton et al., 2011), although there is some evidence that teachers in some alternative training programs such as Professional Development Schools may be more likely to stay in teaching than traditionally trained teachers (Latham, Mertens, & Hamann, 2015; Latham & Vogt, 2007).

The results also indicate that teachers who teach in certain subjects are harder to retain. For instance, teachers in STEM and special education subjects are more likely to leave the profession than those who teach other academic subjects (Cowen et al., 2012; Grissmer & Kirby, 1992; Ingersoll & May, 2012; Kirby, Berends, & Naftel, 1999; Ogundimu, 2014; Stinebrickner, 1998, 1999). This speaks to the difficulty schools and districts have in retaining STEM and special education teachers (Billingsley, 2004, 2007; Ingersoll & May, 2012; Sass et al., 2012). Lastly, studies consistently find that new teachers in the first three years of teaching are more likely to quit teaching than veteran teachers (Boe et al., 1998; Clotfelter et al., 2008; Djonko-Moore, 2016; Jackson, 2012; Steele et al., 2015), and that teachers with prior non-teaching career experience are not more or less likely to leave teaching (Boyd et al., 2011).

## **School Correlates**

**School Organizational Characteristics.** There have been many studies looking at the relationship between school organizational characteristics and teacher attrition. These

characteristics range from enrollment and urbanicity to professional development and mentoring. In terms of student enrollment, studies generally find school size is not an important factor (Mont & Rees, 1996; Kelly, 2004; Imazeki, 2005; Goldhaber, Cross, & Player, 2011; Jones, 2011). In contrast to previous reviews (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006), recent studies do not consistently find that urban teachers are more likely to leave teaching than rural teachers (Bradley, Green, & Leeves, 2006; Donaldson & Johnson, 2010; Imazeki, 2005; Jackson, 2012; Kelly, 2004; Moore, 2011; Smith, 2006). On the other hand, studies generally find that high school and middle school teachers are more likely to leave teaching than elementary school teachers, although many results are statistically insignificant (Marso & Pigge, 1997; Smith & Ingersoll, 2004; Stinebrickner, 1998). In terms of school sector, in agreement with previous reviews private and charter school teachers are more likely to leave teaching than traditional public school teachers (Hahs-Vaughn, 2008; Redding & Smith, 2016; Sass et al., 2012; Stinebrickner, 1998; Stuit & Smith, 2012). Perhaps unsurprisingly, teachers who teach at hard-to-staff schools or schools with low stay ratios may be more likely to leave than those teaching at schools with high stay ratio (Goldhaber, Krieg, & Theobald, 2016; Ronfeldt, 2012).

Though the first half of the school organizational characteristics determinants provides some understanding into teacher attrition, the second half of these determinants may also provide policy relevant insights. Studies generally find that teachers are more likely to leave schools with higher student disciplinary problems (Djonko-Moore, 2016; Ingersoll & May, 2012; Kelly, 2004; Kraft, Marinell, & Yee, 2016). Relatedly, schools with better work environment as characterized by better facilities and less school problems also see less teacher attrition (Boyd et al., 2011; Buckley, Schneider, & Shang, 2005; Ingel, 2009; Loeb, Darling-Hammond, & Luczak, 2005; Martin, 2011; Moore, 2011; Stuit & Smith, 2012). Teachers who have stable teaching

assignments are also more likely to be retained (Ost & Schiman, 2015). Along this line, across several studies, teachers are less likely to leave teaching in schools with stronger administrative support (Boyd et al., 2011; Brown & Wynn, 2008; Eller, Doerfler, & Meier, 2000; Ingersoll, 2001; Luke, 2014; Smith, 2006; Urick, 2016) or with higher levels of teacher collaboration or cohesion (Boyd et al., 2011; Fuller, Waite, & Irribarra, 2016; Kraft, Marinell, & Yee, 2016; Smith & Ingersoll, 2004). Comparable to administrative support, beginning teachers who experience induction and/or mentoring are also less likely to leave teaching than those without (Cannady, 2011; Luke, 2014; Mihaly, Master, & Yoon, 2015; Smith, 2006). This is particularly true for teachers whose mentors who have previous experience working in the school (Rockoff, 2008). Relatedly, teachers who indicated they had good in-service professional development are less likely to leave (DiGaudio, 2017; Erickson, 2008). Teachers with higher classroom autonomy are also less likely to leave than those without (Ingersoll & May, 2012; Dagli, 2012). Surprisingly, there are mixed reports of the influence of leadership on teacher attrition. Jackson (2012), Kraft and colleagues (2016) and Ladd (2011) find that teachers' reports of high levels of principal leadership or influence reduces the likelihood of leaving. On the other hand, Boyd et al. (2011) and Dagli (2016) find that teachers' reports of high levels of their own leadership and influence increases likelihood of leaving, and in contrast, Shaw (2016) finds that participation in a teacher leadership program can positively help keep teachers in the classroom.

Taken together, these results suggest that there are many school organizational characteristics that could be used to lower teacher attrition. In particular, lowering student disciplinary problems, improving work environment, increasing administrative support, providing better professional development and induction/mentoring for beginning teachers and

affording teachers more classroom autonomy are all viable actions that can be taken to reduce teacher attrition.

**School Resources.** Even though the relationship between school resources and student achievement has been well studied, the relationship between school resources and teacher attrition has not been well attended to. First, there are mixed findings on the relationship between the school expenditure for support per teacher and teacher attrition (Eller, Doerfler, & Meier, 2000; Gritz & Theobald, 1996; Imazeki, 2005; Kirby, Berends, & Naftel, 1999). Similarly, providing classroom assistants or teacher aides, or reducing classroom size does not seem to reduce the likelihood of teachers leaving the profession (Barbieri, Rossetti, & Sestito, 2011; Eller, Doerfler, & Meier, 2000; Feng, 2010; Gritz & Theobald, 1996; Smith & Ingersoll, 2004). However, providing adequate teaching materials to teachers does seem to matter (Gritz & Theobald, 1996; Loeb, Darling-Hammond, & Luczak, 2005; Smith, 2006; Stevens, 2010).

**Student Body Characteristics.** The most significant development in this area over the last ten years is the study of how student achievement is related to teacher attrition. Across several studies, scholars have generally found that teachers are less likely to leave teaching in schools with better student performance (Boyd et al., 2008; Eller, Doerfler, & Meier, 2000; Hanushek, Kain, & Rivkin, 2004; Loeb, Kalogrides, & Beteille, 2012; Newton et al., 2011; West & Chingos, 2009). While the result may not be novel, it is robust to increases in student average test scores as well as comparing high to low performing schools.

What may be surprising is that, while teachers may leave teaching more in high minority schools than low minority schools (Hahs-Vaughn & Scherff, 2008; Dagli, 2012), increases in percent Black students, percent Hispanic students, or percent minority students are not consistently associated with increases in teacher attrition (Boyd et al., 2011; Feng, 2009;

Hanushek, Kain, & Rivkin, 2004; Goldhaber, Gross, & Player, 2011; Gritz & Theobald, 1996; Imazeki, 2005; Ingle, 2009; Kelly & Northrop, 2015; Loeb, Darling-Hammond, & Luczak, 2005; Newton et al., 2011; Smith, 2006). These findings suggest that, as a percent increase, the influence may be too small to detect or that the relationship between percent minority and teacher attrition is not a linear relationship. Relatedly, percent increase in free- and reduce-price lunch, FRPL, does not seem to be highly correlated with teacher attrition (Boyd et al., 2008; Feng, 2009; Gritz & Theobald, 1996; Hansen, Backes, & Brady, 2016; Kelly & Northrop, 2015; Moore, 2011). However, percent increase in FRPL may not adequately capture the difference between schools in poverty conditions and affluent schools. When poverty is measured differently, such as the majority of students with low socioeconomic status, some studies do find that teachers are slightly more likely to leave teaching in high poverty schools than low poverty schools, but almost all of the findings are insignificant (Eller, Doerfler, & Meier, 2000; Fulbeck, 2014; Luke, 2014; Stinebrickner, 1998, 1999; Dagli, 2012). Lastly, percent increase in IEP/LEP is not highly associated with increases or decreases in teacher attrition (Djonko-moore, 2016; Falch & Ronning, 2007; Feng, 2010; Ingle, 2009; Moore, 2011). In short, there is only weak evidence that student body characteristics significantly influence attrition with the exception of the level of student achievement.

**Relational Demography.** This category is a recent and ongoing development of how teacher-principal, teacher-teacher and teacher-student race or gender congruency influences teacher attrition. In terms of teacher-principal race congruence, Grissom and Keiser (2011) and Harris (2007) find that teachers are less likely to leave teaching when they are of the same race as the principal. To a smaller extent, teachers are also less likely to leave teaching when they are of the same gender as the principal (Grissom, Nicholson-Crotty, & Keiser, 2012). Similarly,

teachers are less likely to leave teaching when the majority of students that they teach are of the same race (Allensworth, Ponisciak, & Mazzeo, 2009; Feng, 2009). Generally, these studies indicate that race and gender congruency may lower the likelihood of teacher attrition. This is a promising area that needs further research as the findings may have implications for both teacher attrition and social equity (Grissom & Keiser, 2011; Grissom, Rodriguez, & Kern, 2015).

### **External Correlates**

**Accountability.** The factors in this category—assessment impact, teacher effectiveness score, merit pay program, and principal effectiveness score—present exciting developments in the literature on teacher attrition and retention as almost all of the studies were published after Borman and Dowling’s 2008 review. Assessment impact is defined as the influence of being assessed or evaluated, including accountability purposes. Contrary to concerns that teacher evaluation would have deleterious effects on retaining teachers, researchers have provided causal evidence that, on average, teachers who are being assessed or evaluated, even for accountability purposes, are not more likely to leave teaching (Boyd et al., 2008; Feng, 2010). In fact, some studies even find that teachers are less likely to leave when they are evaluated (Boyd et al., 2008; Nah, 2015). Digging deeper, Feng (2010) finds that teachers who experience a substantial increase to their accountability score, a “positive shock,” are more likely to stay and those who experience a substantial decrease, a “negative shock,” are more likely to leave. In sum, the effect of being evaluated does not appear to have drawbacks in terms of attrition and may even have positive effects of retaining more effective teachers and removing ineffective teachers.

Relatedly, two studies examine the effect of accountability, both dealing with the No Child Left Behind (NCLB) Act. Sun, Saultz, and Ye (2017) report that there is a slight increase

in teacher attrition with NCLB in the early years and a slight decrease in the latter years. However, both of these findings are inconclusive, being statistically insignificant and imprecisely estimated. On the other hand, Shirrell (2016) finds that only NCLB subgroup accountability may have affected attrition rates; in particular, Black teachers are less likely to leave teaching under the subgroup accountability. Taken together, the results suggest that, while NCLB accountability may have little to no effect on the overall attrition rate, it may have had positive effects in its subgroup accountability.

Related to teacher assessment and accountability is the quantification of teacher effectiveness as measured by a composite evaluation score or value-added scores. Numerous studies find that increases in teacher effectiveness score are associated with decreases in the likelihood of attrition (Beteille, Kalogrides, & Loeb, 2009; Boyd et al., 2008; Feng & Sass, 2017a; Goldhaber, Gross, & Player, 2011; Ingle, 2009; Krieg, 2006; Loeb, Kalogrides, & Beteille, 2012; Steele et al., 2015). These findings are robust to the various ways that teacher effectiveness scores are operationalized (e.g., Boyd et al., 2008; Feng & Sass, 2017a; Goldhaber, Gross, & Player, 2011; Loeb, Kalogrides, & Beteille, 2012) and some provide causal estimates (Beteille, Kalogrides, & Loeb, 2009; Krieg, 2006; Feng & Sass, 2017a; Loeb, Kalogrides, & Beteille, 2012). In other words, teachers are less likely to leave teaching in high performing environments as their own performance or their peers' performance increases. Moreover, teachers may be more likely to be retained in the top scoring schools (Boyd et al., 2008; Loeb, Kalogrides, & Beteille, 2012), and two studies provide further suggestive evidence that poorly performing teachers, in the bottom quartile or quintile in terms of value-added scores, are also more likely to leave (Goldhaber, Gross, & Player, 2011; Loeb, Kalogrides, & Beteille, 2012). In short, the results from these studies examining teacher effectiveness indicate that the use and



availability of teacher effectiveness scores can potentially change the composition of the teacher work force providing positive effects at both ends of the distribution, keeping the highly effective teachers while removing highly ineffective teachers.

A parallel trend to the use of teacher effectiveness scores is the proliferation of teacher merit pay programs in the past decade. While merit pay programs are intended to increase student outcomes such as test scores, one possible mechanism of improving test scores is changing the composition of the teacher work force (Pham, Nguyen, & Springer, 2017). Across more than a dozen studies, most of the results indicate that merit pay programs have positive effects on teacher attrition by retaining effective teachers (Bayonas & Barker, 2010; Choi, 2015; Clotfelter et al., 2008; Cowan & Goldhaber, 2015; DiGaudio, 2017; Fulbeck, 2014; Glazerman et al., 2013; Glazerman & Seifullah, 2012; Shifrer, Turley, & Heard, 2017; Springer et al., 2008; Springer et al., 2010), though some studies do find null effects (Dee & Wyckoff, 2015; Fryer, 2013; Springer et al., 2009; Steele et al., 2010). In a subgroup analysis, one study finds that merit pay reduces the probability of attrition by nearly 15 percentage points in hard-to-staff schools (Hough, 2012). Moreover, most of these studies provide causal estimates compared to observational studies that are prone to omitted variable bias. In short these results highly suggest that merit pay may have overall positive effects on teacher retention.

Lastly, there has also been development in the study of principal effectiveness and teacher attrition, but there are only a few studies in this area. Beteille, Kalogrides, and Loeb (2009) find that higher principal effectiveness can decrease attrition for teachers with high value-added scores. Similarly, Grissom (2011) and Redding & Smith (2016) report that higher principal effectiveness may be associated with decreased likelihood of teacher attrition, but both of their results are statistically insignificant. The current evidence tentatively suggests that

principal effectiveness can decrease teacher attrition, but more studies are needed to bolster these findings.

**School Improvement.** Even though whole school reforms have been around for decades, there has been little rigorous evaluation of how they could influence teacher attrition and retention. Relatedly, while research practice-partnerships have the potential to keep effective and motivated teachers, these partnerships are still in their infancy and will likely take a few more years before there are studies on whether they retain more teachers over time. Consequently, I find only two studies in this area. However, these two studies are high-quality studies that provide causal estimates. Using a regression discontinuity design, Heissel and Ladd (in press) find that there is some increase in teacher turnover in a school turnaround effort in North Carolina and this increase in turnover is partly attributed to increased administrative burdens. On the other hand, Sun, Penner, and Loeb (2017) find that School Improvement Grants schools in the San Francisco Unified School District, which focus on improving the lowest-performing schools through competitive incentives and prescriptive reform, are more likely to retain effective teachers and less likely to retain teachers based on seniority in a difference-in-differences design. These two studies illustrate that, similar to student outcomes, the program characteristics and implementations of school improvement efforts, and not the reforms in and of themselves, may affect turnover outcomes (Murphy, 2011).

**Work Force.** As researchers are only beginning to examine how external factors outside teacher correlates and school correlates are associated with attrition, there are only a few studies in this category with the exception of teacher salary. In terms of the employment rate or the percent employment rate in the area or the district, two studies provide mixed findings (Clotfelter, Ladd, & Vigdor, 2011; Goldhaber, Gross, & Player, 2011). The practice of late hiring

of teachers, however, is highly and significantly associated with more teachers leaving the profession (Jones, 2011). In terms of salary, across nearly thirty studies the general result is that increases in salary reduce the likelihood of teachers leaving the profession (e.g., Bradley, Green, & Leeves, 2006; Clotfelter, Ladd, & Vigdor 2011; Dolton & van der Klaauw, 1999; Scafidi, Sjoquist, & Stinebrickner, 2007; Stinebrickner, 1998, 1999, 2002). When salary is operationalized as an increase per \$1,000, its influence on teacher attrition is small but still positive (Feng, 2010; Fulbeck, 2014; Harris, 2007; Kirby, Berends, & Naftel, 1999). When it is operationalized as high salary compared to low salary, the influence is modest (Boe et al., 1998; Garcia, Slate, & Delgado, 2009; Harris, 2007; Kelly, 2004; Shin, 1995). In terms of retention bonuses, researchers have generally found that they can slightly reduce teacher attrition (Feng & Sass, 2017b; Springer, Swain, & Rodriguez, 2015). Competing with teacher salary and retention bonuses is non-teacher salary. Increases in non-teacher salary, or stated differently, better paying opportunities elsewhere, can make it harder to retain teachers (Clotfelter, Ladd, & Vigdor, 2011; Dolton & van der Klaauw, 1999; Eller, Doerfler, & Meier, 2000; Gilpin, 2011).

One robust finding in this category is the influence of union membership on attrition. Researchers have found that teachers are significantly less likely to leave teaching when they have union membership (Kelly, 2015; Kukla-Acevedo, 2009; Moore, 2011; Redding & Smith, 2016). Relatedly, laws such as Wisconsin's Act 10, a 2011 law that weakened teacher unions and capped wage growth, can significantly increase attrition (Biasi, 2017; Roth, 2017). Lastly, several states have made changes to tenure laws within the last several years and there are some findings that teacher behavior and attrition may be affected. Goldhaber, Hansen, and Walch (2016) find that extended tenure law reduced teacher absences in Washington, and that teachers with more absences are more likely to leave the profession in North Carolina, but there is little

evidence that teacher attrition is related to tenure extension. On the other hand, Loeb, Miller, and Wyckoff (2015) find that tenure extension reform in New York induced teachers affected by extension to leave their schools and be replaced by more effective teachers. Similarly, Strunk et al. (2016) find that the elimination of teacher tenure in Louisiana increased teacher attrition by about 1.4 percentage points.

As this is a developing area in teacher attrition and retention, there is substantial room for more research to probe deeper and provide a more robust and nuanced picture of how these external forces can drive teacher attrition.

**Empirical Gaps and Policy Levers.** Even though there has been substantial research on teacher attrition and retention, there are empirical gaps that should be filled. For instance, with regards to personal correlates, we only have a handful of studies on how National Board certification and Teach-For-America participation influence teacher attrition and retention. Relatedly, teacher education can provide better support for teachers to partly reduce attrition (Goldhaber & Cowan, 2014; Freedman & Appleman, 2008), but there have been few rigorous evaluations and implementations of how this should be accomplished. Under school correlates, there are some positive indications that teacher collaborations and professional development can reduce attrition, but once again, there are only a handful of studies of retention that have focused on these two promising policy levers. Similarly, there are only a few studies in the relational demography category though theoretical and existing empirical evidence suggest that the factors in this category may positively influence teacher retention.

Perhaps unsurprisingly, the area that needs the most development is the external correlates. The systematic review process reveals only two rigorous empirical studies of how

school improvement broadly defined influences teacher attrition and retention. It is likely that as research-practice partnerships become more prevalent that there will be a rigorous study of how they affect teacher attrition and retention. Likewise, as the research community gets better longitudinal data, we can examine how mandated school reforms could affect the teacher labor market. With the exception of teacher effectiveness score and merit pay program, there are only a few studies that provide tentative results of how work force factors and accountability variables influence attrition. As more studies are done in the area of teacher effectiveness, we will be able to provide a better sense of the practical effect of one standard deviation increase in teacher effectiveness has on teacher attrition, or if the difference in attrition is only applicable to some of the lowest and highest performing schools. For merit pay programs, we need experimentation to determine which program characteristics and award sizes seem to have the most effect on retaining effective teachers. Lastly, there is only one study that examines the effect of late hiring on teacher attrition.

In terms of policy levers, I observe that some teachers need additional supports or incentives to keep them in the teaching profession. For instance, young and new teachers, and STEM and special education teachers are particularly at risk for leaving teaching. We have compelling evidence that there are school organizational characteristics, such as student disciplinary problems, administrative support, teacher collaborations, professional development, and classroom autonomy, which, if improved or strengthened, could substantially reduce the risk of attrition (e.g., Gonzalez, Brown, & Slate, 2008). In particular, educators and policy-makers should consider creating school environments where strong administrative support, consistent teacher collaborations, and regular and meaningful professional development could support new and specialty teachers to keep them in teaching. While there are some efforts in this regard

(Podolsky, Kini, Bishop, & Darling-Hammond, 2016), the field needs more experimentation and rigorous evaluations of these implementations.

Moreover, my review does not find that assessment and evaluation necessarily increase teacher attrition. The extant empirical evidence suggests that when teachers are evaluated and their measures of effectiveness are available to the teachers, this does not increase attrition. On the contrary, it may provide teachers with some sense of empowerment and the possibility of growth and improvement, leading to a decrease in attrition (Boyd et al., 2008; Feng, 2010). Furthermore, even when teacher evaluations are being used for accountability or for bonuses or pay raise according to performance as in merit pay, teachers are less, not more, likely to leave teaching. Relatedly, there is evidence that evaluation and accountability may improve the teacher work force by keeping the most effective teachers and removing the ineffective teachers. In short, evaluation and accountability may be perceived more positively by teachers and can have more positive effects for teachers than have been recognized (Wells, 2011). There may be unintended negative consequences and valid concerns to evaluation and accountability (Darling-Hammond, 2013; Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2012), but as a policy tool, they represent a promising avenue.

### **Discussion and Conclusion**

The literature on teacher attrition and retention has grown substantially since the seminal works of Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008). With more than ten years of additional research, improved systematic search, and the development and proliferation of “big data,” the number of studies has increased several times, providing more reliable results than before, as well as introducing new categories of determinants of attrition and

retention. In some areas, I am able to provide more nuanced findings of the factors that influence teacher attrition and retention, and in others, I find results that contrasted prior findings. Moreover, I am also able to synthesize new knowledge about what drives teacher attrition and identify gaps in empirical research and policy levers that may reduce attrition and improve the teacher work force.

First, I highlight some findings that contrast the previous reviews. For instance, new studies find that female teachers are not more likely to leave teaching than male teachers and that teachers with graduate degrees are not consistently more likely to leave teaching than those without graduate degrees. Recent studies also find that urban teachers are not more likely to leave teaching than rural teachers. Studies also consistently find that teaching specialty areas such as STEM or special education significantly increases the odds of attrition. In these cases, there may be two possible reasons why there are contrasting findings: (1) the additional studies provide a more accurate picture of what influences attrition and retention than previously; and (2) the influence of these factors may have changed over time.

In term of findings where I am able to provide more nuanced details, recent studies find only Hispanic teachers have reduced odds of attrition relative to White teachers when they are able to differentiate between Black, Hispanic, and any minority teachers. New studies also find stronger evidence that teacher satisfaction plays an important role in teacher decisions to leave or stay in teaching. Relatedly, full-time teachers are less likely to leave teaching than part-time teachers. Studies continue to find teachers with regular or standard certification are less likely to leave teaching than those who do not, though there is inconclusive evidence on certain training programs, National Board certification, and Teach For America. In terms of school correlates, studies consistently find that middle and high school teachers are more likely to leave teaching

than elementary teachers. Over dozens of studies, various measures of school characteristics as an organization, namely student disciplinary problems, administrative support, professional development, and classroom autonomy, strongly influence whether teachers stay or leave teaching. In terms of school resources, providing adequate teaching materials seems to play an important role. Somewhat surprisingly, most school body characteristics do not seem to influence attrition or have influences that are rather small. In terms of external correlates or factors that are beyond personal or school characteristics, I synthesize and present several additional factors (e.g., assessment impact, teacher effectiveness score, merit pay) and show how they may influence teacher attrition and retention.

In conclusion, the current study makes several contributions to the study of teacher attrition and retention. Building on the seminal works of Guarino, Santibañez, and Daley (2006) and Borman and Dowling (2008), I present a comprehensive conceptual framework of teacher attrition and retention, which is guided by broader employee turnover literature and supported by the empirical literature. Using updated systematic review methods, leveraging the broader employee turnover literature, and adding in more than ten additional years of research on the determinants of teacher attrition and retention, particularly in light of the proliferation of “big data” and its use in providing new results and causal estimates, I categorized the determinants into nine subcategories grouped under three primary categories of personal correlates, school correlates, and external correlates. Personal correlates include teacher characteristics and teacher qualifications; school correlates include school organizational characteristics, school resources, student body characteristics, and relational demography; and external correlates include school improvement, work force, and accountability. For each category, I discuss the empirical results and their implications for attrition and retention and I also highlight the gaps in the empirical



literature and the possible policy levers to positively influence the teacher work force. In short, through the systematic review and synthesis of the literature this work has created a framework that can be used to study and advance the field's knowledge on teacher attrition and retention in addition to synthesizing the results of nearly forty years of research and providing guideposts for future research in this area of scholarly study.

## **CHAPTER III**

### **THE DETERMINANTS OF TEACHER ATTRITION AND RETENTION: A META-ANALYSIS OF THE LITERATURE**

#### **Introduction**

Teacher attrition and retention play a large and important role in teacher shortages across the United States. The teacher labor market has strong implications for learning and equitable outcomes for students. Educators, researchers, and policy makers have spent considerable time and effort studying if elementary and secondary classrooms are staffed with qualified teachers, concluding that we need to know more about, and do a better job of addressing, labor market conditions (Ingersoll, 2001; Guarino, Santibanez, & Daley, 2006). As such, the purpose of this chapter is to analyze the causes and determinants of teacher attrition and retention in a meta-analysis of the empirical literature.

One key reason why researchers, policy makers, and the public at large care about teacher shortages is that teachers are the foundation of public education. Since public education is a key part of a democratic society and is funded by the public, the general public, researchers, educators, and policy makers also care about issues of equity and productivity. Recent federal educational legislation, No Child Left Behind (NCLB) and Every Student Succeeds Act (ESSA), have emphasized the importance of teachers, particularly highly qualified teachers, and their placement in every classroom.

However, there is strong evidence to suggest that schools and districts vary in the quantity and quality of their teacher workforce. Variations in teacher quantity and quality can be explained by multiple sources such as teacher preferences and district hiring practices (Engel & Cannata, 2015; Engel, Jacob, & Curran, 2014; Lankford, Loeb, & Wyckoff, 2002). These factors affect how teachers are sorted differentially across districts and schools, potentially resulting in

inequitable distribution of teachers and teacher effectiveness. For example, teachers, on average, prefer schools with higher proportions of White and Asian students and their preferences vary systematically according to their own demographic characteristics (Engel, Jacob, & Curran, 2014; Horng, 2009; Smith & Ingersoll, 2004). Lankford, Loeb, and Wyckoff (2002) examined the variation in teacher characteristics across schools and districts, which schools have the least qualified teachers, and how this distribution has changed over time among other patterns of teacher mobility. They found that teachers are indeed systematically sorted across schools and districts, and moreover, some schools have significantly more qualified teachers than others. For instance, they found that urbanicity plays an influential role in teacher distribution. For urban schools, researchers have noted that there may be issues such as geography that influence teacher recruitment and retention (Boyd, Lankford, Loeb, & Wyckoff, 2005; Jacob, 2007).

Moreover, job offers from urban schools may come too late and more qualified teachers may have already accepted earlier offers (Jacob, 2007). Elsewhere, other researchers have found that urban schools, on average, have less qualified teachers than suburban schools, and for some schools this disparity is rather high (Hanushek, Kain, & Rivkin, 2004; Lankford, Loeb, & Wyckoff, 2002). In other words, poor urban schools with low-achieving minority students have less qualified teachers to begin with and of the teachers they have, the more qualified teachers are more likely to leave for greener pasture. More generally, researchers have documented that the most disadvantaged schools, schools that need effective teachers the most, are often the hardest to staff and often face high teacher turnover (Allensworth, Ponisciak & Mazzeo, 2009; Boyd et al., 2011; Ingersoll, 2001; Guarino, Santibañez, & Daley, 2006).

In addition to the difficulties of recruiting teachers, it is also challenging to retain effective teachers due to the increase in demand. Murnane and Steele (2007) discussed some

factors contributing to this increase in demand: increase in student enrollment, decrease in student class size, and teacher retirement. Moreover, talented women and minorities have more and better paying or prestigious career options than before, which limit the pool of talented teachers (Corcoran, Evans, & Schwab, 2002; Hoxby & Leigh, 2004). To this point, the average turnover rate in recent years is fairly substantial, around 15% across all public schools, with higher rates in urban schools and schools with more economically disadvantaged students (Guarino, Santibañez, & Daley, 2006; Ingersoll, 2001; Keigher, 2010).

Related to the issues of equity and productivity is that high levels of turnover can negatively influence students' academic performance, particularly for disadvantaged and underserved students (Ronfeldt, Loeb, & Wyckoff, 2013). A report quantifying the cost of teacher turnover by the National Commission on Teaching and America's Future estimated that districts spend from \$10,000 to \$26,500 per teacher who leaves the district and calculated that Chicago Public Schools, one of the nation's largest urban districts, spends approximately \$86 million per year due to costs associated with teacher turnover (Barnes, Crowe, & Schaefer, 2007; DeFeo et al., 2017). In addition to the loss of human capital, time and resources spent on developing and training teachers in the first place, districts can find it difficult to fill these open teaching positions. In short, teachers represent a substantial portion of public education and there is persistent and compelling interest in retaining teachers generally, and qualified and effective teachers in particular, especially for schools in dire need. This has led researchers and policy makers to develop strategies to recruit and retain effective teachers, highlighting the importance of knowing the determinants of teacher attrition and retention.

A seminal study in this area of research on teacher attrition and retention is a meta-analysis by Borman and Dowling (2008). This meta-analysis examined the quantitative studies

related to teachers' career trajectories from 1980 to 2005 and summarized the prominent themes of this broad literature, providing a substantial basis for the scholarly understanding of the teacher labor market, particularly around teacher attrition and retention. Borman and Dowling's work has been cited numerous times by educators, researchers, and policy makers since its publication in 2008, indicating that it has played a large and critical role in the area of teacher attrition and retention. It is one of the top ten influential papers on teacher labor markets.

There are, however, strong compelling reasons why we need to revisit and update Borman and Dowling's work to advance the scholarly understanding of teacher attrition and retention. First, since 2005 at least eight new theoretical and empirical determinants that influence teacher retention and attrition have been identified: (a) teacher evaluation, (b) teacher merit pay, (c) federal policies, (d) principal effectiveness, (e) teacher-principal race/gender matching, (f) teacher-student race matching, (g) school reform, and (h) research-practice partnerships. Second, the development and proliferation of large longitudinal data systems, "big data," has created an opportunity to examine the stability of the determinants over time. Third, there have been significant methodological improvements in the field of meta-analysis such as the search for the "grey" literature.

This study builds upon and expands previous works by addressing these three issues, and updates the field's knowledge of why teachers leave the teaching profession by analyzing the empirical evidence from 1980 and 2017 of why attrition and retention occur and what factors moderate attrition and retention. More specifically, this study asks and answers the following research questions:

- 1) What are the determinants of teacher retention and attrition?

- 2) To what extent do these determinants influence and moderate teacher attrition and retention?

### **Motivating the Current Study**

**Proliferation of Large Longitudinal Data.** The proliferation of large longitudinal data systems, “big data,” in the last ten years have allowed researchers to empirically advance our understanding of teacher labor market dynamics. As Borman and Dowling noted in their limitations section, there had been few data sources that provided long-term comprehensive longitudinal data on teachers’ outcomes and as such, dynamic trajectories of teachers’ careers are not captured. Moreover, they noted that though “[economic labor market] provides a logical framework for studying teacher retention and attrition, [...] many aspects of teachers’ working conditions are of equal or greater importance” (Borman & Dowling, 2008, p. 400). New studies that rely on large longitudinal data address these prior limitations. For instance, there are studies that address these questions about the teacher labor markets that were heretofore hard to answer (Glazerman et al., 2013; Glazerman & Seifullah, 2012; Simon & Johnson, 2013; Stuit & Smith, 2012). Relatedly, large longitudinal data can also allow researchers to better estimate causal effects of the factors of teacher attrition and retention (Grissom & Bartenan, 2017; Grissom, Nguyen, & Patrick, 2017).

**Methodological Improvements.** There have been substantial changes and updates to meta-analytic processes in the last ten years, particularly around the search process, publication bias, and data analysis. First, applying current standards and practices to the Borman and Dowling study, there are a number of areas that could be improved and strengthened. The literature search method is fairly brief, it was not stated how many studies were screened, and the

authors only found about 150 studies before they applied their inclusion or exclusion criteria. In particular, the authors' description of how they searched for the grey literature, which includes theses, dissertations, reports, and conference proceedings, was just that they used search engines like Google. The exact search phrases and the operators that were used were not included or described and this is important because a simple search of teacher retention or teacher career paths yields thousands of studies and millions of search results. Current best practices would require more precision in searches of the grey literature (Moher et al., 2009).

Second, and related to this issue of how studies were found, is the issue of publication bias. It was unclear how the authors assessed publication bias in their meta-analysis as they did not present any analysis such as funnel plots of estimates or any statistical significance tests. Funnel plots are graphs designed to check for suggestive evidence of publication bias. A symmetric funnel plot with high precision studies plotted near the average and low precision studies spread evenly on both sides of the average would suggest a lack of publication bias (Borenstein et al., 2009). If publication bias is present, null or "negative" findings from small 'n' studies are often missing from the plot.

Third, the study also lacks forest plots of the studies, and there is no indication of how much each study's estimate contributed to the average estimate (no % weight). Forest plots graphically display the overall estimated results from each study along with the 95% confidence interval of the estimate and the percent weight that each study contributes to the average summary estimate (Borenstein et al., 2009; Lipsey & Wilson, 2001). Moreover, the forest plots also show the average effect, its 95% confidence interval, and the  $I^2$  statistic. Forest plots are considered standard in small to moderate meta-analyses (Borenstein et al., 2009; Moher et al., 2009). Moreover, Borman and Dowling did not do robustness checks to see whether their results

would hold if each study could only provide one effect size per determinant or if pooled individual's standard errors were estimated differently (Borenstein et al., 2009; Hedges et al., 2010; Tanner-Smith & Tipton, 2014).

**Summary of contributions.** The current study, therefore, adds to and improves upon the Borman and Dowling (2008) study by expanding the search from 1980 to 2017, adding in more than a decade of research and development, which is particularly meaningful with the inclusion of studies involving teacher evaluation, teacher merit pay, NCLB, principal effectiveness, teacher-principal race/gender matching, teacher-student race matching, comprehensive school reform, and research-practice partnership. Moreover, the proliferation of longitudinal data systems has allowed researchers to empirically improve our understanding of the teacher labor market dynamics, which substantially advances the field's knowledge of teacher attrition and retention in a meta-analysis. The study also makes methodological improvements using current best meta-analytic practices, paying close attention to the grey literature search, publication bias, data analysis, presentation of results and robustness of findings. The updates and improvements in this meta-analysis should enhance the scholarly understanding of what drives teacher attrition and retention and provide the most up-to-date comprehensive review of the field's empirical knowledge on teacher attrition and retention.

### **Conceptual Framework**

Building on the seminal meta-analysis by Borman and Dowling (2008) and a narrative review of the literature by Guarino, Santibanez, and Daley (2006), I develop a new conceptual framework of the determinants of teacher attrition and retention by organizing the determinants into three primary categories and nine subcategories (Chapter II). The focus of my study is on



the factors that influence teachers to exit the system, i.e., leave teaching or leave the state or the data set where they taught (leavers). My conceptual framework can also be extended to teachers who switch schools, or those who leave their current school but remain in teaching (switchers). However, the factors that influence switchers may not influence leavers in the same way. As such, it may not be conceptually accurate to combine them in the same study. Furthermore, to study them both well would be too onerous for a single study. Hence, I focus on the leavers in this study and will subsequently focus on the switchers in a follow up study.

I first describe the existing categories based on prior works and then discuss new categories based on recent studies. Borman and Dowling (2008) identified five categories of determinants of teacher attrition and retention: teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics (Table 1, Columns 1-5). Speaking broadly, teacher demographic variables facilitate our understanding of how teacher background characteristics influence attrition and retention. Teacher qualifications include teacher training, teaching experience, teacher ability or achievement, and specialty area. School organizational characteristics are the characteristics of the school such as the urbanicity, size, and organizational bureaucracy. School resources drill down further to include characteristics such as average class size, and student-teacher ratio. Lastly, student body characteristics describe the composition of the student body, which includes broad areas such as the school's socioeconomic composition, student achievement level, and the racial/ethnic composition of the school. I follow prior work and use these broad categories to organize the determinants of teacher attrition and retention.

There are additional factors that have clear theoretical reasons or empirical evidence that may influence teacher attrition and retention. I have organized these new determinants into four

categories, namely “Relational Demography,” “Accountability,” “School Improvement,” and “Work Force” as shown in columns 6 through 9 of Table 1. I group these nine subcategories into three primary categories of correlates of teacher attrition and retention (Chapter II). Under personal correlates, factors that are more directly related to teachers, are teacher characteristics and teacher qualifications categories. Under school correlates, factors that are about the schools and conditions in which the teachers work, are school organizational characteristics, school resources, student body characteristics, and relational demography categories. Lastly, under external correlates, or factors that come from federal, state, or district policies and initiatives and the economic factors surrounding employment, are accountability, school improvement, and work force categories. Together, these three primary categories of correlates and the nine subcategories represent the conceptual framework of my meta-analysis of teacher attrition and retention (Figure 1).

Table 1: Categories and determinants of teacher attrition and retention

Personal correlates		School correlates				External correlates		
Teacher characteristics	Teacher qualifications	School org characteristics	School resources	Student body characteristics	Relational demography	Accountability	School improvement	Work force
Age	Ability (test scores)	School size	Expenditure	Student achievement	Tch-princ race/gender match	Assessment impact	Mandated school reform	Employment rate
Gender	Education selectivity	Urbanicity	Class size	Percent minority	Tch-tch race match	Teacher effectiveness	Research-practice partnership	Accession rate
Race/ethnicity	Graduate Degree	Sec. vs elem. level	Classroom assistants	Poverty	Tch-student race match	Merit pay		Late hiring
Marital status	Certification	Private, public, charter	Teaching materials	Percent IEP/LEP		Federal policies (NCLB/ESSA)		Salary
Children	Highly qualified (NCLB/ESSA)	Work environment				Principal effectiveness		Retention bonus
Satisfaction	Internship	Administrative support						Non-teacher salary
Full time Teaching	Specialty area (STEM, SPED)	Teacher collaborations						Union
Distance to school	Experience	Teacher leadership						Tenure
		Prior non-teaching career experience	Professional development					
		Induction mentoring						
		Classroom autonomy						
		Stay ratio						

Note. The first five categories are adapted and expanded based on Borman & Dowling (2008). Stay ratio is the teacher retention rate at the school. Internship includes field placement. Teacher leadership includes teacher influence at the school level. Assessment impact includes evaluation used for school-level decision-making. In comparison, teacher effectiveness score is measured by a composite evaluation score or value-added score.

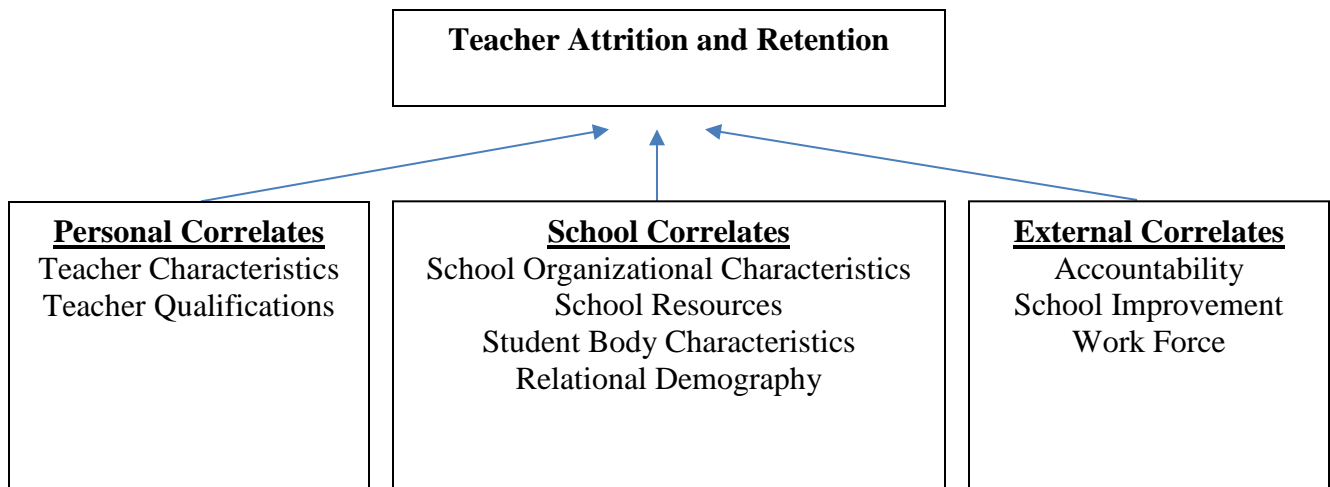


Figure 1. Conceptual Framework of Teacher Attrition and Retention

## **Existing Determinants of Teacher Retention and Attrition**

**Teacher characteristics.** Teacher characteristic variables facilitate our understanding of how teacher background, such as gender, race, age, marital status, having a new child, and number of kids, influence attrition and retention. Previous studies suggest that female teachers are more likely to leave teaching than male teachers (Ingersoll, 2001; Guarino, Santibanez, & Daley, 2006). In terms of race and ethnicity, White teachers are more likely to leave than minority teachers (Borman & Dowling, 2008). Young teachers and teachers near the retirement age are more likely to leave the profession, producing a U-shaped curve of attrition versus age or experience (Guarino, Santibanez, & Daley, 2006). Marital status is also associated with increased odds of leaving the profession (Borman & Dowling, 2008). The most influential factor of attrition, however, is having a new child, which is associated with odds of attrition of 6.69 times relative to teachers who are not having new children.

**Teacher qualifications.** Several studies have examined the relative attrition rates between teachers with a graduate degree and those with undergraduate degree or less (Boe et al., 1998; Kirby, Berends, & Naftel, 1999; Shin, 1995; Smith, 2006). Other studies (e.g., Imazeki, 2005; Ingersoll, 2001; Stinebrickner, 1998, 2002) have examined the attrition rates for teachers with specialty areas such as science or math against those with other specialties. There has also been recent work examining attrition for those who are alternatively certified (Donaldson & Johnson, 2010; Redding & Smith, 2016) or those with National Board certification (Goldhaber & Hansen, 2009). Teacher ability or scholastic achievement and teacher experience also play an important role in influencing teacher attrition and retention (e.g., Allred & Smith, 1984; Arnold, Choy, & Bobbitt, 1993; Boyd, Lankford, Loeb, & Wyckoff, 2005). Generally, these studies have found that training, experience, ability/achievement, and specialty all influence teacher attrition

and retention. For instance, one consistent finding is that attrition is high for young or new teachers and for teachers near the retirement age (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006).

**School organizational characteristics.** Under this umbrella, there are several moderator variables: school location, school sector, school size, administrative support, induction program, mentoring program, collaboration and teacher network, regular communication with administration, and opportunities for advancement. Many of these school organizational characteristics are statistically significant but their effect sizes are small and not practically significant. However, there are factors that are both significant and practically meaningful: private schools compared to public schools, level of administrative support, and school mentoring program for beginning teachers. These results indicate that public teachers, teachers who have higher level of administrative support, and teachers with mentoring programs were much less likely to leave teaching (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). For instance, Smith and Ingersoll (2004) found beginning teachers who had mentoring programs were less likely to leave teaching than beginning teachers who did not, and that public school teachers in high-poverty schools were more likely to leave than similar peers in medium-poverty schools.

**School resources.** Factors in the school resources category include average class size, student-teacher ratio, school expenditure for support per teacher, school expenditure for teaching materials, teacher aide or classroom assistants, instructional spending, and per-pupil spending. Based on Borman and Dowling (2008), for these factors there are only a handful of studies that examine their association with teacher attrition and retention and moreover, most of these factors are statistically and practically weakly associated with teacher attrition.

**Student body characteristics.** This umbrella of characteristics includes three general categories of student characteristics: the school's socioeconomic composition, the racial/ethnic composition of the school, and student achievement level (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). Contrary to expectation, Borman and Dowling (2008) did not find that, on average and across a number of studies, the school's socioeconomic composition greatly influences teacher attrition. Instead, they find that, on average, teachers who worked in high-poverty schools were just as likely to leave as teachers who worked in low-poverty schools. However, recent evidence suggests that teachers, on average, prefer schools with higher proportions of White and Asian students and their preferences vary systematically according to their own demographic characteristics (Engel, Jacob, & Curran, 2014; Horng, 2009). Relatedly, there is some suggestive evidence that teachers are more likely to leave schools where the majority of students are minority students (e.g., Carroll, Reichardt, Guarino, & Mejia, 2000; Hanushek, Kain & Rivkin, 2004; Dagli, 2012). Student achievement, on the other hand, is a strong predictor of teacher attrition. In particular, teachers were less likely to leave if they teach students with high or above average achievement level or in districts where the average math or reading scores were high (Eller, Doerfler, & Meier, 2000; Hanushek, Kain, & Rivkin, 2004).

### **New Determinants of Teacher Retention and Attrition**

Borman's and Dowling's search included only studies from 1980 to 2005. Since then, at least eight new determinants of teacher retention and attrition have been suggested: (a) teacher evaluation, (b) teacher merit pay, (c) federal policies, (d) principal effectiveness, (e) teacher-principal race/gender matching, (f) teacher-student race matching, (g) school reform, and (h) research-practice partnerships. Below I group the determinants based on how they are

conceptually related to each other, and briefly describe each determinant and their theoretical or empirical contribution to the scholarly understanding of teacher attrition and retention. Furthermore, based on the employee turnover literature, I also include and briefly discuss other possible determinants that may drive teacher attrition and retention.

**Relational demography.** A new area of development in teacher attrition and retention under school correlates comes from the relational demography, and relatedly representative bureaucracy, literature (Fairchild et al., 2012; Grissom, Kern, & Rodriguez, 2015; Sohn, 2009). Grissom and Keiser (2011) found there was higher job satisfaction and lower turnover for teachers when there was teacher-principal race congruency. Elsewhere, others have found that teacher-principal gender congruence is also associated with teacher satisfaction and turnover (Grissom, Nicholson-Crotty, & Keiser, 2012). Most recently, Grissom, Nguyen, and Patrick (2017) found that teacher-principal race congruence plays a role in teacher turnover in a multi-ethnic school district, but this influence varies by the teacher's race and the school's demographic context. In short, recent research in relational demography suggests that teacher-principal race/gender matching and teacher-student race matching can influence teacher attrition.

**Accountability.** In terms of external programs from the district or the state that rely or call upon accountability at the teacher or school level, there has been much development in state and federal programs and initiatives that aim to make changes to the teacher labor market. Murnane and Steele (2007) noted some proposed policies, such as the use of teacher evaluation and teacher merit pay, to increase the supply of effective teachers as well as how they can be distributed more equitably. However, many of these policies are newly enacted, they vary widely in terms of implementation and management, and their effectiveness was still being assessed and debated in the mid-2000s (Murnane & Steele, 2007). Recent work has highlighted how schools



and personnel responded differently to teacher evaluation, how evaluation is framed differently depending on the contexts, and that teacher evaluation can have a direct impact on teacher satisfaction, commitment, and retention (Cullen, Koedell, & Parsons, 2016; Murphy, Hallinger, & Heck, 2013; Peterson, 2000; Weiss, 1999).

Relatedly, there are policies and programs that link teacher evaluation, most often via student performance, with consequences and rewards. For instance, the Teacher Advancement Program was established in 1999 but there was not an independent evaluation of its effect on teacher labor market until after 2005 (e.g. Glazerman et al., 2013; Glazerman & Seifullah, 2012; Springer, Ballou, & Peng, 2014). The Teacher Incentive Fund, initially a \$600 million federal grant established by Congress in 2006, was expanded and supported as part of the American Recovery and Reinvestment Act (ARRA) in 2009. Moreover, other state merit pay programs have been implemented and evaluated in the last 10 years, and recent work has found that merit pay can influence the teacher labor market (Pham, Nguyen, & Springer, 2017). Relatedly, there has also been evidence that federal programs and initiatives do influence the teacher labor market, especially with teacher retention decisions (Brownell, Bishop, & Sindelar, 2005; Harrell et al., 2004; Hill & Barth 2004).

Lastly, recent works have found accountability of school administrators, which is often tied to high stakes personnel decisions (Li, 2012), can also influence teacher satisfaction, commitment, and attrition. For instance, Grissom (2011) finds that principal effectiveness is associated with greater teacher satisfaction and a lower probability of teacher turnover. Others have found that teachers' perceptions of school administration, particularly with the principal, have the greatest influence on teacher retention decisions (Boyd et al., 2011; Stockard &

Lehman, 2004). In sum, teacher evaluation, teacher merit pay, federal policies such as NCLB, and principal effectiveness can theoretically influence teacher retention and attrition.

**School improvement.** In addition to decades of school improvement efforts such as comprehensive school reforms, there has been a swell of new approaches and evaluations to school improvement, such as research-practice partnerships, that have a strong focus on teacher development and leadership (Borman, Hewes, Overman, & Brown, 2003; Bryk, Gomez, Grunow, & Lemahieu, 2015; Coburn & Penuel, 2016; Cohen-Vogel, Cannata, Rutledge, & Socol, 2016; Datnow & Castellano, 2001). These school improvement developments aim to increase teacher buy-in and develop their capacity as teachers and leaders (Nguyen & Hunter, 2018; Redding & Viano, 2017; Rubin, Nguyen, & Cannata, 2017), which theoretically can incentivize teachers to stay in their school (Guarino, Santibañez, & Daley, 2006; Macdonald, 1999; Shaw, 2016). However, until recently there has not been rigorous evaluation of how school improvement influences teacher attrition and retention (Heissel & Ladd, 2017; Sun, Penner, & Loeb, 2017). The recent implementation and evaluation of school reforms and research-practice partnerships that may affect the teacher labor market should contribute to the scholarly understanding of teacher attrition and retention.

**Work force.** Work force is a category of determinants that comes mostly from the employee turnover literature outside of the education sector (Cotton & Tuttle, 1986; Griffeth, Hom, & Gaertner, 2000; Rubenstein, Eberly, Lee, & Mitchell, 2017). These determinants are factors that reflect the employment opportunities inside and outside of teaching, and policies that can influence attrition and retention at the district or state levels, but not related to accountability or school improvement efforts. They include employment rate, teacher salary, non-teacher salary, late hiring, and retention bonuses. The employee turnover literature indicates that the

overall employment rate, or alternative job opportunities, generally influences whether people stay or leave their current occupation (Griffeth, Hom, & Gaertner, 2000) and that it could extend to teacher attrition and retention (Barbieri, 2011; Clotfelter, Ladd, & Vigdor, 2011). Late hiring is also another factor that may relate to teacher attrition (Cotton & Tuttle, 1986; Jones, 2011). In terms of monetary incentives, non-teacher salary, teacher salary and teacher retention bonus could incentivize or disincentivize teachers from leaving the profession (Griffeth, Hom, & Gaertner, 2000; Rubenstein, Eberly, Lee, & Mitchell, 2017). For instance, studies of teacher salary on attrition have found that salary does play an important role. For instance, researchers have found that higher earnings were negatively associated with attrition (Podgursky, Monroe, & Watson, 2004; Stockard & Lehman, 2004). Elsewhere, others have found that salary increases were associated with teachers' decisions to switch schools (Hanushek, Kain & Rivkin, 2004; Lankford et al., 2002). Borman and Dowling (2008) found that high and medium salaries may decrease attrition relative to low salaries, but there was only one study that examined this association.

### **Data & Methods**

This study is designed to examine the determinants of teacher retention and attrition. To define the eligibility criteria, literature search, data analysis, and reporting conventions, I follow the Preferred Reporting Items for Systematic Reviews and Meta-Analysis standards as defined by Moher et al. (2009).

**Eligibility Criteria.** The primary studies eligible for inclusion in this meta-analysis needed to meet the following criteria: (a) the sample is comprised of teachers in K-12 education; (b) the studies include characteristics of individuals who enter and remain in the teaching

profession; (c) characteristics of individuals who leave the profession; (d) characteristics of schools and districts related to teacher attrition and retention; (e) compensation policies such as teacher merit pay programs that may affect teacher retention and attrition; (f) pre-service and in-service policies that affect teacher retention; and (g) other characteristics or factors that are related to teacher retention and attrition. As noted previously, this study gives a concerted effort to include studies that employ long-term longitudinal data that can capture the dynamic teacher career trajectories and to state and federal programs and initiatives that aim to change the teacher labor market and teacher retention.

**Literature Search.** I obtained primary studies from searching commonly used economic and general social science databases, including ERIC, WorldCat, ProQuest, JSTOR, NBER and EconLit. Through an iterative process, I created the following search string: teacher AND (attrition OR turnover OR retention OR leav\* OR suppl\* OR career OR attitudes OR mobility OR commit\* OR persist\*).<sup>5</sup> I did not restrict my search by date. I also searched for “grey” literature using Dissertation and Thesis Repositories in WorldCat and ProQuest as well as a general Google search for evaluation reports of well-known merit pay programs such as the Teacher Advancement Program (TAP), the Teacher Incentive Fund (TIF), and the Texas District Awards for Teacher Excellence Program (DATE).<sup>6</sup> In addition to searching databases, my literature search also included an examination of reference lists and previous reviews of the teacher retention and attrition literature (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006; Johnson, Berg, & Donaldson, 2005; Wilson, Floden, & Ferrini-Mundy, 2001). My official search ended August 2017. With these more intensive and updated search methods, in addition to new studies that were published over the last ten years I was able to find additional

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<sup>5</sup> This is the actual search string used in the databases.

<sup>6</sup> The search on merit pay program is supplemented by prior research (Pham, Nguyen, & Springer, 2017).

studies that previous reviews have missed (Boe et al., 1998; Dolton & van der Klaauw, 1999; Harrell et al., 2004; Kelly, 2004; Texas Ed Agency, 1995).

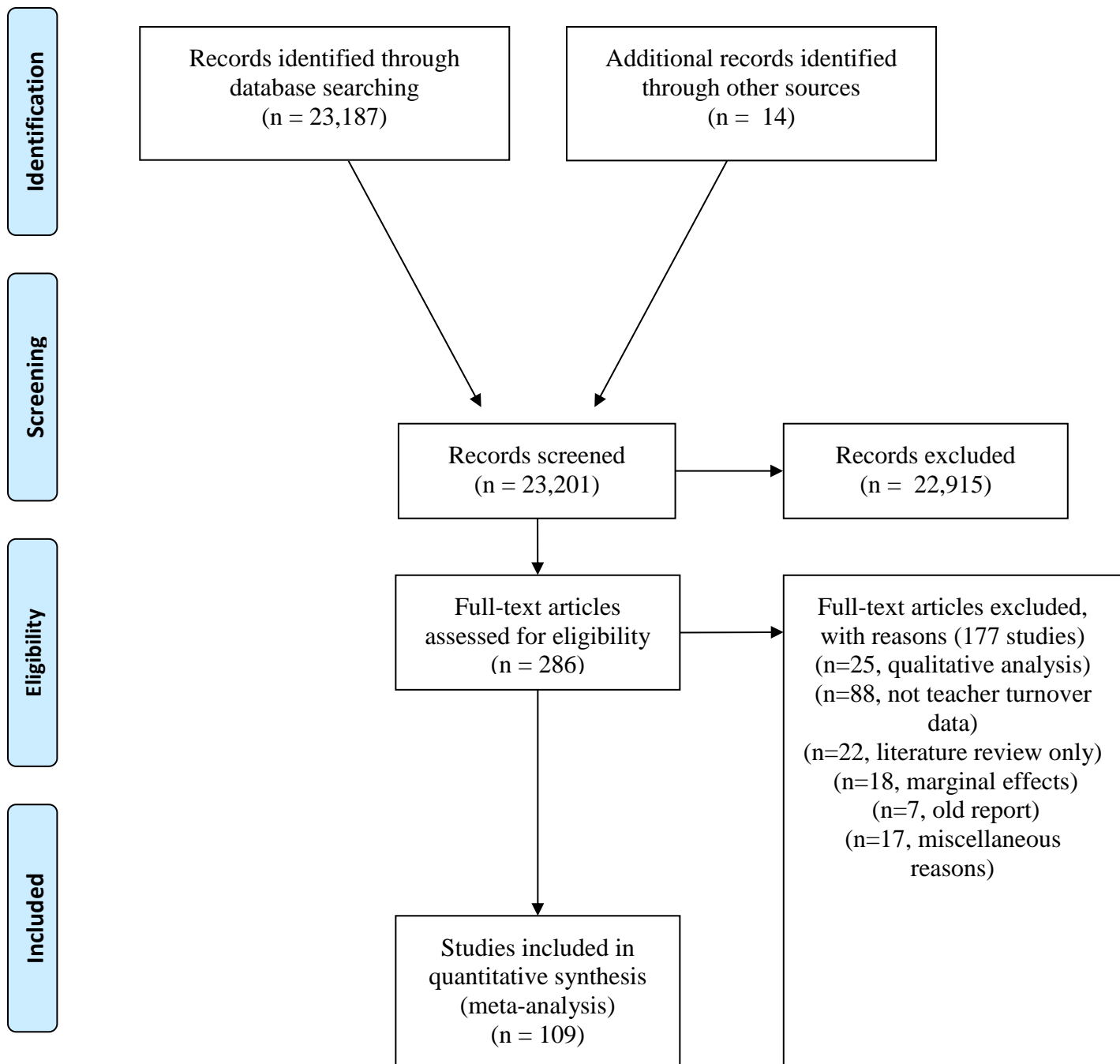


Figure 2. Flow diagram

This diagram depicts the literature screening process resulting in the final sample of primary studies included in the quantitative analysis. Adapted from Moher et al. (2009).

**Studies Meeting Eligibility Criteria.** Starting with the results returned from the search of databases and previous reviews, I used a three-phase process to screen for primary studies that meet all eligibility criteria, as illustrated by Figure 2. First, I read the title, abstract, and introduction for all studies identified in the original search. I retained a study if the title, abstract or introduction mentioned that the study contained empirical results pertaining to teacher retention and attrition or teacher career trajectory. Some examples of studies excluded in this phase include qualitative reports describing only perceptions of why teachers persist or why they leave the profession. The search results can be found in Table 2. I screened a total of 23,201 studies.

Table 2: Results by database

Database	Results
ERIC	5,233
WorldCat	4,445
NBER	4,270
ProQuest	3,895
DOAJ	2,614
JSTOR	1,111
Google scholar	1,000
Taylor and Francis online	619
Total	23,187

Search string: Teacher AND (attrition OR turnover OR retention OR leav\* OR suppl\* OR career OR attitudes OR mobility OR commit\* OR persist\*)

In phase two, a second coder and I were left with 286 studies for full text reading where we independently assessed whether each study fits the eligibility criteria outlined above, erring towards inclusion in this phase. The coders discussed any discrepancies and made exclusion decisions upon consensus. From these studies, we excluded studies that do not have teacher turnover data, studies of teacher intention and not attrition, studies with marginal effects, non-empirical results, and duplicate reports. For multiple reports from the same study (e.g., a

dissertation and corresponding journal article or reports from multiple years for the same evaluation), we kept only the most current publication.

In phase three, we excluded eligible studies if key information such as standard errors for effect estimates could neither be calculated nor obtained from the authors. If the standard error or the  $t$  statistic was not provided, but the significance level was indicated, we used a conservative estimate of the standard error by calculating the  $t$  statistics for the  $p$  value corresponding to reported significance levels. This is a conservative estimate of the standard error since it provides the largest standard error for a given significance level. At the end, we were left with a sample of 109 primary studies representing 9,827,279 teacher-year observations that met all eligibility criteria, which serves as the analytic sample for this meta-analysis.

## **Coding Reports**

A second coder and I independently coded relevant information for each of the 109 eligible studies using the taxonomy from Chapter II, improving upon Borman and Dowling (2008). This new taxonomy included new factors that have been found to relate to teacher retention and attrition such as merit pay and teacher-principal race match. The coding schema and descriptions are provided in Appendix Table 1. I describe relevant items in greater detail below. Treating each cell of our coding matrix as an input, coder agreement occurred in 96% of the cells. Any discrepancy was resolved by consensus between the two coders.

**Determinants of teacher attrition and retention.** Our main outcomes of interest are coefficient estimates of the relationship between a factor and either teacher retention or attrition, which is defined as measures of teachers staying or leaving the profession, and the associated standard error. We focus on and code determinants of teacher attrition and retention, not teacher



intentions, teacher switching schools, or differences in descriptive statistics of teachers who stay or leave teaching. Consequently, there are studies that were included in Borman and Dowling (2008) that are not included in this study (Dworkin, 1980; Hall, Pearson, & Carroll, 1992; Ingersoll & Alsalam, 1997; Shen, 1997; Whitener et al., 1997). The effect sizes are kept as log odds ratios. For studies reporting odds ratios, they are converted to log odds ratios with the natural logarithm transformation. For studies that report proportions, the proportions are converted to log odds ratios along with the associated standard errors (Borenstein et al., 2013; Borman & Dowling, 2008). For ease of interpretation, these log odds ratios are converted back into odds ratios in the presentation. The full list of empirical factors associated with teacher retention and attrition is presented in Table 1.

### **Analytic Strategy**

Analysis of these data follows methods as presented by Borenstein, Hedges, Higgins, & Rothstein (2009) and Moher et al. (2009). Below, I describe analytical decisions in selecting models, accounting for multiple estimates within the same study, reconciling studies that use similar data, and assessing risk of bias from differences in study quality.

One important choice for this meta-analysis was the decision between a fixed-effect versus a random-effects model. The fixed-effect model assumes a common true effect size across all studies, whereas the random-effects model allows the true effect size to vary across studies (Borenstein, et al, 2009). Mechanically, the fixed-effect model assigns weights ( $W_i$ ) to each study ( $i$ ) using the inverse of each within-study variance ( $V_{y_i}$ ):

$$W_{i,Fixed} = \frac{1}{V_{y_i}} \quad (1)$$

In contrast, the random-effects model weights studies using both the within-study variance and the estimated between-study variance ( $T^2$ ):

$$W_{i,Random} = \frac{1}{V_{y_i} + T^2} \quad (2)$$

For this investigation, a random-effects model is most fitting because substantial variation exists across studies in terms of teacher and school characteristics as well as policies and programs that may influence teacher retention and attrition. Moreover, we do not expect the influence of these determinants to be homogenous across different populations and settings.

Borman and Dowling (2008) opted to maximize the number of effect size estimates from each study since there were limited number of studies for some determinants of teacher attrition and retention. In other words, if a study provides multiple estimates of the relationship between a factor and attrition under various model specifications, they would keep them in the meta-analysis. Even though this modeling choice maximizes the available data and allows them to employ meta-analyses for some determinants, it does make the assumption that these effect sizes are statistically independent, which is unlikely to be appropriate for many instances since effect sizes from the same study are not independent and studies providing multiple effect sizes will be weighted more than studies providing only a single effect size. Hence, it is more methodologically appropriate to assume that effect sizes from the same study are dependent. Consequently, my main and preferred model conducts analyses where I do not assume independence of effect sizes. As a robustness check, I follow Borman and Dowling (2008) and run the analyses where studies can provide multiple estimates. As an additional check of the robustness of the findings, I also conduct the analyses using robust variance estimation (RVE), which does not require information about the covariance structure of the effect size estimates (Hedges, Tipton, & Johnson, 2010; Tanner-Smith & Tipton, 2014).

Moreover, Borman and Dowling also included studies that combined teachers who left the system or teaching (leavers) with teachers who switched schools (switchers) as a comparison group against teachers who stayed in their schools (stayers) and studies that provide hazard ratios (from proportional hazards regression for instance) instead of proportions or odds ratios. Hazard ratios where the time to event (in this case teachers leaving the school or exit the system) is utilized are, strictly speaking, not equivalent to odds ratios. However, the two statistics are more or less equal, particularly in terms of the interpretation and direction of the statistics, or the increase and decrease risk of an event happening (Nurminen, 1995). Moreover, when the hazard ratios are small, hazard ratios are a close approximation of odds ratios (Stare & Maucourt-Boulch, 2016). Since many studies utilize hazard models in studying teacher attrition, I have opted to keep them in the meta-analysis as Borman and Dowling did. I note that only a handful of hazard estimates are greater than 3 in values and only 10 effect sizes out of nearly 800 effect sizes have hazard ratios greater than 2. The results of my analysis do not change substantively when I drop these hazard estimates that are larger than 2. However, as another sensitivity check to alleviate this concern about the differences of hazard ratios and odds ratios, I also run the analysis without using hazard ratios.

In the literature, many studies frequently combine switchers and leavers and discuss them generally as teacher attrition, and there are two main reasons why they do so. The first is that these studies are trying to study attrition from the school's perspective where it matters to individual schools why teachers leave their schools. As such, both leavers and switchers can be thought of as attriting from their current school. The second is due to data limitations where researchers cannot always determine if teachers are leavers or switchers but they could determine if they have left the school. Since a substantial number of papers combine leavers and switchers

together and discuss them as teacher attrition, I have also opted to follow this practice and my main analysis will include studies that analyze leavers only and studies with leavers and switchers combined. However, in order to address the conceptual difference between leavers only and leavers and switchers combined, as a sensitivity check I examine the results only for studies that compare leavers against stayers.

In terms of risk of bias, I opted to use an inclusive approach that includes any and all studies that satisfy that eligibility criteria, which may introduce bias from poorly designed studies or studies of low quality. To address this concern, I used the *quality rating approach* as suggested by Lipsey and Wilson (2001). In this approach, I rated each study holistically using my professional judgment of the quality of the study on a scale of 1 to 5 where 1 has high risk of bias and 5 has low risk of bias. Appendix Table 2 contains the criteria I used to determine my rating. The second coder independently assessed these studies in the same way. We then discussed our individual ratings until we obtained a consensus on a final quality rating for each study. I use these ratings as a form of robustness check to the main analyses in a meta-regression framework. Moreover, I also summarize the qualities of the literature on teacher attrition and retention that are included in the meta-analysis.

### **Changes to the empirical literature**

As noted previously, some studies from prior reviews are not included because they analyze teacher intention and not actual attrition or they include only descriptive differences among teachers who stay and those who leave. As such there are only 26 studies included in this current investigation that were included in prior reviews (Table 3). Among these 26 studies, 85 percent were published in peer-reviewed journals, and the median sample size was 2,690

teachers. In terms of studies that utilize at least three year of longitudinal data with a large sample size based on the median sample size,<sup>7</sup> there are seven studies or about 35 percent of the studies. Using the sample size of at least 100,000 observations, there are only two studies or eight percent. Only one study employs quasi-experimental or experimental design. Lastly, the median study quality on the subjective rating scale from 1 to 5 is a 2 and the mean is 2.67.

Table 3. Descriptive information on the primary studies by study characteristics

	Included in prior reviews	New studies
<i>Study characteristics</i>		
Peer Review	85%	63%
Median Sample Size	2,690	9,150
Mean Sample Size	40,227	107,089
“Big Data (Median)”	35%	41%
“Big Data (Mean)”	8%	16%
Quasi-exp/experimental	4%	34%
Median Study Quality	2	4
Mean Study Quality	2.67	3.52
Number of studies	26	83

Note. “Big Data (Median)” studies are studies using longitudinal data of at least three continuous years and having sample sizes larger than 7,000 observations, the median number of observations in the full sample. “Big Data (Mean)” are studies with sample sizes larger than 100,000 observations. Quasi-experimental/experimental studies are studies that provide at least one plausibly causal estimate on a determinant of teacher attrition and retention. Study quality is ranked from 1-5 on a subjective ranking scale where 1 is high risk of bias and 5 is low risk of bias.

In comparison, there are 83 new studies included in the current investigation. With advances in the systematic and extensive search, I am able to find more primary studies, and about 63 percent are published in peer-reviewed journals. These studies then provide a more comprehensive picture of the empirical literature. The median sample size is 9,150 observations, which is substantially larger than the previous estimate. Relatedly, 31 studies or about 41 percent of the 83 studies utilize “big data” using the median sample size. For studies with more than

<sup>7</sup> “Large” sample size is defined as having more than 7,000 observations, the median number of observations in the full sample. The findings are substantively similar if 5,000 or 10,000 students are used as a marker for large sample size.

100,000 observations, there are 13 studies or 16 percent of all the studies. Moreover, a third of the studies employ quasi-experimental or experimental designs. The median study quality is a 4 and the mean is 3.52. This measure of study quality indicates that the quality of the primary studies has improved greatly over the last ten years. In sum, these descriptive statistics indicate that the empirical literature of teacher attrition and retention has deepened and grown substantially, as measured by the sample size, the longitudinal nature of the studies, studies employing quasi-experimental or experimental designs, and the quality of the studies. These differences also highlight the importance and contribution of this meta-analysis to the scholarly study of teacher attrition and retention.

## **Results**

### **Personal Correlates**

**Teacher Characteristics.** Panel A of Table 4 presents the summary effects for the determinants of teacher attrition and retention under the teacher characteristics category. In comparison to previous reviews, the numbers of studies and effect sizes for each category have increased substantially and in the area of teacher race, I am able to provide a more nuanced picture. To start, I find that, across 14 studies, when age is operationalized as a continuous measure, older teachers are less likely to leave teaching than younger teachers. Relatedly, when age is operationalized as a binary comparison of those who are 28 years of age or younger compared to those who are older than 28 years, I observe a statistically significant result that older teachers are 0.71 times less likely to leave teaching.<sup>8</sup> Stated differently, the odds of teachers who are older than 28 years of leaving the profession decrease by 29 percent compared

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<sup>8</sup> For brevity and clarity, I have chosen not to present results for other forms of age due to limited number of studies, and the findings are qualitatively similar to the main findings.

to teachers who are 28 years old or younger. The findings are comparable when age is operationalized as a binary of 30 years of age or younger. Taken together, these results suggest that many young teachers leave the profession within a few years of entry into the profession.

Table 4: Personal correlates as determinants of teacher attrition and retention using dependent effect sizes

Factor	# of studies	# of ES	Main effect estimates						Heterogeneity		
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	p	I <sup>2</sup>	Q	P <sub>Q</sub>
Panel A: Teacher Characteristics											
Age (continuous)	14	14	0.984	-0.016	0.008	-0.032	-0.001	0.038	97.711	568.025	<.001
Age (greater than 28)	14	14	0.707	-0.347	0.120	-0.583	-0.111	0.004	97.767	582.135	<.001
Male	47	47	0.999	-0.001	0.035	-0.069	0.067	0.985	94.570	847.077	<.001
Minority (Black)	22	22	0.948	-0.053	0.138	-0.324	0.217	0.701	99.166	2517.120	<.001
Minority (Hispanic)	17	17	0.591	-0.525	0.102	-0.726	-0.324	<.001	98.391	994.446	<.001
Minority (non-White)	11	11	0.921	-0.083	0.095	-0.269	0.104	0.386	90.364	103.777	<.001
Married	7	7	1.164	0.152	0.099	-0.042	0.346	0.125	22.556	7.748	0.257
Number of children	4	4	0.501	-0.692	0.165	-1.015	-0.369	<.001	<.001	1.755	0.625
Young child	3	3	0.551	-0.596	0.153	-0.896	-0.296	<.001	<.001	1.086	0.581
Career satisfaction	7	7	0.847	-0.167	0.056	-0.276	-0.057	0.003	46.445	11.203	0.082
Full time teaching	6	6	0.619	-0.480	0.142	-0.759	-0.201	0.001	65.000	14.286	0.014
Distance to school	2	2	0.987	-0.013	0.033	-0.078	0.052	0.704	77.509	4.446	0.035
Panel B: Teacher Qualifications											
Ability (test scores)	9	9	1.089	0.085	0.040	0.007	0.164	0.033	85.667	55.815	<.001
School selectivity	8	8	1.094	0.090	0.040	0.012	0.168	0.024	74.867	27.851	<.001
Graduate (MA/PhD v none)	24	24	0.989	-0.011	0.064	-0.137	0.114	0.860	88.806	205.467	<.001
Graduate (MA/PhD v BA)	5	5	1.051	0.050	0.149	-0.242	0.341	0.739	88.120	33.670	<.001
National Board	3	3	0.879	-0.129	0.372	-0.859	0.600	0.728	79.895	9.948	0.007
Teaching Fellow/TFA	2	2	0.766	-0.267	0.641	-1.523	0.990	0.677	98.661	74.700	<.001
Highly qualified (NCLB)	2	2	0.932	-0.070	0.354	-0.763	0.623	0.843	87.440	7.962	0.005
Internship	3	3	0.966	-0.035	0.053	-0.139	0.070	0.515	51.662	4.138	0.126
Standard certification	19	19	0.536	-0.624	0.181	-0.978	-0.270	0.001	98.151	973.469	<.001
Specialty (STEM)	25	25	1.124	0.117	0.039	0.041	0.193	0.002	76.693	102.975	<.001
Specialty (Special ed)	9	9	1.152	0.141	0.044	0.055	0.228	0.001	73.742	30.467	<.001
Specialty (other)	5	5	1.240	0.215	0.031	0.155	0.276	<.001	5.742	4.244	0.374
Experience (cont.)	11	11	0.996	-0.004	0.014	-0.030	0.023	0.778	97.879	471.392	<.001
Experience (<3)	12	12	1.484	0.395	0.086	0.225	0.564	<.001	92.610	148.841	<.001

Note. Assumed correlations between multiple, within-study outcomes is 0.5.



In terms of gender, in contrast to Borman and Dowling (2008), I do not find that female teachers are more likely to leave the profession. Across 47 studies, I find that female teachers are just as likely to leave the profession as male teachers. Figure 3 shows the forest plot of the effect sizes for gender and attrition. There may be two reasons why our finding conflicts with previous work. One explanation is that with the increased number of studies and estimates, I am better able to provide a more accurate picture of how gender influences attrition. The second explanation is that how gender influences attrition may have changed over the last ten years, which recent studies do seem to support (e.g., Barbieri, 2011; Boyd, 2011; Grissom, Nicholson-Crotty, & Keiser, 2012). It is possible that previously women were more likely to leave teaching, but this may have changed in recent years.

In terms of race, I am able to provide a more nuanced picture than before. I am able to compare the odds of Black teachers, Hispanic teachers, and non-White minority teachers leaving the profession compared to White teachers respectively. Our results indicate that there is no evidence that Black teachers and non-White minority teachers are more likely to leave teaching than White teachers, but there is evidence that Hispanic teachers are less likely to leave teaching. Across 17 studies, I find the odds of Hispanic teachers of leaving teaching are reduced by 40 percent compared to White teachers. These results indicate that generally there is no evidence that minority teachers, except Hispanic teachers, are less likely to leave teaching than White teachers.

Forest Plot: Gender (Male) and Teacher Attrition

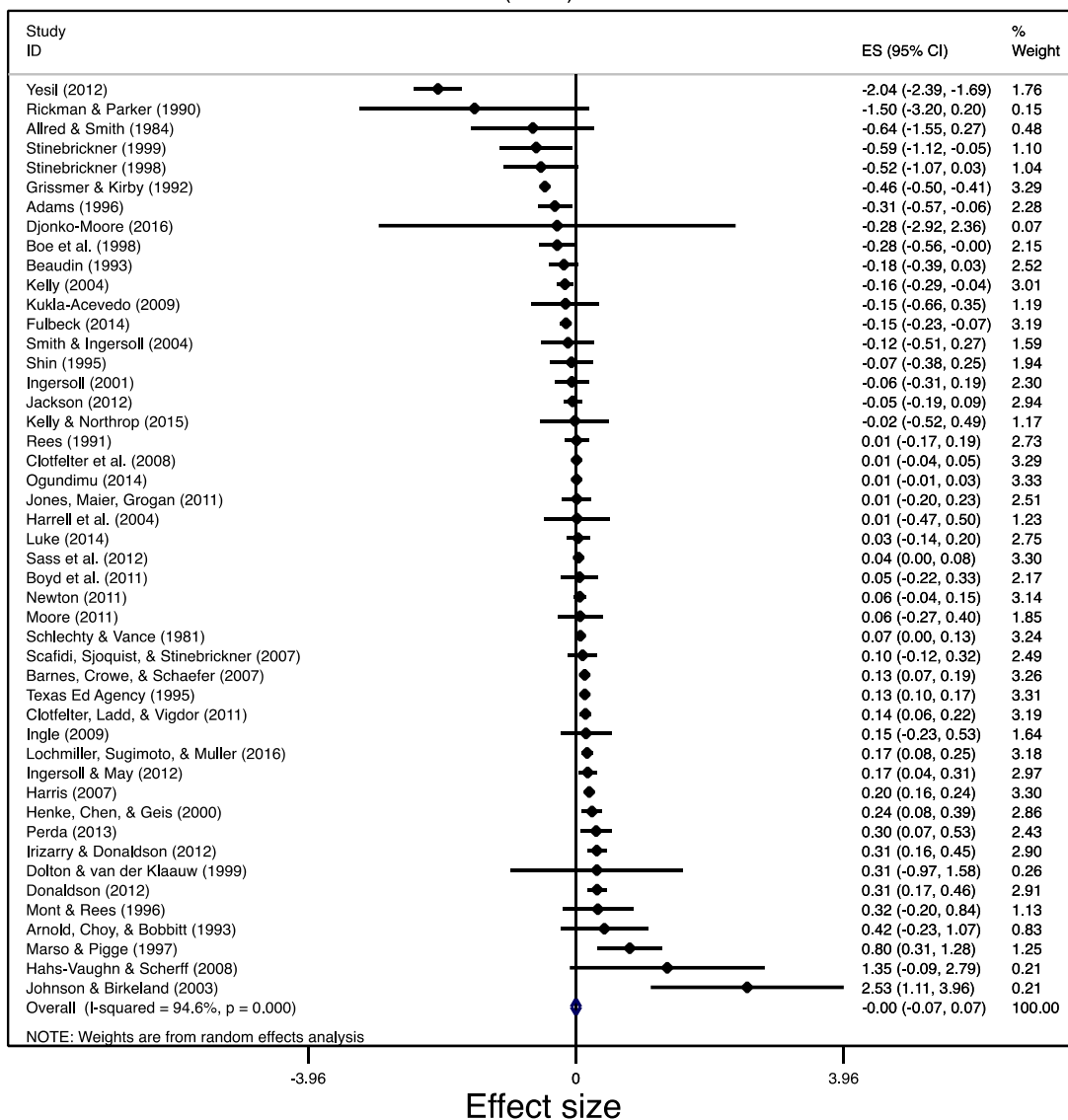


Figure 3. Forest plot for effect estimates of gender (male) on teacher attrition from primary studies. ID is the study identification, ES is the log-odds effect size, CI is the confidence interval, and weights are from random effects analysis. Correlation between multiple outcomes within a study,  $r$ , is 0.5.

In regards to marital status, I find no evidence that married teachers are more likely to leave teaching than non-married teachers. Contrary to popular beliefs, there is no evidence that teachers with young children are more likely to leave teaching. In fact, the odds of teachers with young children of leaving teaching are reduced by 45 percent compared to teachers without young children. Similarly, teachers with more children are also less likely to leave teaching. These results suggest that married teachers and teachers with children may stay in teaching for stability. The last few determinants in teacher characteristics are related to the school. I find full-time teachers are significantly less likely to leave teaching compared to part-time teachers. Moreover, the more satisfied the teachers are with their teaching career, the less likely they are to leave the profession. Lastly, as the distance between where teachers live and where they teach increases, the more likely they are to leave the profession, although the results are insignificant and there are only two studies to provide these estimates.

**Teacher Qualifications.** Teacher qualifications is one of the most well studied areas of teacher attrition (Panel B of Table 4). First, our results indicate teachers with more academic abilities as measured by GPA or test scores such as the SAT or the ACT are slightly more likely to leave than teachers with less academic abilities. Similarly, teachers who come from more competitive or most competitive colleges are more likely to leave teaching than those from less competitive colleges. In other words, teachers with more academic abilities as measured by test scores or the college they attended are more likely to leave than those with less academic abilities. The odds of teachers with graduate degrees leaving are not statistically different than compared to those with only undergraduate degrees or without any degrees. Having a National Board certification and being a Teaching Fellow or TFA are also not strong predictors of teacher attrition, although there were a limited number of studies providing odds ratios estimates of

Teaching Fellow or TFA teachers leaving teaching. Relatedly, there is no evidence that being a highly qualified teacher as defined by NCLB or having internship experience is associated with decreased odds of leaving the profession compared to those who do not.

However, across 19 studies, I observe that the odds of leaving teaching for teachers who have regular or standard certification are 0.54 times less likely than those who do not. Stated differently, the odds of attrition for teachers with standard certification are decreased by 48 percent compared to those without standard certification. The results also indicate that teachers who teach in certain subjects are harder to retain. For instance, the odds of teachers who teach STEM and special education subjects leaving teaching are about 1.12 to 1.15 times, respectively, more likely than those who teach other academic subjects. This speaks to the difficulty schools and districts have in retaining STEM and special education teachers. Lastly, an additional year of teaching experience is not associated with the odds of leaving. On the other hand, new teachers relative to veteran teachers, are consistently more likely to leave teaching with a 48 percent increased in the odds of attrition.

Table 5: School correlates as determinants of teacher attrition and retention using dependent effect sizes

Factor	# of studies	# of ES	Main effect estimates						Heterogeneity		
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	p	I <sup>2</sup>	Q	P <sub>Q</sub>
Panel A: School Organizational Characteristics											
School size	13	13	1.001	0.001	0.001	-0.001	0.002	0.306	66.144	35.444	<.001
Urban	13	13	1.047	0.046	0.075	-0.101	0.193	0.540	91.323	138.296	<.001
High school v. elem	7	7	1.110	0.104	0.076	-0.045	0.254	0.171	84.554	38.845	<.001
Middle school v. elem	6	6	1.159	0.147	0.051	0.046	0.248	0.004	42.868	8.752	0.119
Secondary v. elem	13	13	1.125	0.118	0.063	-0.006	0.241	0.062	78.148	54.914	<.001
Charter v. trad public	3	3	2.002	0.694	0.132	0.436	0.953	<.001	<.001	0.612	0.736
Private v. trad public	4	4	1.876	0.629	0.231	0.177	1.082	0.006	69.937	9.979	0.019
Student disciplinary problem	5	5	1.158	0.147	0.042	0.065	0.228	<.001	2.991	4.123	0.390
Better work environment	5	5	0.557	-0.585	0.271	-1.116	-0.054	0.031	93.421	60.799	<.001
Administrative support	12	12	0.843	-0.171	0.049	-0.268	-0.074	0.001	72.053	39.360	<.001
Teacher collaborations	3	3	0.892	-0.114	0.129	-0.366	0.139	0.377	78.920	9.488	0.009
Teacher leadership	3	3	1.068	0.066	0.114	-0.157	0.288	0.564	93.443	30.500	<.001
Professional development	2	2	0.773	-0.258	0.054	-0.364	-0.152	<.001	<.001	0.007	0.934
Induction/mentoring	10	10	0.763	-0.270	0.074	-0.414	-0.126	<.001	35.252	13.900	0.126
Classroom autonomy	5	5	0.959	-0.041	0.078	-0.194	0.111	0.594	59.737	9.935	0.042
Stay ratio	2	2	0.687	-0.375	0.308	-0.978	0.228	0.223	86.824	7.589	0.006
Panel B: School Resources											
Expend. support per teacher	2	2	0.934	-0.068	0.019	-0.104	-0.032	<.001	<.001	0.144	0.705
Class size	8	8	1.006	0.006	0.004	-0.001	0.014	0.112	82.981	41.130	<.001
Classroom assistant	2	2	1.156	0.145	0.212	-0.270	0.560	0.495	<.001	0.547	0.460
Teaching materials	2	2	0.845	-0.168	0.062	-0.290	-0.047	0.007	<.001	0.138	0.711
Panel C: Student Body Characteristics											
Student achievement	14	14	0.991	-0.009	0.004	-0.017	-0.001	0.026	95.329	278.318	<.001
Percent Black	8	8	1.005	0.005	0.004	-0.002	0.012	0.188	38.589	11.399	0.122
Percent Hispanic	7	7	1.011	0.011	0.008	-0.005	0.027	0.180	11.527	6.782	0.342
Percent Minority	15	15	0.995	-0.005	0.008	-0.020	0.010	0.516	98.386	867.232	<.001
Percent FRPL	17	17	1.006	0.006	0.004	-0.001	0.013	0.089	81.614	87.025	<.001
Poverty	6	6	1.102	0.097	0.088	-0.076	0.269	0.271	56.286	11.438	0.043
Percent IEP/LEP	6	6	0.997	-0.003	0.010	-0.023	0.017	0.769	56.848	11.587	0.041
Panel D: Relational Demography											
Race/gender congruence	3	3	0.873	-0.135	0.154	-0.438	0.167	0.380	64.835	5.687	0.058

Note. Assumed correlations between multiple, within-study outcomes is 0.5.

## School Correlates

**School Organizational Characteristics.** On par with teacher qualifications, there have been many studies looking at the relationship between school organizational characteristics and teacher attrition (Panel A of Table 5). These characteristics range from school size and urbanicity to professional development and induction and mentoring. In terms of school size, I do not observe that teachers leave teaching at larger schools.<sup>9</sup> In contrast to previous reviews, there is little evidence that urbanicity plays a role in influencing teacher attrition. On the other hand, I do observe that school levels do influence teachers leaving; the odds of leaving are higher for middle school teachers than for elementary school teachers. In terms of school sector, I find that the odds of teachers leaving at private and charter schools are higher for teachers at traditional public schools. Perhaps unsurprisingly, teachers who teach at hard-to-staff schools or schools with a low stay ratio may be more likely to leave than those teaching at schools with a high stay ratio, although this result is imprecisely estimated with only two studies.

Though the first half of the school organizational characteristics determinants provide some understanding into teacher attrition, the second half of these determinants may provide more policy relevant insights. To start, I observe that teachers are more likely to leave schools with higher student disciplinary problems. Relatedly, schools with a better work environment as characterized by better facilities and less school problems also see less teacher attrition. In particular, across five studies I observe the odds of teachers leaving schools with better working conditions to decrease by nearly a factor of two compared to schools with worse working conditions. Along these lines, I also observe that, across 12 studies, the odds of teachers leaving schools with stronger administrative supports are 0.84 times the odds of teachers leaving schools

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<sup>9</sup> This result is robust to comparing large to small schools and increase in enrollment per 1,000 students.

with weaker administrative supports. Comparable to administrative support, beginning teachers who experience induction and/or mentoring are also less likely to leave teaching than those without. Relatedly, teachers who indicated they had good in-service professional development are also less likely to leave than those without. Teachers who indicated they had higher classroom autonomy may be less likely to leave but the result is insignificant. Surprisingly, reports of higher levels of leadership or collaboration do not seem to influence teacher attrition but due to the limited number of studies and imprecise estimates of the individual studies, these results are not precisely estimated. Taken altogether, these results suggest that there are many school organizational characteristics that could be used to lower teacher attrition. In particular, lowering student disciplinary problems, improving work environment, increasing administrative support, and providing better professional development and induction/mentoring for beginning teachers are all viable actions that can be taken to reduce teacher attrition.

**School Resources.** In terms of school expenditure for support per teacher, which includes instructional support per \$100, I find some evidence that some expenditures slightly reduce teacher attrition. However, there is no evidence that providing classroom assistants or teacher aides reduces the odds of leaving, and neither does reducing class size. Lastly, providing adequate teaching materials to teachers seems to decrease the odds of attrition by 15 percent, but there were only two studies that provided these estimates and further studies are required to provide better estimates. However, in terms of school resources, providing adequate teaching materials seems the most promising and cost-effective avenue for reducing teacher turnover along with providing support for teacher.

**Student Body Characteristics.** A substantial amount of research has been done in this category over the last ten years. In terms of student achievement, across 14 studies, I observe that

the odds of teacher attrition are slightly lower for schools with higher student achievement than schools with lower student achievement (Panel C of Table 5). This result is robust to separating this determinant into an increase in student average test score or comparing high to low performing schools<sup>10</sup>. However, even though this effect is statistically significant, the odds ratio is still fairly close to 1. In terms of the characteristics of the students of the schools, I observe that the relationships between percent Black or percent non-White minority students and teacher attrition are not significant at conventional levels. The odds of teacher attrition for a percent increase in Hispanic students at the school level are statistically significant, but are only 1.01 times higher. In terms of percent FRPL and percent IEP/LEP, the relationship between either and teacher attrition is statistically insignificant. I do, however, find that high level of poverty as operationalized as majority of students with low socioeconomic status does increase the odds of teacher attrition and the result is highly significant, but once again, the point estimate is still fairly close to 1. In short, there is little evidence that these factors greatly influence teacher attrition.

**Relational Demography.** This category is a recent development, theoretically and empirically, in the study of teacher attrition (Grissom, 2011; Grissom, Nicholson-Crotty, & Keiser, 2012; Grissom, Viano, & Selin, 2016). Due to its infancy, there have been only five studies that examine teacher-principal race/gender congruence or teacher-student congruence and their relationship with turnover. Moreover, of these five studies, only three use logistic regression while two studies use linear probability modeling. Across these three studies, I find the odds of teacher attrition may be smaller when there is congruence relative to incongruence, but the result is insignificant (Panel D of Table 5). While the linear probability estimates are not

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<sup>10</sup> Results available upon request.



comparable with odds ratios for meta-analysis, they also point to a decrease in teacher attrition in favor of congruency (Grissom, 2011; Grissom, Nicholson-Crotty, & Keiser, 2012).

Table 6: External correlates as determinants of teacher attrition and retention using dependent effect sizes

Factor	# of studies	# of ES	Main effect estimates						Heterogeneity		
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	p	I <sup>2</sup>	Q	P <sub>Q</sub>
Panel A: Accountability											
Assessment impact	5	5	0.947	-0.054	0.027	-0.106	-0.002	0.041	48.060	7.701	0.103
Teacher effectiveness score	8	8	0.941	-0.061	0.023	-0.106	-0.016	0.007	80.102	35.180	<.001
Principal effectiveness score	2	2	0.802	-0.220	0.354	-0.914	0.473	0.533	23.714	1.311	0.252
Merit pay	3	3	0.784	-0.243	0.099	-0.436	-0.049	0.014	89.888	19.778	<.001
Merit pay (linear prob.)	10	10	.	-0.016	0.007	-0.029	-0.003	0.016	49.071	17.672	0.039
Panel B: Work Force											
Employment rate	2	2	0.994	-0.006	0.024	-0.053	0.041	0.799	89.527	9.549	0.002
Salary	29	29	0.981	-0.020	0.004	-0.027	-0.013	<.001	91.166	316.956	<.001
Retention bonus	2	2	0.940	-0.062	0.030	-0.122	-0.003	0.040	1.964	1.020	0.313
Non-teacher salary	4	4	0.796	-0.228	0.126	-0.475	0.019	0.071	68.671	9.576	0.023
Union	3	3	0.745	-0.294	0.173	-0.634	0.046	0.090	58.542	4.824	0.090

*Note.* Assumed correlations between multiple, within-study outcomes is 0.5.

## External Correlates

**Accountability.** This category presents an exciting new development in the literature on teacher attrition with almost all of the studies coming in after Borman and Dowling (2008). Accountability contains five distinct factors: assessment impact, merit pay, teacher effectiveness score, and principal effectiveness score (Panel A of Table 6). Assessment impact is defined as the impact of being assessed or evaluated. Across five studies, I find that teacher evaluation is associated with a decrease in the odds of teacher attrition. This suggests that teachers who are assessed or evaluated, even for accountability purposes and not simply informal classroom observations, are not necessarily more likely to leave than those who were not. In particular, one study finds that there is a reduction in teacher attrition for teachers who experience “positive shock” to their accountability score and an increase in attrition for teachers who experience “negative shock” (Feng, 2010). Relatedly Sun et al. (2017) find there was a slight increase in the odds of attrition with NCLB in the early years and a decrease in the odds of attrition for the latter years, but both of these estimates were statistically insignificant. However, Shirrell (2016) finds that Black teachers were less likely to leave teaching under the first year of NCLB subgroup accountability. In general, these results suggest being assessed and evaluated, even for accountability purposes, does not necessarily increase attrition.

The proliferation and study of merit pay in the past decade have also afforded us new opportunities to examine its impacts on teacher attrition. Most of the studies on merit pay provide linear probability estimates instead of odds ratios, but I first present odds ratios estimates for comparability with other studies. Across three studies, I find that the odds of attrition for teachers in merit pay programs are 0.77 times as likely as the odds of attrition for teachers without merit pay programs. Using linear probability estimates, I find that merit pay programs

reduce the probability of attrition by 1.6 percentage points on average. Additionally, in a subgroup analysis, Hough (2012) finds that merit pay greatly reduces the probability of attrition by nearly 15 percentage points in hard-to-staff schools. These results suggest that merit pay may have overall positive effects in terms of attrition and the composition of teachers in the system, even for hard-to-staff schools.

Related to the issue of merit pay is teacher effectiveness as measured by a composite evaluation score or value-added scores.<sup>11</sup> Our analysis and findings with teacher effectiveness are likely one of the most novel findings in this meta-analysis. Across eight studies, I find that increases in the teacher effectiveness score are associated with decreased odds of attrition and the result is statistically significant. In other words, the overall result indicates that more effective teachers are less likely to leave teaching than less effective teachers, where teacher effectiveness is measured and is available to the school and teachers. This result is fairly consistent in terms of whether the increase in effectiveness is measured as a standard deviation increase or the comparison of effective teachers compared to less effective teachers (e.g., Boyd et al., 2008; Feng & Sass, 2017a; Goldhaber, Gross, & Player, 2011; Loeb, Kalogrides, & Beteille, 2012). Additionally, two studies in particular provide further suggestive evidence that poorly performing teachers, in the bottom quartile or quintile in terms of value-added scores, are also more likely to leave (Goldhaber, Gross, & Player, 2011; Loeb, Kalogrides, & Beteille, 2012). In short, the results from these studies examining teacher effectiveness indicate that the use and availability of teacher effectiveness scores can potentially change the composition of the teacher work force providing positive effects at both ends of the distribution, keeping the highly effective teachers while removing highly ineffective teachers (e.g., Dee & Wyckoff, 2015).

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<sup>11</sup> Since teacher effectiveness can be measured as an overall composite score, standardized composite score, standardized value-added, and high versus low, our result speaks broadly to the association of increases in teacher effectiveness and attrition and not an increase in one standard deviation in teacher effectiveness.

Along this line, there have also been studies on the relationships between principal effectiveness and teacher attrition. The overall meta-analytic result suggests that higher principal effectiveness score is associated with decreases in the odds of attrition but the result is statistically insignificant. Delving more deeply into the study, I note that Beteille et al. (2009) finds that higher principal effectiveness is associated with decreased attrition, with the result being statistically significant for teachers with high value-added scores. Similarly, Grissom (2011) and Redding & Smith (2016) find that higher principal effectiveness is associated with decrease odds of attrition, but both of their results are also statistically insignificant.<sup>12</sup>

**Work Force.** Work force is a category of determinants that is a recent addition to the teacher attrition and retention literature, and there are only a few studies for each determinant with the exception of salary, which has been studied extensively (Panel B of Table 6). The specific determinants in this category with empirical results are employment rate, late hiring, teacher salary, retention bonus, non-teacher salary, and union membership. Employment rate is the percent employment rate in the area or district under study. The meta-analytic result for employment rate and teacher attrition is statistically insignificant. The next determinant is late hiring, an examination of late hiring and its relationship with teacher turnover (Jones, Maier, & Grogan, 2011). Since there is only one study, I did not conduct a meta-analysis. However, the result suggests that late hiring significantly increases the odds of attrition (Jones, Maier, & Grogan, 2011). The most studied determinant in this area is teacher salary, but it has been operationalized in various ways in the literature. Most often it is operationalized as increase per \$1,000 (e.g, Feng, 2010; Fulbeck, 2014), but it has also been operationalized as comparing high salary compared to low salary (e.g., Boe et al., 1998, Shin 1995). For brevity and clarity, I have

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<sup>12</sup> The reason why these two studies are not included in the meta-analytic result is that Grissom (2011) uses linear probability models and Redding and Smith (2016) do not provide standard error for this estimate.

decided to include both of these types together to increase the power to detect an effect as Borman and Dowling (2008) were unable to do. Across 29 studies, I find that increase in salary slightly reduces the odds of teachers leaving the profession (Panel B of Table 6). I note that even though the result is statistically significant, the point estimate is close to 1, which indicates that the effect of increasing salary on attrition is small. I note that the results are qualitatively similar when I separate our collapsed factor into smaller factors and our results become imprecisely estimated. Related to salary is the issue of retention bonus. With two studies I find that retention bonuses can reduce attrition but the result is only marginally significant (Feng & Sass, 2017b; Prost, 2013). In terms of non-teacher salary, the relationship appears to be negative, but the results are statistically insignificant. Lastly, a few studies have estimated the relationship between union membership and attrition rates. Across three studies, I find that the odds of attrition for teachers who have union membership are 0.71 times the odds of attrition for teachers who do not belong to unions, but this result is only marginally significant (Kelly & Northrop, 2015; Kukla-Acevedo, 2009; Moore, 2011). Redding and Smith (2016) also have similar findings and the point estimate is comparable; unfortunately, their result for this finding does not have the associated standard error and hence is not included in the meta-analysis. The studies in this category are providing much needed analysis that is previously lacking, but due to the limited number of studies, there is less certainty about the robustness of the meta-analytic results; more research is needed here to provide a more robust and nuanced picture.

### **Robustness and Sensitivity Checks**

To check the robustness of my findings, I first follow Borman and Dowling (2008) to conduct the same exercise but allowing multiple effect sizes from the same study and assuming

independence amongst them. These results can be found in Appendix Table 3. Overall, the results are substantively similar with point estimates very close to the preferred model and the standard errors are generally smaller due to increased number of effect sizes. In terms of the robust variance estimation (Appendix Table 4), the results are also substantively similar to the main model estimates and the independent effect size estimates. However, some of the results cannot be estimated due to the small number of studies and some results become insignificant since RVE tends to be too conservative or unreliable due to many factors having less than 10 studies and 20-40 effect sizes (Hedges, Tipton, & Johnson, 2010; Tanner-Smith & Tipton, 2013). Consequently, I have also chosen to not display results that have less than seven studies. When there are sufficient studies and effect sizes, the robust variance estimation also provides similar conclusions as the other two models.

In addition to addressing the issues of how to deal with multiple within-study outcomes, I also address the concerns of using hazard ratios in conjunction with the odds ratios by dropping hazard ratios estimates (Appendix Table 5). The results from Appendix Table 5 are substantively similar to the main analysis. The main difference is that the standard errors of the summary estimates are substantially larger, particularly for factors with limited studies. As such, some factors such as STEM specialty become insignificant or marginally significant. However, the point estimates are in the same directions as the main model. Moreover, some factors then only have a single study and cannot be used for meta-analysis, but I have retained the original results to show comparability with the main model.

There is also a conceptual concern of using effect estimates that compare leavers and switchers together against stayers. To address this concern, I drop all effect estimates that combine leavers and switchers together, leaving only estimates that compare leavers with stayers

(Appendix Table 6). The results of using leavers only estimates are substantively similar to the main analysis with point estimates that are unchanged or very close to the main model. Lastly, I also run a set of models where I retain all teacher mobility effect sizes, which includes estimates of leavers only, leavers and switchers together, and switchers only (Appendix Table 7). Conceptually, these estimates then provide the relationship between a factor and teachers leaving their schools without regards to whether the teacher moves to a different school or exit the system/profession. The results here are remarkably similar to the main model, showing the robustness of the main findings as well as evidence that the conceptual framework I have created can be applied to many forms of teacher mobility.

In short, to address issues of having multiple within-study estimates, studies employing hazard ratios and odds ratios, and studies that combine leavers and switchers, issues that are ubiquitous to the scholarly study of teacher attrition and retention, I have run separate models dealing with each issue. I find that, despite these technical and conceptual challenges, the main analysis estimates are substantively similar to all five alternate estimates.

### **Forest Plot and Publication Bias**

Since there are many determinants of teacher attrition, it would not be advisable to do forest plots and contoured enhanced funnel plots for all of them. I have opted to choose the determinant with the most number of primary studies to present the forest plot and contoured enhanced funnel plot. Figure 3, the forest plot of the effect sizes of gender and attrition, shows that most studies find gender does not greatly influence teacher attrition. There are a few studies that find male teachers are less likely to leave teaching than female teachers, but there are also



studies that find the opposite. The overall meta-analytic log-odds result, as discussed previously, is precisely zero, indicating that gender is not an important determinant of teacher attrition.

The contoured enhanced funnel plot is used to examine the possibility of publication bias. The concern here is that if we observe asymmetry in positive and negative studies and their significance, which would suggest some particular type of bias. However, the funnel plot, Figure 4, shows no asymmetry since we observe both positive and negative findings and their significance levels are well represented in each cone. In other words, I find no evidence to suggest there is any publication bias for the studies that include gender as a determinant.<sup>13</sup> Analyses of forest plots and funnel plots of other factors provide substantively similar conclusions.<sup>14</sup>

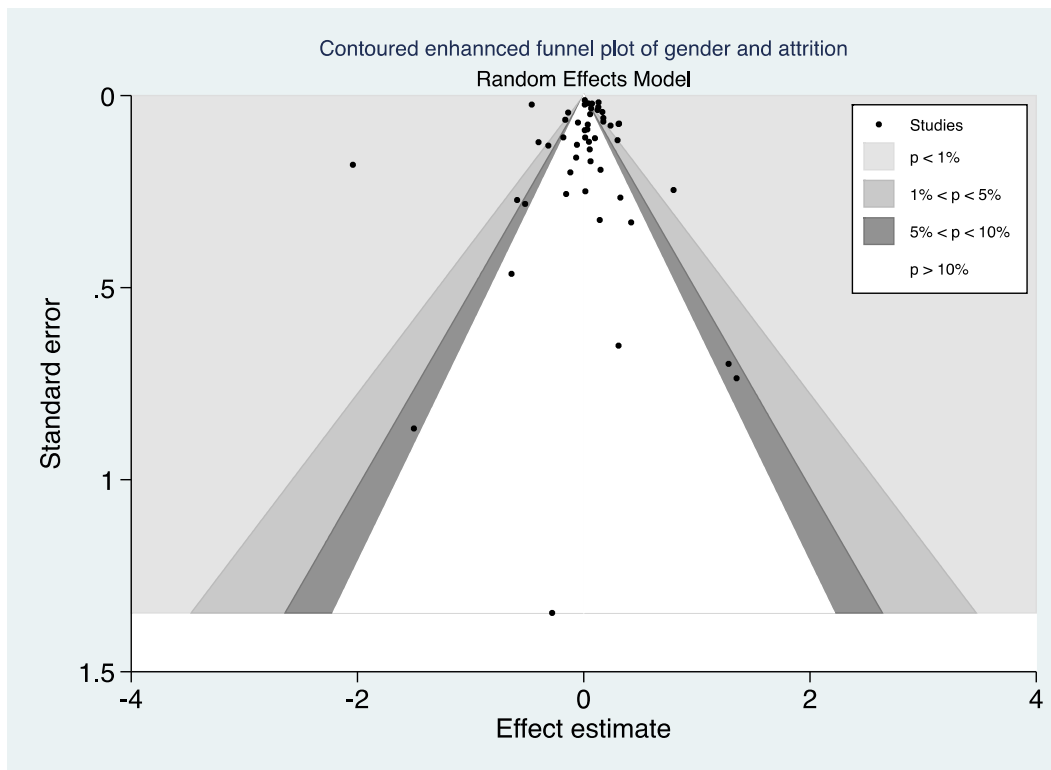


Figure 4. Contoured enhanced funnel plot of gender (male) and attrition

<sup>13</sup> Contoured enhanced funnel plots of other determinants suggest the same conclusion. Results are available upon request.

<sup>14</sup> Results are available upon request.

## **Meta-regression Analyses**

For ease of interpretation and presentation, meta-regression results for five moderators are compiled together in Table 7 and only the coefficients of interest, the slopes on the moderator variables, along with their significance levels are presented. A positive significant result indicates that the odds of attrition increase for a unit increase in the measure of the moderator or when the moderator is “on” instead of “off.” It should be noted that since there are limited number of studies for many determinants, there is increased risk of the meta-regression analysis to be severely under-powered and the estimation is also at risk of driven by only a few studies (Bartolucci & Hillegass, 2010). As such, I have limited the meta-regression to determinants with at least eight studies and results with less than twenty studies should be interpreted cautiously. Among the determinants with more twenty or more observations or studies for meta-regression analyses, all except one result is statistically insignificant with only the peer review indicator being marginally significant. This result indicates that, for peer-reviewed studies, the odds of attrition is decreased for teachers who are STEM teachers compared to non-specialty teachers. In other words, this result suggests that, even though studies generally find that STEM teachers are more likely to leave teaching than non-specialty teachers, peer reviewed studies tend to find that the odds of attrition to be less pronounced than non-peer-reviewed studies.

For factors with less than twenty studies, the meta-regression results are generally not significant (likely underpowered) and there are no apparent patterns among the significant results except for the secondary versus elementary factor. The meta-regression results for this factor indicate that longitudinal studies, higher quality studies, and studies after 2005 generally find a decrease in the odds of attrition for secondary teaches relative to non-secondary teachers. In other words, studies using longitudinal data, higher quality studies, and more recent studies are

more likely to find that secondary teachers are not more likely to leave teaching than elementary teachers.

Overall, the results are mostly insignificant and there is little consistency in how these moderators influence the effects of the determinants.

Table 7. Bivariate meta-regression results

Factor	Longitudinal indicator	Big data indicator	Peer review indicator	Study quality indicator	After 2005	N
Age (cont.)	-0.033	-0.123	-0.034	0.069	0.066	14
Age (greater than 28)	0.252	0.200	0.148	0.174	-0.036	14
Male	0.123	0.030	-0.076	-0.067	0.062	47
Minority (Black)	-0.479	-0.058	0.219	0.028	0.494	22
Minority (Hispanic)	0.768	0.607	-0.101	0.132	-0.387	17
Minority (non-White)	0.261	0.076	0.436	0.23	-0.003	11
Ability (test scores)	0.116 <sup>+</sup>	0.071	-0.255*	0.014	0.091	9
School selectivity	0.014	0.009	-0.23	0.149	0.247 <sup>+</sup>	8
Graduate (v. none)	-0.16	-0.036	0.025	-0.092	-0.146	24
Standard certification	0.055	0.568	-0.5	0.266	-0.151	19
Specialty (STEM)	-0.026	-0.048	-0.147 <sup>+</sup>	-0.091	-0.079	25
Specialty (Spec ed)	-0.035	0.002	0.116	0.028	-0.086	9
Experience (cont.)	-0.021	0.007	-0.052	-0.03	-0.043	11
Experience (<3)	-0.057	-0.057	0.075	-0.053	-0.322	12
Urban	0.171	0.297*	0.102	0.025	0.127	13
Secondary v. elem	-0.337*	-0.318 <sup>+</sup>	0.125	-0.225*	-0.361**	13
Administrative support	0.034	-0.003	0.011	<.001	0.051	12
Induction/mentoring	0.298**	-0.056	-0.014	<.001	-0.101	10
Class size	-0.073 <sup>+</sup>	-0.025	-0.054	-0.022	0.042	8
Student achievement	-0.101	-0.101	0.145	-0.182	0.156	14
Percent Black	0.202	0.234	-0.308	0.16	-0.379**	8
Percent Minority	0.206	0.077	0.191	0.231	-0.305	15
Percent FRPL	<.001	0.004	-0.011	-0.004	0.008	17
Salary	-0.013	0.002	0.036	0.012	-0.006	29

Note. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

## Discussion and Conclusion

The literature on teacher attrition and retention has matured since Borman and Dowling ran their systematic search of the literature in 2005.<sup>15</sup> With more than ten years of additional research and the development of large longitudinal data, the field on teacher attrition and retention has extended the number of studies, providing more reliable results than before as well

<sup>15</sup> Borman and Dowling's work is published in 2008 but the search stops in 2005.

as introducing new categories of determinants of attrition and retention. Consequently, in some areas, we are provided with results that contrast prior findings, and in others, we are provided with a more nuanced understanding of the factors that influence teacher attrition; and perhaps most importantly, we are also provided with novel knowledge about what drives teacher attrition, areas of promising future research, and policy levers that may reduce attrition and improve the teacher work force.

First, I highlight a few findings that contrast Borman & Dowling (2008). With the additional studies in my meta-analysis, I find that female teachers and married teachers are not more likely to leave teaching than male teachers. In terms of having a graduate degree versus no graduate degree or versus a bachelor degree, with more studies and estimates, I do not find there is an increase in the odds of attrition and my summary effect is very close to the previous summary estimate. I consistently find that teaching specialty areas such as STEM or special education significantly increases the odds of attrition. In these cases, I suspect there may be two possible reasons why there are contrasting findings: (1) the additional studies provide a more accurate picture of what influences attrition and retention than previously; and (2) the influence of these factors may have changed over time. While I believe that my more rigorous and updated search provides better estimates, I also conduct meta-regression to see if results from studies published after Borman and Dowling's work are statistically different than previous results. The bivariate meta-regression results yield no statistical significance, although due to the limited number of studies and effect sizes, I may not have had the power to detect any such difference (Table 7).

In terms of findings where I am able to provide more nuance or further details, first I start with personal correlates or factors associated with the teachers. I note that I find only Hispanic

teachers have reduced odds of attrition relative to White teachers when new studies are able to differentiate between Black, Hispanic, and any minority non-White teachers. I also find stronger evidence that teacher satisfaction plays an important role in teacher decisions to leave or stay in teaching. Relatedly, full-time teachers are less likely to leave teaching than part-time teachers. I continue to find teachers with regular or standard certification are less likely to leave teaching than those who do not, though I do not find significant results for National Board certification or going through a program like Teaching Fellow or Teach For America. In terms of school correlates, I consistently find that middle school teachers are more likely to leave teaching than elementary teachers. I find that various measures of school characteristics as an organization, namely student disciplinary problems, administrative support, and professional development, strongly influence whether teachers stay or leave teaching. In terms of school resources, I find that providing teaching materials reduces odds of attrition. Somewhat surprisingly, most school body characteristics do not seem to influence attrition or that their influences are rather small. In terms of external correlates, I find that these factors do influence teacher attrition and retention. Being evaluated, even for accountability purposes, does not necessarily increase teacher attrition; in fact, the odds of attrition for teachers who are assessed are somewhat smaller than those who are not. In terms of teacher effectiveness, higher quality teachers are less likely to attrit than lower quality teachers, and there is evidence that teachers in the lowest quartile or quintile of value-added scores are more likely to leave teaching. Relatedly, teachers in merit pay programs are less likely to leave teaching than those who are not.

In addition to providing a comprehensive and quantitative analysis of the factors that influence teacher attrition and retention, this meta-analysis also provides scholars and policy-makers with some policy implications and areas of future research. First, on the front end, we

have some preliminary evidence that suggests providing retention bonus and limiting late hiring could reduce teacher attrition, although much more research is needed to confirm these findings. Second, we recognize that some specific types of teachers need additional supports or incentives to keep them in the teaching profession. For instance, teachers who enter the teaching profession in their early to mid twenties and STEM and special education teachers are particularly at risk for leaving teaching. We have compelling evidence that there are school organizational characteristics, such as student disciplinary problems, administrative support, teacher collaborations, and professional development, which, if improved or strengthened, could substantially reduce the risk of attrition. It is, by no means, an easy feat to simply decrease student disciplinary problems or improve administrative support, nor is it guaranteed that such actions would necessarily keep young teachers or specialty teachers in teaching, but the evidence suggests that this is a promising area of research. In particular, educators and policy-makers should consider creating school environments where strong administrative support, consistent teacher collaborations, and regular and meaningful professional development could provide young or specialty teachers the resources and support needed to keep them in teaching. While there are some efforts in this regard (Podolsky, Kini, Bishop, & Darling-Hammond, 2016), we need more experimentation as well as rigorous evaluations of these implementations.

Moreover, contrary to some concerns about the negative effects of teacher evaluations and accountability (Darling-Hammond, 2013; Darling-Hammond, Amrein-Beardsley, Haertel, & Rothstein, 2012), I do not find that evaluation necessarily increase teacher attrition. The extant empirical evidence suggests that when teachers are evaluated and their measures of effectiveness are available to the teachers, this does not increase attrition, but in fact, it may provide teachers with some sense of empowerment and the possibility of growth and improvement since they can

observe where they are effective and where they are not, leading to a decrease in attrition (Boyd et al., 2008; Feng, 2010). Furthermore, even when teacher evaluations are being used for accountability or for bonuses or pay raises according to performance as in merit pay, we observe that teachers are less, not more, likely to leave teaching. Relatedly, we also have evidence that evaluation and accountability may improve the teacher work force by keeping the most effective teachers and removing the most ineffective teachers. In short, evaluation and accountability may be perceived more positively by teachers and can have positive effects for teachers than have been recognized. I note this does not mean that there are not any negative consequences or warranted concerns about any and all use of evaluation and accountability, but rather as a policy tool, there may indeed be merit to evaluation and accountability.

As the scholarly study of evaluation and accountability and teacher attrition and retention is fairly nascent, much more work remains to be done in this area. For instance, even though merit pay is linked with reduced teacher attrition, we know less about which program characteristics of merit pay are associated with or most likely responsible for keeping teachers in the profession. Moreover, as some of the research in merit pay relies on associational evidence, we do not know for certain if the estimates are unbiased or if there are unobserved factors about the schools and districts that have merit pay that may induce teachers to stay in teaching relative to schools and districts that do not have merit pay. We also have less evidence about whether merit pay programs are attracting more effective teachers or the distribution of the reduction in teacher attrition across effectiveness measures. Relatedly, we have less evidence about how teacher evaluation is used such that it may reduce attrition. Lastly, in terms of future research for teacher attrition, relational demography and school improvement are two areas that are in grave need of development and exploration. We have only a few suggestive studies about the

relationship between relational demography and attrition and how school reforms and research-practice partnerships influence teacher attrition and retention.

In conclusion, this meta-analysis has substantially expanded the field's knowledge of teacher attrition and retention by providing more robust and nuanced findings than before as well as providing novel findings that come from recent work. Moreover, it has provided suggestions for policy levers that may be used to reduce teacher attrition as well as areas of future research that would greatly improve the scholarly study of teacher attrition and retention.



## CHAPTER IV

### THE FACTORS OF TEACHER ATTRITION AND RETENTION: EVIDENCE FROM REPEATED CROSS-SECTIONAL NATIONAL DATA

#### Introduction

Teacher labor markets have strong implications for learning outcomes and social equity for students. Although researchers have partnered with policy makers to ensure that elementary and secondary classrooms are staffed with qualified teachers (Ingersoll, 2001; Guarino, Santibanez, & Daley, 2006), there is compelling evidence suggesting that schools and districts vary in the quantity and quality of the teacher workforce (Hanushek, Kain, & Rivkin, 2004; Lankford, Loeb, & Wyckoff, 2002), and this has strong implications for student learning. For instance, considerable research has shown that teachers greatly influence student learning and account for 7.5 percent to 8.5 percent of the variation in student performance (Goldhaber, 2002; Rockoff, 2004). Nye et al. (2004) found that that the difference in achievement between having a 25<sup>th</sup> percentile teacher and a 75<sup>th</sup> percentile teacher is, on average, 0.35 standard deviations for reading and almost a half a standard deviation for math. Hanushek (2011) estimated students with a very good teacher as measured by student standardized test score, on average, gain a whole year's worth of learning more than students with a very bad teacher, and that the U.S.'s gap in academic performance compared to high-performing countries like Finland could be closed by replacing the bottom 8 percent of public school teachers with average quality teachers. Simply put, given the evidence accumulated through decades of research, teacher effectiveness is the most influential school factor in student achievement, and yet, researchers have documented that the most disadvantaged schools, schools that need effective teachers the most, are often the hardest to staff and often face high teacher turnover (Allensworth, Ponisciak & Mazzeo, 2009; Boyd et al., 2011; Ingersoll, 2001; Guarino, Santibañez, & Daley, 2006).

Extant research shows that teachers who remain in teaching have systematically different perceptions of school and profession-related issues than those who attrit, and that factors such as salaries, working conditions including demographics and school racial composition, teacher preparation, and mentoring influence attrition (Darling-Hammond, 2003; Imazeki, 2005; Lankford, Loeb, & Wyckoff, 2002; Macdonald, 1999). There is a robust literature that indicates that increases in salary reduce teacher attrition (Clotfeler, Ladd, & Vigdor, 2011; Eller, Doerfler, & Meier, 2000; Hanushek, Kain, & Rivkin, 2004). Redding and Smith (2016) find that alternatively certified teachers were more likely to leave teaching than traditionally certified teachers. Carroll, Reichardt, and Guarino (2000) find that teacher attrition is higher for high-minority districts than for low-minority districts. Similarly, Hanushek and colleagues (2004) find higher teacher attrition rate for low-achieving and high-minority schools. This movement was mostly due to White teachers moving toward non-minority higher-income schools and Black teachers moving toward schools with higher Black enrollment. Similarly, using a nationally representative sample of schools and teachers, Smith and Ingersoll (2004) find that public school teachers in high-poverty schools were more likely to leave than similar peers in medium-poverty schools. Urban schools have difficulty attracting and retaining highly qualified teachers (Lankford, Loeb, & Wyckoff, 2002). Student and teacher characteristics and racial compositions also affect many teacher outcomes such as job satisfaction, expectations, and attrition (Mueller et al., 1999; Gershenson, Holt, & Papageorge, 2016; Lankford, Loeb, & Wyckoff, 2002; Sohn, 2009). Researchers have also found that teacher-principal race and gender matching also influence teacher satisfaction and retention (Grissom & Keiser, 2011; Grissom, Nicholson-Crotty, & Keiser, 2012). Other working conditions such as administrative support have been linked to teacher attrition (Boyd et al., 2010; Ladd, 2011; Shen, Leslie, Spybrook, & Ma, 2012).

There is growing evidence of the effect of working conditions on teacher attrition beyond demographics and racial composition of the school (Ingersoll, 2001; Johnson et al., 2012; Ladd, 2011; Loeb, Darling-Hammond, & Luczak, 2005).

The factors determining retention and attrition come from a large number of studies that vary substantially from each other with respect to time period, location, sample, sampling strategy, and methodology. Empirically, each factor has been found to have an association with teacher attrition and retention, but no study has analyzed the extent to which these relationships hold when these factors are studied simultaneously. The concern is essentially omitted variable bias since these factors are likely to be correlated with each other and they are also correlated with the outcome of interest, which means that failing to include them as covariates would bias the estimates. For instance, it is possible that prior studies have found teacher-principal race or gender congruence to influence teacher attrition only because they have not accounted for principal effectiveness and training or the support provided by the administration (e.g., Grissom & Keiser, 2011; Grissom, Nicholson-Crotty, & Keiser, 2012).

Another limitation is that the majority of the studies have analyzed the relationship between a set of factors and teacher retention and attrition in a given year or a single district or state. This limitation severely constrains the generalizability of the findings because they could be idiosyncratic to the time and place of the individual studies. Moreover, most studies on teacher turnover focus on teachers leaving the profession and not teachers moving schools. It is likely that the factors that influence teachers leaving the profession are not the same as those that influence whether they switch schools. From the school's perspective, teachers who leave the profession and those who move are both contributing to the turnover at their school and it would be important to know both what keeps teachers in teaching and what keeps them in the school

where they have taught. Consequently, there is substantial room for contribution to the research on the factors of teacher retention and attrition. This study aims to analyze whether and how the relationships of these categories of factors and teacher retention and attrition, individually and jointly, hold true nationally and over time. More specifically, the study asks and answers the following research questions:

- 1) To what extent do teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics collectively and separately influence teacher retention and attrition?
- 2) To what extent do these determinants of retention and attrition vary over time?

In answering these research questions, this study makes several contributions to the scholarly study of teacher attrition and retention. First, I use data from the School and Staffing Survey (SASS) with a rich set of covariates such as teacher characteristics, teacher qualifications, and school organizational characteristics, which alleviates some concerns of omitted variable bias. Second, to overcome the idiosyncratic nature of using short-term district or state-level data, the data are over-time nationally representative data, so the results are more generalizable. Third, to advance the study of teacher attrition and retention I also differentiate between teachers who move schools from those who leave the profession and analyze the factors that influence each set of teachers separately. Lastly, I am also able to examine if the influences of the factors of teacher turnover are changing over time.

The rest of the paper is structured as follows. First, I discuss the broad categories of the determinants of teacher attrition and how they influence teacher turnover. Then I discuss the data and methods used in this paper and the descriptive statistics for each category of determinants and for each wave of SASS. Then I discuss how the individual factors within each category are

associated with attrition and then how all the factors are associated with attrition when they are examined jointly, which is the preferred specification and focus of the analysis. Based on the saturated models where all the individual factors are examined jointly, I analyze select variables whose influence appears to be changing over time. I then situate my findings with the prior literature.

### **Literature Review**

According to the empirical literature, teacher characteristics, teacher qualifications, school organization characteristics, school resources, and student body characteristics are principal factors that influence teacher retention and attrition (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006). There has also been recent empirical development of additional factors that influence teacher attrition and retention under these broad categories.<sup>16</sup> Each broad category and recent developments are discussed in further details below.

**Teacher characteristics.** Teacher demographic variables facilitate our understanding of how teacher background characteristics influence attrition and retention. In the Borman and Dowling article (2008), the moderator variables under this category are gender, race, age, marital status, having a new child, and number of kids. In terms of gender, most studies suggest that gender plays an influential role in who leaves or stays in the profession (Ingersoll, 2001a; Guarino, Santibanez, & Daley, 2006). Borman and Dowling (2008) find that women are more likely to leave the profession than men. In terms of race and ethnicity, White teachers are more likely to leave than minority teachers (Borman & Dowling, 2008). Teacher's age also is also a stronger predictor of attrition, namely that young teachers and teachers near the retirement age

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<sup>16</sup> These recent developments may be grouped under new categories (Nguyen, 2018), but for sake of simplicity and feasibility of discussion, they are grouped under existing categories in this paper.

are more likely to leave the profession, producing a U-shaped curve of attrition versus age or experience (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). Marital status is also associated with increased odds of leaving the profession (Borman & Dowling, 2008). The most influential factor of attrition, however, is having a new child, which is associated with odds of attrition of 6.69 times relative to teachers who are not having new children. The number of children is not statistically significant in changing the odds of attrition. This set of teacher demographic variables indicates that teacher background characteristics such as their gender, race/ethnicity, age, marital and parental status, play a substantial role in teacher attrition.

A recent development in this category is the teacher-principal race and gender congruence or matching, which comes from the relational demography and representative bureaucracy literature (Fairchild et al., 2012; Grissom, Kern, & Rodriguez, 2015; Grissom, Viano, & Selin, 2016; Sohn, 2009). Grissom and Keiser (2011) find there was higher job satisfaction and lower turnover for teachers when there was teacher-principal race congruency. Elsewhere, scholars have examined the direct relationship between race/gender congruence and teacher attrition (Grissom, 2012; Grissom & Keiser, 2011; Harris, 2007). For instance, Grissom and Keiser (2011) find that teachers are less likely to leave teaching when they are of the same race/ethnicity as the principal. Grissom (2012) finds that teachers are less likely to attrit when they are of the same gender as the principal. Likewise, teachers are less likely to leave the profession when the majority of students that they teach match their ethnicity (Allensworth, 2009; Feng, 2009). Most recently, Grissom, Nguyen, and Patrick (in progress) find that teacher-principal race congruence does play a role in teacher turnover in a multi-ethnic school district, but this influence varies by the teacher's race and the school's demographics context. Generally, this developing literature indicates that teacher-principal gender or racial congruence is

associated with positive outcomes, while incongruence is associated with negative outcomes, but the ramifications of this demographic matching have not yet been fully explored (Grissom, Kern, & Rodriguez, 2015).

**Teacher qualifications.** There are four general categories of teacher professional qualifications that serve as moderators of attrition: teacher training, experience, teacher ability or achievement, and teaching specialty area (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). A fair number of studies have examined the relative attrition rates between teachers with a graduate degree and those with undergraduate degree or less (Borman & Dowling, 2008). Teachers who experienced induction and mentoring in their first year of teaching were less likely to leave teaching or change schools (Smith & Ingersoll, 2004). Other studies (e.g., Imazeki, 2005; Ingersoll, 2001; Stinebrickner, 1998, 2002) have examined the attrition rates for teachers with specialty area such as science or math degree against those with other degrees. There has also been recent work examining attrition for those who are alternatively certified (Donaldson & Johnson, 2011; Redding & Smith, 2016). Teacher ability or scholastic achievement and teacher experience also play an important role in influencing teacher attrition and retention (e.g., Allred & Smith, 1984; Arnold, Choy, & Bobbitt, 1993; Boyd, Lankford, Loeb, & Wyckoff, 2005). Generally, these studies have found that training, experience, ability/achievement, and specialty all influence teacher attrition and retention. For instance, one consistent finding is that attrition is high for young or new teachers and for teachers near the retirement age (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006).

**School organizational characteristics.** School organizational characteristics, or the school-to-school variations in organizational conditions, are one of the most often studied areas of teacher attrition and retention. Under this umbrella, there are several moderator variables:

school location, school sector, school size, administrative support, school mentoring program for beginning teachers, collaboration and teacher network, regular supportive communication with administration, opportunities for advancement, and bureaucracy (Borman & Dowling, 2008). Many of these school organizational characteristics are statistically significant but their effect sizes are practically small. For instance, the odds of teachers leaving in urban or suburban schools are marginally higher compared to the odds of teachers leaving in rural schools. Similarly, school size and enrollment are significant but practically small (Borman & Dowling, 2008). There are factors that are both significant and practically meaningful: private schools compared to public schools, level of administrative support, and school mentoring program for beginning teachers. These results indicate that public teachers, teachers who have higher level of administrative support, and teachers with mentoring programs were much less likely to leave teaching (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). For instance, Smith and Ingersoll (2004) find beginning teachers who had mentoring programs were less likely to leave teaching than beginning teachers who did not and that public school teachers in high-poverty schools were more likely to leave than similar peers in medium-poverty schools. Administrative support has been linked to teacher attrition (Boyd et al., 2010; Ladd, 2011; Shen, Leslie, Spybrook, & Ma, 2012). There is also preliminary evidence that other factors, such as teacher collaboration, regular supportive communication with administrators, and opportunities for advancement, may reduce attrition but there were not enough studies for meta-analyses (e.g., Eller, Doerfler, & Meier, 2000; Smith & Ingersoll, 2004).

**School resources.** The factors in the school resources category represent school-to-school differences that moderate teacher attrition and retention. They include the average class size, student-teacher ratio, school expenditure for support per teacher, school expenditure for



teaching materials, teacher aide or classroom assistants, instructional spending, per-pupil spending, and teacher salary (Borman & Dowling, 2008). Based on Borman and Dowling (2008), for most of these factors other than salary, there are only a handful of studies that examine their association with teacher attrition and retention and moreover, most of these factors are statistically and practically weakly associated with teacher attrition with the exception of teacher salary. The importance of teacher salary with teacher attrition and retention had been discussed previously in a systematic review of the literature (Guarino, Santibanez, & Daley, 2006). Generally, studies of teacher salary on attrition have found that salary does play an important role. For instance, researchers have found that higher earnings were negatively associated with attrition (Podgursky, Monroe, & Watson, 2004; Stockard & Lehman, 2004). Elsewhere, others have found that salary increases were associated with teachers' decisions to move schools (Hanushek, Kain & Rivkin, 2004; Lankford et al., 2002). Borman and Dowling (2008) found that high and medium salary may decrease attrition relative to low salary but there was only one study that provided the estimations.

**Student body characteristics.** This umbrella of characteristics includes three general categories of student characteristics: the school's socioeconomic composition, student achievement level, and the racial/ethnic composition of the school (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006). Contrary to expectation, Borman and Dowling (2008) do not find that, on average and across a number of studies, the school's socioeconomic composition greatly influences teacher attrition. Instead, they find that, on average, teachers who worked in high-poverty schools were just as likely to leave as teachers who worked in low-poverty schools. However, recent evidence suggests that teachers, on average, prefer schools with higher proportions of White and Asian students and their preferences vary systematically

according to their own demographic characteristics (Engel, Jacob, & Curran, 2014; Horng, 2009). Relatedly, there is some suggestive evidence that teachers were more likely to leave in school where the majority of students were minority students, but there was limited evidence (e.g., Carroll, Reichardt, & Guarino, 2000; Hanushek, Kain, & Rivkin, 2004). Student achievement, on the other hand, is a strong predictor of teacher attrition. In particular, teachers were less likely to leave if they teach students with high or above average achievement level or in districts where the average math or reading scores were high; likewise, teachers were more likely to leave if they taught a higher percentage of students with poor performances (Borman & Dowling, 2008).

### **Data and Methods**

I use data from the Schools and Staffing Survey (SASS) and its supplement, the Teacher Follow-Up Survey (TFS). SASS, administered by the National Center for Educational Statistics (NCES), consists of nationally representative samples of districts, schools, principals, and teachers for public schools. For this study, I use all four iterations of SASS and TFS where teacher turnover data can be generated. More specifically, I use the 1999-2000, 2003-2004, 2007-2008, and 2011-2012 SASS waves with their respective TFS along with the sampling weights to make the results nationally representative.<sup>17</sup> These surveys include detailed comprehensive data on teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics. As such, these data are ideal for exploring the factors that influence teacher retention and attrition nationally and over time. However, one category, school resources, is rather poorly represented, as there are little to no

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<sup>17</sup> To address the issue that the results are only truly nationally representative when the whole sampling frame is used, I will include charter schools and teachers in the sample as a robustness check. Furthermore, I will also run the analysis without weights to show the robustness of results.

questions on expenditures in SASS. As such I supplement the SASS data with Common Core of Data (CCD), which includes expenditure information at the district level.

The dependent variable for this study comes from the report of a teacher's employment status in the TFS. With the detailed information from the TFS, I can create three categories of teacher status for the school year following the baseline survey year: teachers who stay at the school where they taught in the base year (stayers), teachers who leave teaching (leavers), and teachers who move to another school but remain in teaching (movers). I use multinomial logistic regression models to estimate the turnover probabilities for switching schools and leaving the profession for each teacher. More specifically, the main equation to estimate this relationship is:

$$\Pr(\textit{turnover})_{ijkl} = \frac{e^f}{1 + e^f}$$

where  $f = \beta_0 + \beta_1\mathbf{X} + S_k + \gamma_l + e_{ijkl}$ .

The odds of teacher  $i$  turning over from school  $j$  in state  $k$  in year  $l$  is a function of  $\mathbf{X}$ , a vector of variables for each category of determinants of teacher turnover.  $S_k$  is state fixed effects to account for unobserved heterogeneity across states. The model also includes wave fixed effects,  $\gamma_l$ , to account for time-specific correlates of teacher turnover. Wave-specific models will not include wave fixed effects. Lastly,  $e_{ijkl}$  is a random error term. Nationally representative weights are employed for each wave in the main analysis. I standardize administrative support, teacher cooperation, student discipline problem, principal effectiveness, and satisfaction with salary variables to have mean zero and standard deviation one in each wave after accounting for sampling weights.

To examine whether the influence of each variable in each category of factors such as teacher characteristics has changed over time, I estimate separate models for each wave of SASS as well as an interaction model where the variables are interacted with time/wave. To examine

how these groups of factors influence teacher turnover, I utilize a model where all the factors are included simultaneously with the pooled data and wave fixed effects, and separate wave-specific models as well as interaction models where the variables are interacted with time/wave. The results can be presented as either odds ratios and/or marginal effects. The odds ratios indicate the change in the odds of teacher attrition for each variable, while the marginal effects indicate the change in the probability of attrition for each variable, both of which are useful ways of analyzing the factors of teacher attrition and retention. Due to the number of models and number of variables in each model, it is not advisable to present both odds ratios and marginal effects results at the same time. As such, I present the odds ratios in the main text as most studies do and the marginal effects at the means in the Appendix.

Relatedly, since there are several indicators for each category and five categories in all, it is not appropriate or warranted to interact every variable with every wave since this would greatly complicate the analysis and introduce Type I errors. As such, only variables whose statistical significance or magnitudes changed substantially from wave to wave would be interacted with the wave variables to determine if their influences on teacher attrition and retention are changing over time. More specifically, these interactions of select variables and time will indicate whether the association between the variable of interest and teacher attrition is significantly changing over time.

While the wave fixed effects can account for time-specific heterogeneity in the data, they do not account for important unobservable school or district characteristics that may influence turnover. There are, however, drawbacks to the use of school and district fixed effects. One, the use of school and district fixed effects reduces the generalizability of the findings as the analysis is conducted on a restricted sample. Two, the sampling design does not guarantee the same

schools or even districts will appear in one wave to the next. There are very few schools and districts that remained in the sample from wave to wave. Third, the use of school fixed effects will then exclude any time-invariant observable school characteristics, so variables in school organizational characteristics and school resources may be potentially no longer viable (unless it is in the pooled models where there may be variations across school and time/wave). Consequently, I use state fixed effects in the models as the SASS sampling design allows for representativeness at the state level and all states are represented in the sample from wave to wave. Moreover, this will allow me to interpret the results as within state results or accounting for state-specific, time-invariant heterogeneity in the data.

Table 1 provides the nationally representative descriptive statistics for each category and for each wave. On average, most variables remain fairly stable across time. Consequently, I will focus the discussion with the pooled data in model 5. For teacher characteristics, with all four waves of SASS pooled, the results show that about 13 percent of teachers are 28 years old or younger, and three out of four teachers are female. In terms of race, more than 80 percent of teachers are White, seven percent are Black, seven percent are Hispanic, and two percent are Asian. In terms of congruence, about half the teachers are of the same gender as their principal and nearly four out of five teachers are of the same race as their principal. For teacher qualifications, only one percent of teachers have doctoral degrees and two percent have advanced graduate certification, while almost fifty percent have master degrees. The vast majority of teachers, eighty-nine percent, have standard or regular certification. Fourteen percent and twelve percent of teachers teach STEM subjects and special education subjects respectively. On average, about ten percent of teachers are first time beginning teachers.

Table 1. Descriptive Statistics of teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
<i>Teacher Characteristics</i>					
Young teacher (age<=28)	0.14	0.14	0.15	0.12	0.13
Female	0.75	0.75	0.76	0.76	0.76
White	0.85	0.84	0.85	0.84	0.84
Black	0.08	0.08	0.07	0.07	0.07
Asian	0.02	0.02	0.02	0.02	0.02
American Indian	0.01	0.01	0.01	0.01	0.01
Hispanic	0.05	0.06	0.07	0.08	0.07
Principal-Teacher gender congruence	0.51	0.53	0.54	0.55	0.53
Principal-Teacher race congruence	0.80	0.80	0.79	0.78	0.79
<i>Teacher Qualifications</i>					
Has PhD	0.01	0.01	0.00	0.01	0.01
Has Master Degree	0.46	0.47	0.50	0.54	0.49
Advanced Graduate Cert.	0.02	0.02	0.02	0.02	0.02
Teach STEM subjects	0.13	0.13	0.14	0.15	0.14
Teach special education	0.10	0.13	0.12	0.13	0.12
Has standard/reg certification	0.87	0.88	0.89	0.91	0.89
New teacher	0.11	0.10	0.11	0.07	0.10
<i>School organizational characteristics</i>					
Urban school	0.26	0.28	0.25	0.27	0.26
Suburban school	0.51	0.53	0.55	0.50	0.51
School enrollment	807	800	821	818	812
Union member	0.79	0.78	0.76	0.74	0.77
Secondary school	0.33	0.29	0.31	0.31	0.31
Combined elementary and secondary	0.02	0.05	0.04	0.06	0.04
Administrative support (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Teacher cooperation (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Student discipline problem (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Principal effectiveness (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Total principal exp	8.87	7.66	7.58	7.25	7.80
	(7.59)	(6.93)	(6.72)	(6.23)	(6.88)
Principal has PhD	0.11	0.10	0.10	0.12	0.11
Principal has MA or specialist degree	0.88	0.89	0.89	0.87	0.88
<i>School Resources</i>					
Teacher salary per \$1,000	52.11	53.01	52.11	52.74	52.50
	(17.03)	(16.58)	(16.07)	(16.74)	(16.61)
Salary satisfaction	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Expenditure per student	9002.33	10034.00	10755.94	10667.87	10146.89
	(2814.81)	(3540.95)	(4040.67)	(6911.09)	(4693.45)
<i>Student Body Characteristics</i>					
Percent FRPL	34.67	41.10	41.35	47.65	41.39
	(28.14)	(29.25)	(28.36)	(28.98)	(29.06)
Percent minority	33.41	37.75	38.92	42.89	38.39
	(32.34)	(33.44)	(32.58)	(31.92)	(32.75)
Majority Black/Hispanic	0.23	0.28	0.28	0.30	0.27
Percent IEP	12.30	13.72	13.00	12.68	12.94
	(9.57)	(11.72)	(11.50)	(10.08)	(10.80)
Percent LEP	5.65	7.32	7.90	8.26	7.33
	(12.77)	(14.62)	(14.34)	(13.43)	(13.87)
Observations	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. Salary and expenditure have been adjusted to constant 2012 dollar. Observations have been rounded to the nearest 10 per IES compliance. Administrative support, teacher cooperation, student discipline problem, principal effectiveness, and satisfaction with salary were standardized for each wave accounting for sampling weights.

In terms of school organizational characteristics, about a quarter of the schools are urban and about half are suburban. Three out of four teachers nationally have union membership. On average, teachers teach at schools that enroll about 800 students and about 31 percent of the schools are secondary schools and four percent are combined elementary and secondary schools. I note that administrative support, teacher cooperation, student discipline problem, and principal effectiveness are standardized by wave accounting for nationally representative weights (for more information, see Appendix Table 1). The average principal experience is 7.8 years and 11 percent of principals have doctoral degrees. For school resources, adjusted for inflation, teachers' salary is about \$52,500 in constant 2012 dollar. Teacher satisfaction with salary is standardized by wave. The average expenditure per student is about \$10,000, although there is significant variation around this mean.

Unlike the other variables, I see the most substantial shifts in the student body characteristics. The average percent of students eligible for free and reduced price lunch (FRPL) is about 41.4 percent, but the average has increased substantially since 1999-2000 where 34.7 percent of students are FRPL relatively to 47.7 percent in 2011-2012. Similarly, the percent of minority non-White students has increased from 33.4 percent in 1999-2000 to 42.9 percent in 2011-2012. Reflecting this shift, schools where the majority of students are Black or Hispanic have increased from 23 percent to 30 percent. The percent of students with IEP has remained around 12-13 percent, while the percent of students with LEP has increased steadily from 5.7 percent to 8.3 percent from 1999-2000 to 2011-2012.<sup>18</sup>

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<sup>18</sup> Since SASS is designed to be nationally representative for public schools including charter schools, there may be concerns about representativeness if charter schools are not included. As such, I have included a descriptive statistics table, Appendix Table 2, which includes public and charter schools. The results, with and without charter schools, are nearly identical.

## Results

Before delving into how the individual factors within each category are associated with attrition, I examine the overall attrition rate for teachers nationally (Table 2). Similar to other studies that use SASS I observe that total attrition rate, which includes teachers who move schools but remain in teaching (movers) and teachers who leave the profession (leavers), is about 14-15 percent. For both movers and leavers, I observe that the rate of attrition peaks in 2004, at nearly 16 percent, and drops back to 14 percent in 2008, which is likely due to the economic recession of 2007 (NBER, n.d.). In 2012, the rate of attrition for leavers has dropped further to 6.53 percent while the rate of attrition for movers has climbed back up to 7.17 percent.

Next I examine how individual factors are associated with attrition and whether this has changed over time for select variables. Tables 3 through 7 present the multinomial logistic regression results for each category of attrition determinants for each wave and with all the waves pooled together, while Appendix Tables 3 through 7 present the marginal effect estimates from the same multinomial logistic regression models. The preferred specifications and focus of my analysis can be found in Table 8, where I present the saturated models of multinomial logistic regression estimates for each wave and with the pooled results. Appendix Table 8 provides the marginal effects from the main regression models. For these tables, panel A presents results for movers, and panel B presents results for leavers. Lastly, Table 9 presents the results for changes over time for select variables whose associations with attrition seem to have changed significantly from wave to wave. The directions and significance of the multinomial logistic regression models and the marginal effects are comparable for all the tables. I choose to present the multinomial logistic regression results as most studies on teacher attrition do.



Table 2. National rate of attrition for public school teachers

Teacher status	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Stayer	85.06	84.23	86.31	86.30	85.49
Mover	7.33	7.93	7.02	6.53	7.20
Leaver	7.61	7.83	6.67	7.17	7.31
Observations	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. Stayers are teachers who remain in the school where they taught in the previous year. Movers are teachers who remain in teaching but have moved to a different school. Leavers are teachers who left teaching. Observations have been rounded to the nearest 10 per IES compliance.

Table 3. Multinomial logistic regression estimates of the influence of teacher characteristics on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Young (<=28 years)	2.224** (10.07)	2.242** (9.90)	2.267** (9.38)	2.364** (9.21)	2.258** (19.10)
Female	1.147+ (1.73)	0.957 (-0.55)	0.888 (-1.47)	1.007 (0.08)	0.988 (-0.30)
Black	1.014 (0.09)	1.097 (0.65)	1.360+ (1.95)	1.573* (2.07)	1.234* (2.49)
Asian	1.161 (0.50)	0.853 (-0.77)	1.430 (1.15)	0.676 (-1.17)	0.956 (-0.32)
American Indian	0.944 (-0.25)	0.757 (-1.12)	0.862 (-0.46)	0.768 (-0.95)	0.823 (-1.36)
Hispanic	1.418* (2.24)	0.605* (-2.45)	0.897 (-0.55)	1.314 (1.51)	1.000 (0.00)
Prin-Tch gender congr	1.180* (2.31)	0.962 (-0.55)	1.153+ (1.88)	1.056 (0.68)	1.071+ (1.84)
Prin-Tch race congr	1.107 (1.04)	0.727** (-3.29)	0.737** (-2.88)	0.905 (-0.85)	0.844** (-3.23)
Panel B: Leavers					
Young (<=28 years)	1.577** (5.20)	1.200+ (1.84)	1.610** (4.93)	1.524** (4.13)	1.461** (7.89)
Female	1.071 (0.95)	0.853* (-2.15)	0.933 (-0.78)	1.058 (0.67)	0.969 (-0.79)
Black	1.138 (0.94)	1.425* (2.49)	1.310+ (1.76)	1.467* (2.01)	1.337** (3.61)
Asian	0.422** (-4.97)	0.845 (-0.89)	1.376 (1.15)	0.482* (-2.50)	0.713** (-2.64)
American Indian	0.962 (-0.19)	0.947 (-0.19)	0.928 (-0.35)	0.876 (-0.44)	0.955 (-0.35)
Hispanic	0.834 (-1.07)	0.800 (-1.04)	1.017 (0.08)	0.674* (-2.03)	0.812* (-2.09)
Prin-Tch gender congr	1.211** (2.78)	1.025 (0.35)	0.921 (-1.07)	1.043 (0.53)	1.049 (1.30)
Prin-Tch race congr	0.757** (-2.91)	0.881 (-1.21)	0.915 (-0.77)	0.750* (-2.50)	0.820** (-3.65)
N	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include state fixed effects; pooled models include state and wave fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance. +  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

**Teacher Characteristics.** Table 3 presents the multinomial logistic regression estimates of the influence of teacher characteristics variables on movers and leavers for each wave and then pooled. All models include state fixed effects that account for state-specific heterogeneity in the data. The point estimates are odds ratios where odds ratios higher than one indicate increases in the odds of attrition and odds ratios lower than one indicate decreases in the odds of attrition. For clarity, I choose to discuss the pooled results instead of the results for each wave, particularly since I generally observe that the associations between individual factors and attrition are comparable from wave to wave. For movers, I observe that young teachers are substantially more likely to move than teachers who are 29 years old or older. In terms of race/ethnicity, I observe that the odds of Black teachers to move from one school to another are 1.23 times as the odds of White teachers. Stated differently, the odds of moving from one school to another are increased by 23 percent for Black teachers compared to White teachers. In terms of race and gender congruence between teachers and principals, I observe no significance for gender congruence but race congruence is associated with a decrease in the odds of moving. In comparison, for leavers, young teachers are more likely to leave teaching than older teachers. On average, Black teachers are more likely to leave teaching while Asian teachers are less likely compared to White teachers. The odds of leaving the profession are also lower for teachers who have principals of the same race than those who do not. These results provide some initial insights that the factors influencing attrition are different for movers and leavers. As noted previously, the marginal effects from Appendix Table 3 provide similar conclusions. For instance, young teachers are 5.0 percentage points more likely to move and 2.1 percentage points more likely to leave than older teachers.

Table 4. Multinomial logistic regression estimates of the influence of teacher qualifications on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
PhD	1.539 (1.27)	3.469** (3.09)	1.225 (0.45)	0.908 (-0.23)	1.691* (2.43)
Master	0.940 (-0.84)	0.843* (-2.24)	1.023 (0.29)	1.188+ (1.93)	0.981 (-0.47)
Adv Grad Cert	0.924 (-0.25)	1.057 (0.23)	1.088 (0.32)	0.999 (-0.00)	1.020 (0.15)
Teach STEM subj	0.865 (-1.56)	0.727** (-3.53)	0.932 (-0.76)	0.947 (-0.57)	0.864** (-3.16)
Teach special ed	1.607** (4.58)	1.390** (3.44)	1.459** (3.46)	1.082 (0.69)	1.363** (5.87)
Standard/reg. cert	0.754** (-2.75)	0.670** (-3.45)	0.755* (-2.47)	0.844 (-1.36)	0.750** (-5.07)
New teachers	1.979** (6.88)	1.577** (3.76)	2.096** (6.40)	2.586** (8.61)	1.996** (12.20)
Panel B: Leavers					
PhD	1.598 (1.43)	0.855 (-0.48)	3.410** (3.50)	1.522 (1.15)	1.727** (3.03)
Master	1.055 (0.74)	1.033 (0.45)	0.998 (-0.02)	1.099 (1.08)	1.035 (0.89)
Adv Grad Cert	1.016 (0.07)	1.435+ (1.93)	1.096 (0.43)	0.772 (-1.00)	1.089 (0.77)
Teach STEM subj	1.044 (0.51)	0.934 (-0.74)	1.326** (2.67)	1.011 (0.12)	1.066 (1.35)
Teach special ed	1.156 (1.38)	1.107 (1.00)	1.430** (3.09)	1.152 (1.08)	1.196** (3.10)
Standard/reg. cert	0.741** (-3.15)	0.550** (-5.92)	0.687** (-3.37)	0.928 (-0.56)	0.696** (-6.79)
New teachers	1.418** (3.35)	1.221+ (1.85)	1.387** (2.85)	1.587** (3.76)	1.399** (6.00)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

**Teacher Qualifications.** Next I move on to teacher qualifications in Table 4. For movers, having graduate degrees significantly increase the odds of teachers moving. In particular, having a doctoral degree increases the odds of moving by 69 percent. In terms of specialty, teachers who teach STEM subjects are less likely to move, while special education teachers are more likely to move. Teachers with standard certification are less likely to move than those without standard certification. In terms of teaching experience, the odds of first time beginning teachers of moving are almost twice as high as more experience teachers. Similarly, teachers with doctoral degrees are more likely to leave teaching than those without graduate degrees. Special education teachers are both more likely to leave teaching than others. Having standard certification decreases the odds of teachers leaving by 30 percent, and new teachers are more likely to leave. Once again, I note that the factors that influence teachers moving may not have the same influence for leaving the profession.

**School Organizational Characteristics.** Moving on the school organizational characteristics, I observe that teachers who teach in urban and suburban schools are more likely to move (Table 5). Teachers who teach in larger schools and secondary schools are less likely to move. Interestingly, having union membership reduces the odds of moving by 25 percent. I also observe that better administrative support and teacher cooperation are both associated with decrease in the odds of moving. Increases in principal experience are associated with decreases in the odds of moving but the point estimate is very close to one. Surprisingly, teachers with principals who have graduate degrees compared to principals who do not are more likely to move. In terms of leaving the profession, similar to movers, teachers who teach at urban and suburban schools are more likely to leave than those who teach in rural schools. Likewise, larger schools and union membership are associated with decreases in odds of leaving, while secondary

teachers are slightly more likely to leave teaching than elementary teachers. One standard deviation increase in administrative support is associated with a decrease of 10 percent in the odds of leaving, while increases in student disciplinary problem increases the odds of leaving. Increases in principal effectiveness and experience are associated with decreases in the odds of leaving, while principal education does not seem to have a significant relationship with teacher attrition.

Table 5. Multinomial logistic regression estimates of the influence of school organizational characteristics on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Urban	1.106 (0.97)	1.154 (1.34)	1.143 (1.21)	1.351** (2.61)	1.193** (3.21)
Suburban	1.231* (2.43)	1.118 (1.24)	1.183* (1.97)	1.064 (0.69)	1.157** (3.35)
Enrollment per 1,000	0.728** (-4.57)	0.819** (-2.74)	0.814** (-2.83)	0.667** (-5.17)	0.762** (-7.37)
Union	0.808** (-2.61)	0.742** (-3.42)	0.732** (-3.17)	0.743** (-2.73)	0.754** (-6.00)
Secondary	0.800** (-3.24)	0.754** (-3.79)	1.004 (0.06)	1.007 (0.09)	0.878** (-3.49)
Combined elem/sec	0.787* (-2.22)	0.758* (-2.29)	0.873 (-1.42)	0.817 (-1.50)	0.810** (-3.45)
Admin support	0.856** (-3.45)	0.992 (-0.18)	0.895* (-1.99)	0.868** (-2.99)	0.906** (-4.09)
Teacher cooperation	0.834** (-4.89)	0.860** (-3.79)	0.843** (-4.44)	0.888** (-2.68)	0.855** (-7.82)
Student disc problem	1.010 (0.33)	1.043 (1.55)	0.970 (-1.05)	1.060* (2.08)	1.019 (1.32)
Principal effectiveness	1.033 (0.65)	0.979 (-0.43)	0.997 (-0.05)	0.978 (-0.42)	0.997 (-0.09)
Principal experience	0.986** (-3.04)	1.001 (0.22)	0.989+ (-1.84)	0.988* (-1.99)	0.991** (-3.24)
Principal has PhD	1.581 (1.22)	1.845* (2.02)	2.652** (3.02)	1.047 (0.11)	1.547* (2.18)
Principal has MA	1.506 (1.14)	1.706* (1.87)	3.135** (3.79)	0.949 (-0.13)	1.522* (2.19)
Panel B: Leavers					
Urban	1.408** (3.57)	1.312** (2.81)	1.095 (0.79)	1.516** (3.94)	1.328** (5.51)
Suburban	1.177+ (1.94)	1.228* (2.51)	0.985 (-0.16)	1.365** (3.57)	1.199** (4.19)
Enrollment per 1,000	0.818** (-3.55)	0.846** (-2.64)	0.978 (-0.31)	0.825** (-2.73)	0.859** (-4.59)
Union	0.828* (-2.35)	0.696** (-4.02)	0.776** (-2.58)	0.872 (-1.33)	0.783** (-5.17)
Secondary	1.026 (0.37)	1.153+ (2.00)	1.024 (0.28)	1.047 (0.57)	1.066* (1.68)
Combined elem/sec	1.055 (0.43)	1.001 (0.01)	1.145 (1.10)	0.927 (-0.54)	1.027 (0.43)
Admin support	0.880** (-3.04)	0.910* (-2.35)	0.913* (-1.99)	0.916+ (-1.73)	0.902** (-4.58)
Teacher cooperation	0.895** (-2.85)	1.003 (0.08)	0.978 (-0.51)	0.973 (-0.61)	0.963+ (-1.80)
Student disc problem	1.089** (3.34)	1.073** (3.46)	1.063* (2.46)	0.993 (-0.19)	1.059** (4.69)
Principal effectiveness	0.974 (-0.60)	0.978 (-0.48)	0.957 (-0.79)	0.850** (-2.72)	0.941* (-2.37)
Principal experience	0.994 (-1.28)	0.998 (-0.45)	0.989* (-1.99)	0.993 (-1.12)	0.993** (-2.67)
Principal has PhD	1.007 (0.02)	1.548+ (1.68)	1.531 (0.79)	1.117 (0.29)	1.224 (1.01)
Principal has MA	0.852 (-0.45)	1.427 (1.47)	1.206 (0.36)	0.798 (-0.63)	1.008 (0.04)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance. +  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

**School Resources and Student Body Characteristics.** In terms of the influences of school resources on teacher attrition, salary increases reduce the odds of moving and leaving for teachers, while the point estimate on expenditure per student is essentially one in both cases and the significance varies from year to year (Table 6). This lack of school resources variables is a limitation of this study. In terms of student body characteristics, most variables are either statistically insignificant or practically insignificant with point estimates being very close to one (Table 7).

Table 6. Multinomial logistic regression estimates of the influence of school resources on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Salary per \$1,000	0.968** (-11.22)	0.969** (-12.34)	0.973** (-9.29)	0.974** (-7.82)	0.971** (-20.03)
Salary satisfaction	0.996 (-0.11)	1.041 (1.10)	1.058 (1.42)	1.011 (0.27)	1.033 <sup>+</sup> (1.69)
Expenditure per student	1.000* (2.07)	1.000** (3.31)	1.000* (2.25)	1.000 (0.75)	1.000* (2.28)
Panel B: Leavers					
Salary per \$1,000	0.992** (-3.36)	0.991** (-3.24)	0.995 (-1.28)	1.001 (0.17)	0.995** (-3.56)
Salary satisfaction	0.999 (-0.01)	0.988 (-0.33)	1.061 (1.48)	0.979 (-0.46)	1.010 (0.50)
Expenditure per student	1.000* (2.10)	1.000 <sup>+</sup> (1.83)	1.000** (3.04)	1.000 (1.19)	1.000* (2.23)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Table 7. Multinomial logistic regression estimates of the influence of student body characteristics on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Percent FRPL	1.007** (4.27)	1.003 (1.51)	1.005** (2.64)	1.000 (-0.19)	1.003** (3.60)
Percent FRPL missing indicator	1.329 (1.63)	0.803 (-1.01)	1.042 (0.18)	0.744 (-1.21)	1.020 (0.18)
Percent minority	0.999 (-0.40)	1.004+ (1.80)	1.004+ (1.73)	1.004+ (1.85)	1.003** (2.66)
Majority Black/Hispanic students	1.011 (0.08)	0.867 (-0.96)	0.837 (-1.10)	1.218 (1.24)	0.966 (-0.44)
Percent IEP	0.991* (-2.48)	1.004+ (1.84)	1.000 (-0.05)	1.001 (0.23)	1.000 (0.23)
Percent LEP	1.001 (0.19)	0.999 (-0.32)	0.999 (-0.41)	0.999 (-0.14)	1.000 (-0.25)
Panel B: Leavers					
Percent FRPL	1.001 (0.42)	0.999 (-0.63)	1.001 (0.35)	0.997 (-1.57)	0.999 (-0.67)
Percent FRPL missing indicator	1.166 (1.02)	1.161 (0.86)	1.151 (0.47)	0.938 (-0.27)	1.119 (1.16)
Percent minority	1.005* (2.12)	1.008** (3.75)	1.007** (2.86)	1.009** (3.73)	1.007** (6.21)
Majority Black/Hispanic students	0.974 (-0.19)	1.009 (0.06)	0.972 (-0.19)	0.907 (-0.65)	0.971 (-0.40)
Percent IEP	1.004 (1.06)	0.997 (-0.86)	1.002 (0.93)	1.000 (-0.05)	1.000 (-0.00)
Percent LEP	1.002 (0.73)	0.994 (-1.51)	0.996 (-0.97)	0.999 (-0.23)	0.997 (-1.25)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$



Table 8. Saturated models of multinomial logistic regression estimates of the determinants of movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Young (<= 28 years)	1.497** (4.17)	1.536** (4.31)	1.608** (4.41)	1.707** (4.59)	1.589** (8.80)
Female	0.934 (-0.80)	0.823* (-2.28)	0.826* (-2.19)	0.876 (-1.52)	0.863** (-3.40)
Black	0.864 (-0.93)	0.993 (-0.05)	1.233 (1.28)	1.326 (1.25)	1.098 (1.07)
Asian	1.165 (0.50)	0.818 (-0.94)	1.448 (1.21)	0.619 (-1.43)	0.930 (-0.51)
American Indian	0.888 (-0.50)	0.670 (-1.54)	0.837 (-0.54)	0.697 (-1.24)	0.767+ (-1.80)
Hispanic	1.278 (1.51)	0.552** (-2.68)	0.842 (-0.86)	1.197 (0.94)	0.923 (-0.82)
Princ-Tch gender congruence	1.113 (1.47)	0.914 (-1.28)	1.125 (1.54)	1.005 (0.06)	1.021 (0.54)
Princ-Tch race congruence	1.197+ (1.81)	0.772** (-2.64)	0.811* (-2.00)	0.968 (-0.28)	0.914+ (-1.71)
PhD	1.848+ (1.71)	4.377** (3.87)	1.245 (0.44)	1.122 (0.28)	2.009** (3.20)
Master	1.280** (3.11)	1.131 (1.52)	1.286** (2.89)	1.431** (3.87)	1.260** (5.41)
Adv Grad Cert	1.125 (0.36)	1.309 (1.11)	1.220 (0.75)	1.093 (0.37)	1.177 (1.24)
Teach STEM subjects	0.981 (-0.19)	0.790** (-2.58)	0.956 (-0.48)	0.995 (-0.05)	0.928 (-1.59)
Teach special ed	1.612** (4.57)	1.378** (3.22)	1.527** (3.85)	1.092 (0.76)	1.374** (5.91)
Standard/reg. cert	0.873 (-1.34)	0.835 (-1.59)	0.847 (-1.45)	0.944 (-0.46)	0.874* (-2.38)
New teacher	1.310* (2.46)	1.067 (0.53)	1.398** (2.71)	1.630** (3.85)	1.312** (4.42)
Urban	1.145 (1.20)	1.056 (0.47)	1.080 (0.66)	1.225 (1.55)	1.117+ (1.83)
Suburban	1.369** (3.52)	1.164 (1.60)	1.269** (2.58)	1.039 (0.42)	1.196** (3.97)
Enrollment per 1,000 students	0.777** (-3.70)	0.865+ (-1.95)	0.857* (-2.05)	0.680** (-4.65)	0.797** (-5.98)
Union	0.918 (-1.02)	0.839* (-2.01)	0.814* (-2.01)	0.818+ (-1.79)	0.844** (-3.52)
Secondary	0.843* (-2.15)	0.737** (-3.75)	1.021 (0.25)	0.956 (-0.55)	0.871** (-3.42)
Combined	0.826 (-1.64)	0.647** (-3.31)	0.829+ (-1.72)	0.736* (-2.03)	0.744** (-4.35)
Admin support	0.840** (-3.85)	0.973 (-0.62)	0.888* (-2.13)	0.835** (-3.87)	0.885** (-5.02)
Teacher cooperation	0.874** (-3.57)	0.887** (-3.04)	0.861** (-3.83)	0.919+ (-1.91)	0.884** (-6.14)
Student disc problem	0.995 (-0.17)	1.017 (0.56)	0.938* (-2.07)	1.047 (1.60)	0.998 (-0.16)
Principal effectiveness	0.991 (-0.18)	0.955 (-0.91)	0.965 (-0.61)	0.964 (-0.71)	0.971 (-1.12)
Principal experience	0.989* (-0.18)	1.003 (-0.91)	0.991 (-0.61)	0.989+ (-0.71)	0.993* (-1.12)

	(-2.26)	(0.63)	(-1.48)	(-1.87)	(-2.45)
Principal has MA	1.752	1.933*	2.737**	1.056	1.677*
	(1.47)	(2.21)	(3.00)	(0.13)	(2.56)
Principal has PhD	1.643	1.736*	3.242**	0.976	1.625*
	(1.35)	(1.96)	(3.73)	(-0.06)	(2.50)
Salary per \$1,000	0.972**	0.972**	0.977**	0.977**	0.975**
	(-7.94)	(-9.55)	(-6.15)	(-5.75)	(-14.31)
Salary satisfaction	1.035	1.073 <sup>+</sup>	1.094 <sup>+</sup>	1.067	1.073**
	(0.89)	(1.92)	(2.21)	(1.53)	(3.60)
Disc exp for educ	1.000	1.000*	1.000	1.000	1.000 <sup>+</sup>
Per \$1,000,000	(1.08)	(2.26)	(0.73)	(-0.07)	(1.71)
Percent FRPL	1.005*	1.000	1.004 <sup>+</sup>	0.997 <sup>+</sup>	1.001
	(2.43)	(-0.05)	(1.87)	(-1.80)	(0.75)
Percent FRPL missing indicator	1.315	0.861	1.040	0.683	1.013
	(1.53)	(-0.65)	(0.17)	(-1.48)	(0.11)
Percent minority	1.002	1.006*	1.004	1.005 <sup>+</sup>	1.004**
	(0.61)	(2.35)	(1.34)	(1.68)	(3.16)
Majority Black/Hispanic students	0.967	0.805	0.841	1.113	0.930
	(-0.23)	(-1.45)	(-1.08)	(0.64)	(-0.92)
Percent IEP	0.988**	1.005 <sup>+</sup>	0.999	0.999	1.000
	(-2.96)	(1.72)	(-0.42)	(-0.27)	(-0.18)
Percent LEP	0.999	0.999	0.999	0.999	0.999
	(-0.35)	(-0.26)	(-0.36)	(-0.21)	(-0.47)
Panel B: Leavers					
Young (<= 28 years)	1.370**	0.894	1.449**	1.436**	1.244**
	(2.81)	(-0.93)	(3.05)	(2.86)	(3.65)
Female	1.086	0.857 <sup>+</sup>	0.971	0.999	0.971
	(1.05)	(-1.93)	(-0.31)	(-0.01)	(-0.70)
Black	1.008	1.157	1.085	1.304	1.138
	(0.06)	(0.97)	(0.52)	(1.45)	(1.56)
Asian	0.407**	0.816	1.272	0.476*	0.688**
	(-5.08)	(-1.07)	(0.84)	(-2.54)	(-2.89)
American Indian	0.941	0.870	0.862	0.781	0.907
	(-0.30)	(-0.50)	(-0.65)	(-0.78)	(-0.74)
Hispanic	0.757	0.675 <sup>+</sup>	0.918	0.642*	0.744**
	(-1.63)	(-1.93)	(-0.43)	(-2.18)	(-2.94)
Princ-Tch gender congruence	1.215**	1.007	0.920	1.008	1.034
	(2.76)	(0.10)	(-1.08)	(0.10)	(0.88)
Princ-Tch race congruence	0.839 <sup>+</sup>	0.991	1.035	0.838	0.916
	(-1.89)	(-0.09)	(0.30)	(-1.61)	(-1.62)
PhD	1.518	0.849	3.419**	1.516	1.698**
	(1.24)	(-0.50)	(3.49)	(1.14)	(2.93)
Master	1.140 <sup>+</sup>	1.077	1.026	1.090	1.073 <sup>+</sup>
	(1.71)	(0.95)	(0.30)	(0.94)	(1.67)
Adv Grad Cert	1.022	1.533*	1.097	0.759	1.105
	(0.09)	(2.27)	(0.42)	(-1.06)	(0.90)
Teach STEM subjects	1.063	0.897	1.297*	1.023	1.062
	(0.69)	(-1.12)	(2.29)	(0.24)	(1.21)
Teach special ed	1.098	1.133	1.441**	1.166	1.198**
	(0.86)	(1.19)	(3.14)	(1.21)	(3.09)
Standard/reg. cert	0.782*	0.592**	0.726**	0.979	0.737**
	(-2.54)	(-5.17)	(-2.86)	(-0.16)	(-5.64)
New teacher	1.174	1.212	1.163	1.412*	1.242**
	(1.30)	(1.59)	(1.15)	(2.40)	(3.36)
Urban	1.265*	1.041	0.933	1.306*	1.117*
	(2.36)	(0.38)	(-0.58)	(2.28)	(2.00)

Suburban	1.161 <sup>+</sup> (1.67)	1.208 <sup>*</sup> (2.22)	0.968 (-0.34)	1.273 <sup>**</sup> (2.72)	1.154 <sup>**</sup> (3.24)
Enrollment per 1,000 students	0.828 <sup>**</sup> (-3.24)	0.849 <sup>*</sup> (-2.41)	0.969 (-0.43)	0.798 <sup>**</sup> (-2.95)	0.852 <sup>**</sup> (-4.60)
Union	0.866 <sup>+</sup> (-1.80)	0.726 <sup>**</sup> (-3.56)	0.805 <sup>*</sup> (-2.21)	0.883 (-1.21)	0.808 <sup>**</sup> (-4.48)
Secondary	1.064 (0.80)	1.108 (1.29)	0.958 (-0.43)	1.044 (0.50)	1.053 (1.24)
Combined	1.001 (0.01)	1.001 (0.01)	1.036 (0.29)	0.918 (-0.53)	1.000 (0.01)
Admin support	0.875 <sup>**</sup> (-3.16)	0.908 <sup>*</sup> (-2.42)	0.908 <sup>*</sup> (-2.10)	0.906 <sup>+</sup> (-1.94)	0.898 <sup>**</sup> (-4.76)
Teacher cooperation	0.916 <sup>*</sup> (-2.24)	1.027 (0.69)	0.987 (-0.29)	0.986 (-0.31)	0.979 (-1.01)
Student disc problem	1.077 <sup>**</sup> (2.97)	1.062 <sup>**</sup> (2.76)	1.046 <sup>+</sup> (1.79)	0.985 (-0.43)	1.046 <sup>**</sup> (3.64)
Principal effectiveness	0.953 (-1.08)	0.960 (-0.90)	0.940 (-1.10)	0.843 <sup>**</sup> (-2.87)	0.927 <sup>**</sup> (-2.90)
Principal experience	0.997 (-0.58)	1.000 (0.07)	0.990 <sup>+</sup> (-1.79)	0.994 (-0.96)	0.995 <sup>*</sup> (-1.98)
Principal has MA	0.976 (-0.06)	1.665 <sup>*</sup> (1.99)	1.582 (0.87)	1.090 (0.23)	1.245 (1.10)
Principal has PhD	0.844 (-0.47)	1.508 <sup>+</sup> (1.74)	1.269 (0.46)	0.812 (-0.59)	1.042 (0.22)
Salary per \$1,000	0.995 <sup>+</sup> (-1.74)	0.994 <sup>+</sup> (-1.83)	1.000 (0.10)	1.002 (0.39)	0.998 (-1.41)
Salary satisfaction	1.044 (1.16)	1.005 (0.13)	1.078 <sup>+</sup> (1.81)	1.039 (0.80)	1.042 <sup>*</sup> (1.98)
Disc exp for educ Per \$1,000,000	1.000 (0.34)	1.000 (0.09)	1.000 <sup>*</sup> (2.02)	1.000 (0.56)	1.000 (1.25)
Percent FRPL	1.000 (0.01)	0.999 (-0.60)	1.001 (0.43)	0.997 <sup>+</sup> (-1.70)	0.999 (-0.95)
Percent FRPL missing indicator	1.164 (1.00)	1.070 (0.38)	1.100 (0.30)	0.972 (-0.12)	1.085 (0.83)
Percent minority	1.003 (1.09)	1.008 <sup>**</sup> (3.42)	1.005 <sup>*</sup> (2.17)	1.007 <sup>*</sup> (2.37)	1.006 <sup>**</sup> (4.70)
Majority Black/Hispanic students	0.955 (-0.33)	0.998 (-0.02)	0.977 (-0.15)	0.898 (-0.70)	0.966 (-0.46)
Percent IEP	1.002 (0.58)	0.995 (-1.18)	1.000 (-0.09)	0.998 (-0.75)	0.998 (-1.06)
Percent LEP	1.004 (1.18)	0.996 (-1.05)	0.997 (-0.66)	1.000 (-0.09)	0.999 (-0.61)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

<sup>+</sup>  $p < 0.10$ , <sup>\*</sup>  $p < 0.05$ , <sup>\*\*</sup>  $p < 0.01$

**Saturated Models.** In general, the estimates from Tables 3 through 7 provide some useful insights into how individual factors are associated with teacher attrition and how individual factors can have differential effects for movers and leavers. In some ways, these partially conditional models provide a clean picture of how individual factors in each category of teacher attrition determinant is related to teacher attrition. The concern, however, is that there is likely to be omitted variable bias in each model. In other words, the relationship between a factor and an attrition outcome may be biased when other factors that co-vary with both the factor and the outcome are not included in the model. To alleviate this concern of omitted variable bias, I employ a saturated model where I include all the factors that have been included in individual models thus far (Table 8). To be clear, these models are my preferred specifications. In order to keep the discussion crisp and focused, I will discuss only select variables in the pooled model.

For movers, in terms of teacher characteristics, young teachers are still substantially more likely to move than older teachers (Panel A of Table 8). Female becomes statistically significant in the pooled model, but its significance varies from wave to wave. On the other hand, Black teachers are no longer more likely to move compared to White teachers. Interestingly, principal-teacher race congruence becomes insignificant in the pooled model once other factors are controlled for, but it remains significant for two of the four waves. In terms of teacher qualifications, teachers with doctoral degrees remain more likely to move compared to teachers without graduate degrees, but once again, this appears to be driven largely by the 2004 wave. Teachers with master degrees remain more likely to move than teachers without graduate degrees. STEM teachers are not more likely to move while special education teachers are more likely to move. Having a standard certification remains significant and practically meaningful in

reducing the odds of attrition. In particular, having a standard certification reduces the odds of switching schools by 13 percent even when I control for a host of other factors.

In terms of school organizational characteristics, urban teachers are not more likely to switch schools and suburban teachers remain more likely to switch schools compared to rural teachers. The odds of teachers moving schools for teachers with union membership are reduced by 16 percent. Administrative support and teacher cooperation remain significant in reducing the odds of teachers moving schools. For school resources, salary increase remains significant in reducing the odds of moving. Finally, as before the factors in student body characteristics are not highly associated with teachers moving schools or the point estimates are not practically different than 1. Next, I discuss how these factors influence the odds of teachers leaving the profession.

For teachers leaving the profession (Panel B of Table 8), young teachers are similarly likely to leave teaching as before. Female teachers are not observed to be more likely to leave teaching. Once other factors are controlled for, Black teachers are no longer more likely to leave teaching than White teachers. On the other hand, both Asian and Hispanic teachers are less likely to leave teaching than White teachers. Similar for movers, principal-teacher race congruence becomes insignificant once I control for other variables. In terms of teacher qualifications, the odds of teachers leaving the profession are increased by 70 percent for teachers with doctoral degrees. However, this finding is likely to be due to the 2008 wave where the odds ratios of teachers with doctoral degrees are three times as large compared to teachers without graduate degrees. This could have been driven by the economic recession of 2007. In terms of specialty, special education teachers are more likely to leave teaching even when I control for a host of

other factors. Similar to the finding for movers, having standard certification greatly reduces the odds of leaving the profession.

In terms of school organizational characteristics, both urban and suburban teachers are more likely to leave teaching than rural teachers. As before, union teachers are less likely to leave teaching. In terms of administrative support, the odds of leaving the profession are reduced by 10 percent for one standard deviation increase in administrative support. Unlike the odds of teachers switching schools the relationship between teacher cooperation and leaving the profession is not significant. On the other hand, increases in student disciplinary problem are associated with increases the odds of leaving the profession, while principal effectiveness is associated with reduction in the odds of leaving. For school resources, salary increase remains significant in reducing the odds of leaving. Surprisingly increases in salary satisfaction are associated with increased odds of teachers leaving. However, this finding is not consistent between waves and the point estimate is fairly close to one; this finding in the pooled could be significant due to the overpowered sample size that makes even small differences seem significant. As before, student body characteristics do not seem to have significant relationships with teacher attrition.

One of the contributions and strengths of this study is that I am able to observe whether a factor's relationship with attrition changes over time or if a significant finding is limited to particular years. As observed and noted previously, there are some factors whose influences on attrition seem to have changed over time (Table 8). For instance, having a doctoral degree increases the odds of moving for teachers in the 2004 wave but is insignificant in other waves. Likewise, principal-teacher race congruence comes in and out of significance and in the 2000 wave, it even reverses direction and interpretation compared to the latter waves. To test whether

the influences of select factors are changing over time, I interact them with time in the saturated pooled model. The multinomial logistic regression results (columns 1 and 2) and the marginal effects results (columns 3 and 4) are presented in Table 9.

**Changes Over Time.** The results in Table 9 indicate that there may have been a shift in whether female teachers move or leave teaching in comparison to male teachers over time. Relative to the 2000 wave, female teachers are less likely to leave teaching in the 2004 wave and are marginally less likely to move schools in the 2008 wave. This shift in attrition by gender in recent years has also been found in other studies (see Chapters II). In terms of race/ethnicity, I do not observe any significant changes in attrition for Black teachers over time. I do see that Asian teachers are significantly more likely to leave teaching in the 2008 wave than in the 2000 wave. Hispanic teachers, on the other hand, are significantly less likely to switch schools in the 2004 wave compared to the 2000 wave; this trend continues to the 2008 wave but the result is only marginally significant. Moving on to the principal-teacher race congruence, in comparison to the 2000 wave, principal-teacher race congruence significantly reduces the odds of teachers switching schools in the 2004 and 2008 waves and these results are highly significant. However, this relationship is not significant for reducing the odds of teachers leaving the profession. For teachers with doctoral degrees, there is a marginally significant increase in the odds of teachers leaving the profession in the 2008 wave relative to the 2000 wave. Lastly, I observe STEM teachers are marginally less likely to move in the 2004 wave compared to the 2000 wave. For special education teachers, they are less likely to switch schools in the 2012 wave compared to the 2000 wave.

Table 9. Changes over time for select variables (saturated pooled models)

Interactions	Multinomial Logit		Marginal Effects	
	Movers	Leavers	Movers	Leavers
Female * 2004	0.875 (-1.22)	0.800* (-2.26)	-0.007 (-1.08)	-0.014* (-2.18)
Female * 2008	0.813+ (-1.90)	0.924 (-0.73)	-0.012+ (-1.86)	-0.004 (-0.60)
Female * 2012	0.922 (-0.71)	1.011 (0.10)	-0.005 (-0.72)	0.001 (0.15)
Black * 2004	1.010 (0.05)	1.204 (1.01)	-0.000 (-0.02)	0.012 (1.02)
Black * 2008	1.326 (1.36)	1.144 (0.71)	0.016 (1.32)	0.007 (0.61)
Black * 2012	1.421 (1.36)	1.306 (1.23)	0.019 (1.28)	0.016 (1.12)
Asian * 2004	0.893 (-0.35)	1.614* (2.08)	-0.009 (-0.46)	0.032* (2.12)
Asian * 2008	1.307 (0.70)	2.641** (3.22)	0.011 (0.51)	0.062** (3.16)
Asian * 2012	0.595 (-1.24)	0.841 (-0.55)	-0.030 (-1.22)	-0.009 (-0.44)
Hispanic * 2004	0.439** (-3.35)	0.905 (-0.39)	-0.048** (-3.35)	-0.003 (-0.17)
Hispanic * 2008	0.663+ (-1.76)	1.161 (0.61)	-0.025+ (-1.81)	0.011 (0.72)
Hispanic * 2012	0.966 (-0.16)	0.951 (-0.21)	-0.002 (-0.14)	-0.003 (-0.20)
Prin-Tch race congr * 2004	0.674** (-3.04)	1.191 (1.33)	-0.024** (-3.15)	0.013 (1.54)
Prin-Tch race congr * 2008	0.686** (-2.74)	1.251 (1.64)	-0.023** (-2.88)	0.016+ (1.83)
Prin-Tch race congr * 2012	0.831 (-1.31)	0.970 (-0.22)	-0.011 (-1.30)	-0.001 (-0.13)
PhD * 2004	2.403+ (1.69)	0.525 (-1.40)	0.054+ (1.79)	-0.046 (-1.53)
PhD * 2008	0.737 (-0.51)	2.307+ (1.76)	-0.021 (-0.61)	0.056+ (1.81)
PhD * 2012	0.590 (-0.96)	0.966 (-0.07)	-0.031 (-0.96)	0.000 (0.00)
Spec Ed * 2004	0.886 (-0.86)	1.020 (0.13)	-0.007 (-0.88)	0.002 (0.19)
Spec Ed * 2008	0.954 (-0.31)	1.279 (1.58)	-0.004 (-0.44)	0.016 (1.60)
Spec Ed * 2012	0.687* (-2.41)	0.986 (-0.09)	-0.022* (-2.41)	0.001 (0.07)
STEM * 2004	0.802+ (-1.66)	0.856 (-1.23)	-0.012 (-1.58)	-0.009 (-1.12)
STEM * 2008	1.039 (0.29)	1.241 (1.59)	0.001 (0.17)	0.014 (1.58)
STEM * 2012	1.070 (0.50)	0.977 (-0.18)	0.004 (0.52)	-0.002 (-0.22)
Observations	139,170		139,170	

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$



**Robustness checks.** In addition to providing the marginal effects from the multinomial logistic regression results in Appendix Tables 3 through 8, I also assess the robustness of the findings with respect to the use of weights to make the results nationally representative. Since the SASS nationally representative sampling frame includes charter schools, there may be concerns that the exclusion of charter schools in the sample would not then strictly be nationally representative. Charter schools are excluded because they operate very differently in many ways than traditional public schools and I would not expect teachers to be influenced by various factors in the same way at charter and traditionally public schools. However, to alleviate the concerns that the findings are not truly nationally representative, I included charter schools in the sample in a set of separate models. For parsimony, I do not replicate all the previous tables with charter schools included. I do provide the descriptive statistics for all public schools including charter schools as well as the saturated models in Appendix Tables 2 and 9 respectively. These results are nearly identical to the results using only traditional public schools. As a further check of how robust my findings are, I also run a set of models without the use of any weights using only traditional public schools. I have presented the results of these saturated models without weights in Appendix Table 10. These results are substantively similar to the main findings as well as the saturated models using both traditional public and charter schools.

## **Discussion and Conclusion**

By studying a set of characteristics at a time and for each wave, and with all the characteristics and waves pooled together, I am able to see some interesting patterns. One of the most apparent conclusions is that the exclusion of a rich set of covariates in prior studies is likely to result in biased findings. For instance, principal-teacher race congruence seems to be an

important factor that influences teachers leaving the profession in the naïve models (Table 3), but it becomes largely insignificant and close to 1 once I include other covariates that also influence attrition (Table 8). Thus, having a rich set of covariates mitigates some concerns that results may be biased due to the omission of important variables.

Moreover, as the data include multiple waves of SASS instead of a single wave, I am able to examine whether a significant relationship between a variable and attrition is wave-sensitive or if the relationship is consistent over time. For instance, in the 2000 wave principal-teacher gender congruence seems to significantly increase the odds of teachers switching schools as well as teacher leaving the profession (Table 3). If we used only this single wave of SASS, we may have come to the likely incorrect conclusion that principal-teacher gender congruence increases odds of teacher turnover when this relationship seems to be rather insignificant across other years, particularly when we pool the waves together (Model 5 of Table 3 and Model 5 of Table 8). Thus, having multiple waves of SASS reduces the likelihood that we make conclusions based on findings that may have happened by chance or are idiosyncratic to a particular year.

In terms of how we study teacher turnover, we have seen that it is important to separate turnover into movers and leavers as the factors that influence movers are not always the same as the factors that influence leavers. Moreover, as the majority of studies on teacher attrition focuses on teachers leaving the profession and much less on teachers switching schools (e.g., Goldhaber, Lavery, & Theobald, 2016; Grissom, Nicholson-Crotty, & Keiser, 2012; Jackson, 2007; Kukla-Acevedo, 2009), this study provides a novel and more thorough insights into what drives teachers to leave their current school but remain in teaching and what drives teachers to leave the teaching profession altogether.

Consequently, I focus my discussion on the factors that influence movers and leavers in the saturated models in Table 8. In this section, I discuss how some results that bolster prior findings and others that are different or novel. To start, I find that new teachers are substantially more likely to switch schools and to leave teaching all together (Boe et al., 1998; Clotfelter, 2011; Imazeki, 2005).<sup>19</sup> In contrast to some older studies (Adams, 1996; Boe et al., 1998; Kelly, 2004) and in agreement with newer studies (Barbieri, 2011; Boyd, 2011; Grissom, 2012), female teachers are not more likely to leave teaching than male teachers. However, female teachers are less likely to move schools. In terms of race/ethnicity, as we are able to separate minority teachers into their respective race/ethnicity, I find, in contrast to prior works (Borman & Dowling, 2008; Guarino, Santibañez, & Daley, 2006), that not all minority teachers are more likely to stay in teaching. Moreover, I do find Hispanic teachers are less likely to leave teaching than White teachers in the pooled model (Adams, 1996; Kukla-Acevedo, 2009; Moore, 2011; Newton, 2011; Sass et al., 2012; Yesil, 2012). In terms of teacher-principal race/gender congruence, I observe that congruence does not seem to play a consistent role in reducing the odds of moving or leaving as prior literature suggests (Grissom, 2012; Grissom & Keiser, 2011; Harris, 2007). One explanation is omitted variable bias, which I have discussed previously, and another is that the prior results may have been idiosyncratic to a particular time and place and they may not generalizable to other context or be nationally representative.

In terms of teacher qualifications, I find that only teachers with doctoral degrees are more likely to leave teaching and move schools while teachers with masters degrees are more likely to move schools relative to teachers without graduate degrees, which adds some evidence to the mixed findings in the literature (Djonko-Moore, 2016; Harrell et al., 2004; Imazeki, 2005; Kelly & Northrop, 2015; Newton, 2011; Ondrich, 2008). I find special education teachers are more

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<sup>19</sup> The findings are comparable when young teachers are operationalized as 30 years of age or younger.

likely to leave teaching in the pooled models as prior studies do (Grissmer & Kirby, 1992; Imazeki, 2005; Ingersoll, 2001; Jackson, 2012; Smith, 2007) and special education teachers are consistently more likely to switch schools than other teachers. These results bolster the prior findings on the difficulty of retaining special education teachers (Billingsley, 2004, 2007; Ingersoll, 2001). Similar to many other studies, I find that teachers with standard certification are much less likely to leaving (Harris-Mcintyre, 2015; Helms-Lorenz, 2016; Ingle, 2009; Johnson, 2003; Kelly, 2004; Luke, 2014; Newton, 2011); additionally, I also find they are less likely to move schools.

In terms of school organizational characteristics, as with recent studies I find teachers at urban schools are not consistently more likely to leave teaching than rural teachers (Bradley, Green, & Leeves, 2006; Donaldson & Johnson, 2010; Imazeki, 2005; Jackson, 2012; Kelly, 2004; Moore, 2011; Smith, 2007), and they are not more likely to switch schools as rural teachers. Unlike some studies that find null results (Mont & Rees, 1996; Kelly, 2004; Imazeki, 2005; Goldhaber, Cross, & Player, 2011; Jones, 2011), I find teachers at larger schools are less likely to leave as well as move. In terms of union membership, there is strong evidence that teachers who belong to unions are less likely to leave and move schools (Kelly, 2015; Kukla-Acevedo, 2009; Moore, 2011; Redding & Smith, 2016). Likewise, teachers who experience positive administrative support (Boyd et al., 2011; Brown & Wynn, 2007; Eller, Doerfler, & Meier, 2000; Ingersoll, 2001; Luke, 2014; Smith, 2007; Urick, 2016), more effective or experienced principals (Beteille, 2009; Grissom, 2011), and less student disciplinary problems (Djonko-Moore, 2016; Ingersoll, 2012; Kelly, 2004; Kraft, 2016) are more likely to stay in teaching. Along a similar line, I also find teachers who experience these positive school conditions are also less likely to switch.

Lastly, in terms of school resources and student body characteristics, teachers with higher salary are less likely to leave or move (Bradley, Green, & Leeves, 2006; Clotfelter, 2011; Dolton, 1999; Scafidi, 2007; Stinebrickner, 1998, 1999, 2002). An anomalous result is that teachers who report higher level of satisfaction are more likely to leave and switch schools in the 2008 year. While some studies find that teachers are more likely to leave high minority schools than low minority schools (Hahs-Vaughn, 2008; Yesil, 2012), my results are in agreement with many studies that, once other confounding variables are accounted for, increases in minority students do not seem to be highly associated with teacher attrition (Boyd et al., 2011; Feng, 2009; Hanushek, Kain, & Rivkin, 2004; Goldhaber, Gross, & Player, 2011; Gritz & Theobald, 1996; Imazeki, 2005; Ingel, 2009; Kelly & Northrop, 2015; Loeb, Darling-Hammond, & Luczak, 2005; Newton, 2011; Smith, 2007).

In terms of changes over time, female teachers are less likely to leave teaching than male teachers in 2004 relative to 2000 and they are not more likely to leave teaching in the later waves, which reflects findings from a previous and a current meta-analysis on teacher attrition and retention (Borman & Dowling, 2008; Nguyen, 2018 [Chapter III]). In terms of principal-teacher race congruence, this matching seems to reduce the odds of teachers switching schools in 2004 and 2008 relative to the 2000 wave, but this influence becomes insignificant in the 2012 wave, and as noted previously, it is insignificant in the pooled model. Lastly, teachers with doctoral degree are much more likely to leave teaching in 2008, possibly due to the 2007 economic recession; this effect may have been alleviated in the intervening years since, by 2012, this relationship has become insignificant again.

This study also has policy implications for several areas concerning recruitment and attrition. First, efforts to recruit minority teachers, particularly Hispanic teachers, may improve

teacher retention as the retention rate for minority teachers are at least as high as White teachers. In terms of specialty and qualifications, we need to consider how to better support special education teachers as they are more likely to leave teaching than other teachers. Better administrative support, teacher cooperation and principal effectiveness, especially targeted at specialty teachers, may help to retain more qualified and high-demand teachers. Relatedly, we should consider how to provide more opportunities or more appealing opportunities for teachers with graduate education, particularly with doctoral degrees, to retain them in teaching roles. Lastly, policy makers need to take into account how standard certification and union membership greatly reduce the odds of teacher turnover, as measured by either switching schools or leaving the profession.

In conclusion, this paper makes several contributions to the study of teacher attrition and retention. First, the use of longitudinal nationally representative data instead of short-term district- or state-level data to study teacher turnover provides a more thorough picture of turnover nationally and over time. Second, the data from SASS have detailed comprehensive information on teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics, which is ideal in studying how these factors influence teacher turnover as it alleviates some concerns of omitted variable bias. Third, I am able to differentiate between movers and leavers, and I find that factors that influence movers may not influence leavers and vice versa, which substantially adds to the empirical knowledge of the factors of teacher attrition and retention. Fourth, I find that, while the influences of most factors remain stable through time, there are some variables whose influences have changed over the twelve-year time frame.

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\* denotes primary studies used in meta-analysis

~ denotes studies used in systematic review

## APPENDIX A

### Chapter II Appendix

Appendix Table 1: Coding and descriptions of determinants

Determinant	Description/Coding
<b>Teacher characteristics</b>	
Age	Continuous, age<28, age<30, others
Gender	Male vs. Female
Race	Black, Hispanic, non-White vs. White
Marital status	Married vs. non-married
Having a new child	New child vs. no new child
Number of kids	Number of kids
Career satisfaction	Teacher's satisfaction with their job
Full time teaching	Full time vs. part time teaching
Distance to school	Distance from house to school
<b>Teacher qualifications</b>	
Ability/achievement	Teacher's ability (SAT/ACT/rank quartile)
Training: grad vs non grad	Degree (MA/PhD) vs. non-graduate degree/BA
Training programs	National Board, Teaching Fellow/TFA, NCLB
Standard certification	Certification (traditional/regular) vs. no cert.
Specialty area	STEM/special ed vs. regular
Years of teaching experience	Teaching experience (continuous measure)
New teacher	Less than 3 years of exp v. 3 or more years
<b>School organizational characteristics</b>	
School size	Large vs. small schools; school enrollment
Urbanicity	Urban vs. rural schools
School level	Secondary vs. elementary; high school/middle schools vs. elementary schools
School sector	Charter/private vs. traditional public
Work environment	Facilities, teaching assignments, school issues
Disciplinary	Student disciplinary problem
Administrative support	Measures of administrative support; teachers have regular supportive communication with administrators
Collaboration	Teacher collaboration/network of teachers
Leadership	Levels of teacher leadership/influence
Professional development	Measures of professional development; quality of professional development
Induction/Mentoring program	Participation in induction/mentoring program
Classroom autonomy	Levels of classroom autonomy
Stay ratio	Teacher retention rate at the school
<b>School resources</b>	
Expenditure for support per teacher	Expenditure for support per teachers (in dollar amount)

Class size	Teacher's average class size
Classroom assistant	Has a teacher aid/assistant vs. none
Teaching materials	Has adequate teaching materials
<b>Student body characteristics</b>	
Student achievement	Measures of average student achievement
Percent minority students	School-level percent of Black, Hispanic, or minority
Percent FRPL	School-level percent of free and reduced price lunch
Poverty	Majority of school is in low socio-economic status
Percent IEP/LEP	School-level percent of individualized education program (IEP) or limited English proficiency (LEP)
<b>Relational demography</b>	
Teacher-principal race/gender matching	Race and gender matching between teacher and principal
Teacher-student race matching	Race matching between students and teacher
<b>Accountability</b>	
Assessment impact	Effect of assessment impact, classroom observation and other evaluations
Teacher effectiveness score	Teacher effectiveness score from value-added measures; high vs. low teacher effectiveness
Principal effectiveness score	Principal effectiveness from school-level value-added measures; other measures of principal effectiveness
Merit pay program	Impact of merit pay programs
<b>School improvement</b>	
School reform	Participation in some school reform such as Success for All
Research-practice partnership	Participation in a research-practice partnership
<b>Work Force</b>	
Employment rate	Overall employment rate in the state or district
Late hiring	Teachers hired late in the academic year
Teacher salary	Salary (in dollar amount); high vs. low
Retention bonus	Bonus given to teachers who stay in hard-to-staff schools or specialty subjects
Non-teacher salary	The salary of administrators and other opportunities
Union	Teacher has teacher union membership

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## APPENDIX B

### Chapter III Appendix

Appendix Table 1: Coding and descriptions of determinants

Determinant	Description/Coding
<b>Teacher characteristics</b>	
Age	Continuous, age<28, age<30, others
Gender	Male vs. Female
Race	Black, Hispanic, non-White vs. White
Marital status	Married vs. non-married
Having a new child	New child vs. no new child
Number of kids	Number of kids
Career satisfaction	Teacher's satisfaction with their job
Full time teaching	Full time vs. part time teaching
Distance to school	Distance from house to school
<b>Teacher qualifications</b>	
Ability/achievement	Teacher's ability (SAT/ACT/rank quartile)
Training: grad vs non grad	Degree (MA/PhD) vs. non-graduate degree/BA
Training programs	National Board, Teaching Fellow/TFA, NCLB
Standard certification	Certification (traditional/regular) vs. no cert.
Specialty area	STEM/special ed vs. regular
Years of teaching experience	Teaching experience (continuous measure)
New teacher	Less than 3 years of exp v. 3 or more years
<b>School organizational characteristics</b>	
School size	Large vs. small schools; school enrollment
Urbanicity	Urban vs. rural schools
School level	Secondary vs. elementary; high school/middle schools vs. elementary schools
School sector	Charter/private vs. traditional public
Work environment	Facilities, teaching assignments, school issues
Disciplinary	Student disciplinary problem
Administrative support	Measures of administrative support; teachers have regular supportive communication with administrators
Collaboration	Teacher collaboration/network of teachers
Leadership	Levels of teacher leadership/influence
Professional development	Measures of professional development; quality of professional development
Induction/Mentoring program	Participation in induction/mentoring program
Classroom autonomy	Levels of classroom autonomy
Stay ratio	Teacher retention rate at the school
<b>School resources</b>	
Expenditure for support per teacher	Expenditure for support per teachers (in dollar amount)

Class size	Teacher's average class size
Classroom assistant	Has a teacher aid/assistant vs. none
Teaching materials	Has adequate teaching materials
<b>Student body characteristics</b>	
Student achievement	Measures of average student achievement
Percent minority students	School-level percent of Black, Hispanic, or minority
Percent FRPL	School-level percent of free and reduced price lunch
Poverty	Majority of school is in low socio-economic status
Percent IEP/LEP	School-level percent of individualized education program (IEP) or limited English proficiency (LEP)
<b>Relational demography</b>	
Teacher-principal race/gender matching	Race and gender matching between teacher and principal
Teacher-student race matching	Race matching between students and teacher
<b>Accountability</b>	
Assessment impact	Effect of assessment impact, classroom observation and other evaluations
Teacher effectiveness score	Teacher effectiveness score from value-added measures; high vs. low teacher effectiveness
Merit pay program	Impact of merit pay programs
Principal effectiveness score	Principal effectiveness from school-level value-added measures; other measures of principal effectiveness
NCLB accountability	Effect of NCLB accountability
<b>School improvement</b>	
School reform	Participation in some school reform such as Success for All
Research-practice partnership	Participation in a research-practice partnership
<b>Work Force</b>	
Employment rate	Overall employment rate in the state or district
Late hiring	Teachers hired late in the academic year
Teacher salary	Salary (in dollar amount); high vs. low
Retention bonus	Bonus given to teachers who stay in hard-to-staff schools or specialty subjects
Non-teacher salary	The salary of administrators and other opportunities
Union	Teacher has teacher union membership

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Appendix Table 2: Study quality and risk of bias considerations

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**Quality Rating Considerations**

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Did the study provide a clear review of prior research and motivate the study?

Were the research questions(s) clearly stated, and did the study answer the question(s)?

Was the dependent variable, teacher attrition or retention, clearly defined?

Were the independent variables clearly defined and appropriately operationalized?

Was the analytic approach adequately described, and what are the relative merits of the approach used?

Did the analytic approach adjust statistically for confounding variables? For qualitative studies, did the analysis consider and evaluate confirming and disaffirming evidence?

Were threats to internal and external validity considered and addressed?

Were findings robust to different analytical decisions and model specifications? For qualitative studies, were the findings generalizable to different contexts or circumstances within the study, or were the results idiosyncratic to some particular time and place?

What sampling decisions were made by the authors and did the analytic sample present any concerns to internal or external validity?

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Appendix Table 3: Determinants of teacher attrition and retention using independent effect sizes

Factor	# of studies	# of ES	Main effect estimates					p
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	
Panel A: Teacher Characteristics								
Age (continuous)	14	16	0.990	-0.010	0.007	-0.024	0.003	0.117
Age (greater than 28)	14	33	0.650	-0.430	0.082	-0.591	-0.269	<.001
Male	47	53	1.005	0.005	0.030	-0.054	0.065	0.862
Minority (Black)	22	27	0.968	-0.032	0.105	-0.237	0.173	0.758
Minority (Hispanic)	17	20	0.604	-0.504	0.095	-0.690	-0.318	<.001
Minority (non-White)	11	12	0.970	-0.030	0.094	-0.215	0.154	0.746
Married	7	8	1.173	0.159	0.187	-0.206	0.525	0.393
Number of children	4	4	0.501	-0.692	0.165	-1.015	-0.369	<.001
Young child	3	4	0.541	-0.615	0.148	-0.905	-0.325	<.001
Career satisfaction	7	12	0.810	-0.210	0.078	-0.363	-0.058	0.007
Full time teaching	6	10	0.616	-0.484	0.150	-0.779	-0.189	0.001
Distance to school	2	2	0.987	-0.013	0.033	-0.078	0.052	0.704
Panel B: Teacher Qualifications								
Ability (test scores)	9	17	1.091	0.087	0.028	0.033	0.141	0.002
School selectivity	8	12	1.091	0.087	0.037	0.014	0.161	0.019
Graduate (MA/PhD v none)	24	38	1.015	0.015	0.038	-0.060	0.090	0.695
Graduate (MA/PhD v BA)	5	5	1.051	0.050	0.149	-0.242	0.341	0.739
National Board	3	7	0.874	-0.135	0.250	-0.625	0.356	0.590
Teaching Fellow/TFA	2	2	0.766	-0.267	0.641	-1.523	0.990	0.677
Highly qualified (NCLB)	2	2	0.932	-0.070	0.354	-0.763	0.623	0.843
Internship	3	4	0.973	-0.027	0.047	-0.119	0.064	0.560
Standard certification	19	22	0.558	-0.584	0.149	-0.876	-0.292	<.001
Specialty (STEM)	25	42	1.118	0.111	0.029	0.054	0.168	<.001
Specialty (Special ed)	9	11	1.138	0.129	0.039	0.053	0.205	0.001
Specialty (other)	5	5	1.240	0.215	0.031	0.155	0.276	<.001
Experience (cont.)	11	13	1.002	0.002	0.013	-0.024	0.027	0.901
Experience (<3)	12	23	1.431	0.358	0.057	0.248	0.469	<.001
Panel C: School Organizational Characteristics								
School size	13	14	1.001	0.001	0.001	<.001	0.002	0.104
Urban v. rural	13	14	1.039	0.038	0.072	-0.102	0.178	0.597
High school v. elem	7	9	1.080	0.077	0.050	-0.021	0.174	0.123
Middle school v. elem	6	9	1.090	0.086	0.018	0.052	0.121	<.001
Secondary v. elem	13	16	1.115	0.109	0.059	-0.007	0.225	0.065
Charter v. trad public	3	3	2.002	0.694	0.132	0.436	0.953	<.001
Private v. trad public	4	4	1.876	0.629	0.231	0.177	1.082	0.006
Student disciplinary problem	5	5	1.158	0.147	0.042	0.065	0.228	<.001
Better work environment	5	6	0.615	-0.485	0.252	-0.979	0.008	0.054
Administrative support	12	15	0.822	-0.196	0.048	-0.290	-0.101	<.001
Teacher collaborations	3	4	0.831	-0.185	0.138	-0.456	0.086	0.181
Teacher leadership	3	3	1.068	0.066	0.114	-0.157	0.288	0.564
Professional development	2	2	0.773	-0.258	0.054	-0.364	-0.152	<.001
Induction/mentoring	10	18	0.800	-0.223	0.068	-0.356	-0.091	0.001
Classroom autonomy	5	7	0.956	-0.045	0.022	-0.088	-0.003	0.037
Stay ratio	2	2	0.687	-0.375	0.308	-0.978	0.228	0.223
Panel D: School Resources								
Expend. support per teacher	2	3	0.934	-0.068	0.015	-0.097	-0.039	<.001
Class size	8	9	1.007	0.007	0.004	-0.001	0.015	0.073
Classroom assistant	2	5	1.154	0.143	0.212	-0.272	0.558	0.499
Teaching materials	2	5	0.673	-0.396	2.020	-4.355	3.563	0.845



Panel E: Student Body Characteristics								
Student achievement	14	28	0.985	-0.015	0.004	-0.022	-0.008	<.001
Percent Black	8	13	1.014	0.013	0.010	-0.005	0.032	0.159
Percent Hispanic	7	12	1.014	0.014	0.014	-0.013	0.041	0.303
Percent Minority	15	22	1.003	0.003	0.001	<.001	0.006	0.030
Percent FRPL	17	24	1.006	0.006	0.003	-0.001	0.012	0.080
Poverty	6	7	1.121	0.114	0.083	-0.048	0.276	0.168
Percent IEP/LEP	6	8	0.998	-0.002	0.006	-0.013	0.008	0.658
Panel F: Relational Demography								
Race/gender congruence	3	4	0.839	-0.175	0.143	-0.455	0.105	0.220
Panel G: Accountability								
Assessment impact	5	9	0.957	-0.044	0.022	-0.086	-0.001	0.044
Teacher effectiveness score	8	22	0.967	-0.034	0.007	-0.048	-0.020	<.001
Principal effectiveness score	2	3	0.853	-0.159	0.384	-0.912	0.594	0.678
Merit pay	3	4	0.750	-0.287	0.086	-0.455	-0.119	0.001
Merit pay (LPM)	10	14	.	-0.015	0.005	-0.026	-0.005	0.005
Panel H: Work Force								
Employment rate	2	4	1.007	0.007	0.009	-0.011	0.025	0.462
Salary	29	48	0.981	-0.019	0.004	-0.026	-0.012	<.001
Retention bonus	2	8	0.922	-0.081	0.026	-0.132	-0.029	0.002
Non-teacher salary	4	10	0.831	-0.185	0.063	-0.309	-0.061	0.003
Union	3	4	0.783	-0.244	0.161	-0.559	0.071	0.129

Appendix Table 4: Determinants of teacher attrition and retention with robust variance estimation

Factor	# of studies	# of ES	Main effect estimates						Adj df	p
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound			
Age (cont.)	14	16	0.982	-0.018	0.029	-0.069	0.034	11.753	0.549	
Age (greater than 28)	14	33	0.711	-0.341	0.150	-0.606	-0.075	12.792	0.041	
Male	47	53	0.999	-0.001	0.050	-0.085	0.083	37.017	0.982	
Minority (Black)	22	27	0.947	-0.054	0.209	-0.415	0.306	19.063	0.797	
Minority (Hispanic)	17	20	0.589	-0.530	0.298	-1.054	-0.005	14.033	0.097	
Minority (non-White)	11	12	0.910	-0.094	0.134	-0.341	0.152	8.491	0.500	
Married	7	8	1.185	0.170	0.129	-0.082	0.422	5.929	0.238	
Career satisfaction	7	12	0.801	-0.222	0.080	-0.385	-0.060	4.944	0.040	
Ability (test scores)	9	17	1.087	0.083	0.036	0.013	0.153	5.859	0.061	
School selectivity	8	12	1.077	0.075	0.080	-0.081	0.231	5.733	0.386	
Graduate (v. none)	24	38	0.987	-0.013	0.076	-0.145	0.119	15.789	0.866	
Standard certification	19	22	0.535	-0.626	0.199	-0.972	-0.280	16.951	0.006	
Specialty (STEM)	25	42	1.129	0.121	0.037	0.057	0.186	16.407	0.004	
Specialty (Spec ed)	9	11	1.157	0.146	0.043	0.061	0.231	5.602	0.016	
Experience (cont.)	11	13	0.996	-0.004	0.018	-0.037	0.028	7.813	0.805	
Experience (<3)	12	23	1.469	0.385	0.100	0.202	0.568	8.963	0.004	
School size	13	14	1.001	0.001	0.001	-0.001	0.002	2.773	0.457	
Urban	13	14	1.048	0.047	0.075	-0.088	0.182	10.387	0.545	
High school v. elem	7	9	1.122	0.115	0.085	-0.063	0.292	4.324	0.244	
Secondary v. elem	13	16	1.123	0.116	0.074	-0.021	0.252	8.530	0.154	
Admin. support	12	15	0.849	-0.164	0.060	-0.280	-0.048	6.371	0.033	
Induction/mentorin	10	18	0.751	-0.287	0.074	-0.433	-0.140	5.564	0.010	
Class size	8	9	1.006	0.006	0.005	-0.007	0.020	2.567	0.331	
Student achievement	14	28	0.993	-0.007	0.005	-0.017	0.002	5.521	0.181	
Percent Black	8	13	1.005	0.005	0.003	-0.003	0.013	1.969	0.198	
Percent Hispanic	7	12	1.012	0.012	0.011	-0.025	0.048	1.763	0.419	
Percent Minority	15	22	0.992	-0.008	0.039	-0.081	0.065	7.973	0.839	
Percent FRPL	17	24	1.006	0.006	0.003	<.001	0.012	8.741	0.092	
Teacher effect. score	8	22	0.949	-0.052	0.040	-0.152	0.048	2.639	0.296	
Merit pay (linear prob.)	10	14	.	-0.016	0.006	-0.028	-0.004	5.838	0.040	
Salary	29	48	0.981	-0.019	0.004	-0.026	-0.012	10.716	0.001	

Note. Assumed correlations between multiple, within-study outcomes is 0.5. Results are substantively similar for rho of 0.8.

Appendix Table 5: Determinants of teacher attrition and retention without hazard ratios estimates

Factor	# of studies	# of ES	Main effect estimates					p
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	
Panel A: Teacher Characteristics								
Age (continuous)	10	10	0.948	-0.054	0.030	-0.113	0.005	0.072
Age (greater than 28)	9	9	0.698	-0.359	0.189	-0.729	0.011	0.057
Male	35	35	1.034	0.033	0.036	-0.038	0.104	0.360
Minority (Black)	14	14	1.080	0.077	0.320	-0.551	0.704	0.811
Minority (Hispanic)	11	11	0.473	-0.749	0.176	-1.095	-0.404	<.001
Minority (non-White)	10	10	0.854	-0.158	0.096	-0.345	0.030	0.099
Married	4	4	1.091	0.087	0.050	-0.012	0.186	0.084
Number of children	1	1	0.379	-0.971	0.294	-1.548	-0.394	0.001
Young child	2	2	0.561	-0.578	0.154	-0.880	-0.275	<.001
Career satisfaction	7	7	0.847	-0.167	0.056	-0.276	-0.057	0.003
Full time teaching	6	6	0.619	-0.480	0.142	-0.759	-0.201	0.001
Distance to school	1	1	1.014	0.014	0.004	0.006	0.022	<.001
Panel B: Teacher Qualifications								
Ability (test scores)	5	5	1.118	0.112	0.069	-0.024	0.247	0.105
School selectivity	5	5	1.108	0.103	0.130	-0.152	0.358	0.429
Graduate (MA/PhD v none)	17	17	1.047	0.046	0.094	-0.138	0.230	0.623
Graduate (MA/PhD v BA)	3	3	0.882	-0.125	0.318	-0.748	0.497	0.693
National Board	1	1	0.548	-0.602	0.453	-1.489	0.286	0.184
Teaching Fellow/TFA	1	1	0.401	-0.914	0.137	-1.182	-0.645	<.001
Highly qualified (NCLB)	2	2	0.932	-0.070	0.354	-0.763	0.623	0.843
Internship	1	1	0.459	-0.779	0.395	-1.553	-0.006	0.048
Standard certification	15	15	0.467	-0.762	0.231	-1.214	-0.309	0.001
Specialty (STEM)	11	11	1.087	0.083	0.072	-0.059	0.225	0.250
Specialty (Special ed)	5	5	1.202	0.184	0.101	-0.014	0.382	0.069
Specialty (other)	2	2	1.353	0.302	0.463	-0.606	1.210	0.514
Experience (cont.)	9	9	1.005	0.005	0.018	-0.030	0.040	0.782
Experience (<3)	11	11	1.515	0.415	0.103	0.214	0.617	<.001
Panel C: School Organizational Characteristics								
School size	10	10	1.001	0.001	0.002	-0.003	0.004	0.792
Urban v. rural	9	9	1.059	0.058	0.090	-0.118	0.233	0.521
High school v. elem	4	4	1.312	0.272	0.199	-0.119	0.662	0.172
Middle school v. elem	4	4	1.505	0.409	0.144	0.126	0.691	0.005
Secondary v. elem	6	6	1.492	0.400	0.248	-0.086	0.886	0.107
Charter v. trad public	2	2	1.983	0.685	0.167	0.358	1.011	<.001
Private v. trad public	2	2	1.584	0.460	0.428	-0.380	1.299	0.283
Student disciplinary problem	4	4	1.186	0.170	0.105	-0.035	0.375	0.103
Better work environment	5	5	0.557	-0.585	0.271	-1.116	-0.054	0.031
Administrative support	12	12	0.843	-0.171	0.049	-0.268	-0.074	0.001
Teacher collaborations	3	3	0.892	-0.114	0.129	-0.366	0.139	0.377
Teacher leadership	3	3	1.068	0.066	0.114	-0.157	0.288	0.564
Professional development	2	2	0.773	-0.258	0.054	-0.364	-0.152	<.001
Induction/mentoring	10	10	0.763	-0.270	0.074	-0.414	-0.126	<.001
Classroom autonomy	5	5	0.959	-0.041	0.078	-0.194	0.111	0.594
Stay ratio	0	0	.	.	.	.	.	.
Panel D: School Resources								
Class size	6	6	1.018	0.018	0.013	-0.008	0.043	0.184
Classroom assistant	1	1	1.159	0.148	0.212	-0.268	0.563	0.486
Teaching materials	1	1	0.845	-0.168	0.062	-0.290	-0.046	0.007
Panel E: Student Body Characteristics								

Student achievement	10	10	0.901	-0.105	0.020	-0.144	-0.065	<.001
Percent Black	6	6	1.004	0.004	0.003	-0.002	0.010	0.161
Percent Hispanic	4	4	1.005	0.005	0.005	-0.004	0.015	0.290
Percent Minority	13	13	0.946	-0.056	0.021	-0.096	-0.015	0.007
Percent FRPL	13	13	1.006	0.006	0.004	-0.002	0.013	0.153
Poverty	3	3	1.277	0.244	0.311	-0.366	0.855	0.433
Percent IEP/LEP	5	5	0.999	-0.001	0.009	-0.019	0.018	0.945
Panel F: Relational Demography								
Race/gender congruence	2	2	0.545	-0.607	0.788	-2.151	0.936	0.441
Panel G: Accountability								
Assessment impact	5	5	0.947	-0.054	0.027	-0.106	-0.002	0.041
Teacher effectiveness score	7	7	0.964	-0.037	0.021	-0.078	0.004	0.079
Principal effectiveness score	2	2	0.802	-0.220	0.354	-0.914	0.473	0.533
Panel H: Work Force								
Employment rate	1	1	0.969	-0.032	0.014	-0.059	-0.005	0.022
Retention bonus	1	1	0.990	-0.010	0.060	-0.128	0.108	0.868
Non-teacher salary	2	2	6.305	1.841	2.789	-3.624	7.307	0.509
Salary	17	17	0.978	-0.022	0.008	-0.038	-0.007	0.004
Union	3	3	0.745	-0.294	0.173	-0.634	0.046	0.090

Appendix Table 6: Determinants of teacher attrition and retention using “Leavers only” estimations (without leavers and switchers combined as one group)

Factor	# of studies	# of ES	Main effect estimates					p
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	
Panel A: Teacher Characteristics								
Age (continuous)	12	12	0.979	-0.021	0.009	-0.039	-0.003	0.022
Age (greater than 28)	11	11	0.629	-0.464	0.123	-0.705	-0.222	<.001
Male	40	40	0.986	-0.014	0.042	-0.096	0.068	0.735
Minority (Black)	17	17	0.991	-0.009	0.187	-0.374	0.357	0.963
Minority (Hispanic)	12	12	0.559	-0.582	0.159	-0.893	-0.271	<.001
Minority (non-White)	9	9	0.890	-0.116	0.156	-0.422	0.189	0.454
Married	7	7	1.164	0.152	0.099	-0.042	0.346	0.125
Number of children	4	4	0.501	-0.692	0.165	-1.015	-0.369	<.001
Young child	3	3	0.551	-0.596	0.153	-0.896	-0.296	<.001
Career satisfaction	5	5	0.828	-0.189	0.071	-0.329	-0.050	0.008
Full time teaching	6	6	0.619	-0.480	0.142	-0.759	-0.201	0.001
Distance to school	12	12	0.979	-0.021	0.009	-0.039	-0.003	0.022
Panel B: Teacher Qualifications								
Ability (test scores)	9	9	1.095	0.091	0.044	0.005	0.176	0.038
School selectivity	6	6	1.055	0.053	0.086	-0.116	0.222	0.537
Graduate (MA/PhD v none)	20	20	0.964	-0.037	0.076	-0.187	0.112	0.626
Graduate (MA/PhD v BA)	4	4	1.007	0.007	0.219	-0.422	0.436	0.975
National Board	3	3	0.795	-0.230	0.464	-1.139	0.679	0.620
Teaching Fellow/TFA	2	2	0.766	-0.267	0.641	-1.523	0.990	0.677
Highly qualified (NCLB)	1	1	1.288	0.253	0.095	0.067	0.439	0.008
Internship	2	2	0.965	-0.036	0.015	-0.065	-0.007	0.014
Standard certification	16	16	0.464	-0.768	0.228	-1.215	-0.321	0.001
Specialty (STEM)	21	21	1.154	0.143	0.041	0.062	0.224	0.001
Specialty (Special ed)	7	7	1.126	0.119	0.046	0.028	0.209	0.010
Specialty (other)	5	5	1.240	0.215	0.031	0.155	0.276	<.001
Experience (cont.)	8	8	0.984	-0.016	0.015	-0.046	0.013	0.283
Experience (<3)	9	9	1.651	0.501	0.116	0.274	0.728	<.001
Panel C: School Organizational Characteristics								
School size	11	11	1.000	<.001	<.00	<.001	0.001	0.315
Urban v. rural	10	10	1.079	0.076	0.070	-0.061	0.212	0.277
High school v. elem	6	6	1.198	0.180	0.057	0.069	0.292	0.001
Middle school v. elem	6	6	1.159	0.147	0.045	0.060	0.235	0.001
Secondary v. elem	11	11	1.179	0.165	0.068	0.032	0.298	0.015
Charter v. trad public	3	3	2.002	0.694	0.132	0.436	0.953	<.001
Private v. trad public	3	3	2.331	0.846	0.169	0.515	1.177	<.001
Student disciplinary problem	4	4	1.143	0.133	0.069	-0.002	0.268	0.053
Better work environment	3	3	0.415	-0.880	0.408	-1.679	-0.081	0.031
Administrative support	9	9	0.828	-0.188	0.055	-0.297	-0.080	0.001
Teacher collaborations	3	3	0.892	-0.114	0.129	-0.366	0.139	0.377
Teacher leadership	3	3	1.068	0.066	0.114	-0.157	0.288	0.564
Professional development	1	1	0.771	-0.260	0.060	-0.378	-0.142	<.001
Induction/mentoring	8	8	0.705	-0.350	0.061	-0.470	-0.229	<.001
Classroom autonomy	4	4	1.018	0.018	0.076	-0.131	0.166	0.815
Stay ratio	2	2	0.687	-0.375	0.308	-0.978	0.228	0.223
Panel D: School Resources								
Expend. support per teacher	2	2	0.934	-0.068	0.019	-0.104	-0.032	<.001
Class size	7	7	1.004	0.004	0.004	-0.003	0.011	0.275

Classroom assistant	1	1	1.159	0.148	0.212	-0.268	0.563	0.486
Teaching materials	1	1	0.845	-0.168	0.062	-0.290	-0.046	0.007
Panel E: Student Body Characteristics								
Student achievement	10	10	0.998	-0.002	0.002	-0.006	0.002	0.253
Percent Black	7	7	1.005	0.005	0.004	-0.002	0.012	0.180
Percent Hispanic	6	6	1.012	0.012	0.010	-0.007	0.031	0.216
Percent Minority	12	12	0.963	-0.037	0.009	-0.056	-0.019	<.001
Percent FRPL	13	13	1.004	0.004	0.004	-0.004	0.011	0.336
Poverty	6	6	1.032	0.032	0.068	-0.102	0.166	0.641
Percent IEP/LEP	5	5	0.991	-0.009	0.041	-0.090	0.072	0.819
Panel F: Relational Demography								
Race/gender congruence	3	3	0.873	-0.135	0.154	-0.438	0.167	0.380
Panel G: Accountability								
Assessment impact	5	9	0.957	-0.044	0.022	-0.086	-0.001	0.044
Teacher effectiveness score	8	22	0.967	-0.034	0.007	-0.048	-0.020	<.001
Principal effectiveness score	2	3	0.853	-0.159	0.384	-0.912	0.594	0.678
Merit pay	3	4	0.750	-0.287	0.086	-0.455	-0.119	0.001
Merit pay (LPM)	10	14	.	-0.015	0.005	-0.026	-0.005	0.005
Panel H: Work Force								
Employment rate	2	2	0.995	-0.005	0.025	-0.055	0.045	0.842
Retention bonus	2	2	0.940	-0.062	0.030	-0.122	-0.003	0.040
Non-teacher salary	4	4	0.735	-0.308	0.196	-0.693	0.076	0.116
Salary	25	25	0.982	-0.018	0.004	-0.025	-0.010	<.001
Union	1	1	0.568	-0.566	0.144	-0.848	-0.283	<.001

Note. Estimates assume dependent effect sizes with within study correlation of 0.5.

Appendix Table 7: Determinants of teacher attrition and retention for teachers leaving their current school (Leavers, Leavers and Switchers, and Switchers)

Factor	# of studies	# of ES	Main effect estimates					p
			Odds ratio	Log odds ratio	SE	Lower bound	Upper bound	
Panel A: Teacher Characteristics								
Age (continuous)	15	15	0.976	-0.024	0.008	-0.040	-0.008	0.003
Age (greater than 28)	14	14	0.597	-0.515	0.249	-1.003	-0.028	0.038
Male	48	48	1.008	0.008	0.030	-0.051	0.067	0.786
Minority (Black)	24	24	0.919	-0.084	0.129	-0.337	0.168	0.513
Minority (Hispanic)	20	20	0.688	-0.375	0.090	-0.551	-0.199	<.001
Minority (non-White)	11	11	0.951	-0.051	0.093	-0.234	0.132	0.587
Married	8	8	1.035	0.034	0.122	-0.205	0.274	0.780
Number of children	4	4	0.501	-0.692	0.165	-1.015	-0.369	<.001
Young child	3	3	0.633	-0.458	0.109	-0.671	-0.245	<.001
Career satisfaction	7	7	0.850	-0.163	0.052	-0.265	-0.060	0.002
Full time teaching	7	7	0.645	-0.438	0.126	-0.685	-0.192	<.001
Distance to school	2	2	0.990	-0.010	0.024	-0.056	0.037	0.689
Panel B: Teacher Qualifications								
Ability (test scores)	9	9	1.037	0.037	0.025	-0.013	0.086	0.148
School selectivity	8	8	1.082	0.079	0.045	-0.010	0.167	0.081
Graduate (MA/PhD v none)	24	24	1.053	0.052	0.063	-0.071	0.175	0.410
Graduate (MA/PhD v BA)	5	5	1.059	0.058	0.142	-0.221	0.337	0.685
National Board	3	3	0.747	-0.292	0.166	-0.618	0.034	0.079
Teaching Fellow/TFA	2	2	0.958	-0.043	0.428	-0.881	0.796	0.921
Highly qualified (NCLB)	2	2	0.932	-0.070	0.354	-0.763	0.623	0.843
Internship	3	3	0.966	-0.035	0.053	-0.139	0.070	0.515
Standard certification	19	19	0.638	-0.449	0.104	-0.653	-0.245	<.001
Specialty (STEM)	26	26	1.135	0.127	0.032	0.063	0.190	<.001
Specialty (Special ed)	9	9	1.203	0.185	0.039	0.109	0.261	<.001
Specialty (other)	5	5	1.223	0.201	0.032	0.138	0.264	<.001
Experience (cont.)	11	11	0.993	-0.007	0.015	-0.037	0.023	0.647
Experience (<3)	13	13	1.232	0.209	0.057	0.097	0.320	<.001
Panel C: School Organizational Characteristics								
School size	14	14	1.001	0.001	0.001	<.001	0.002	0.209
Urban v. rural	16	16	0.988	-0.013	0.074	-0.157	0.132	0.865
High school v. elem	8	8	1.061	0.060	0.071	-0.080	0.199	0.401
Middle school v. elem	6	6	1.121	0.114	0.028	0.060	0.168	<.001
Secondary v. elem	14	14	1.115	0.109	0.058	-0.006	0.223	0.063
Charter v. trad public	3	3	2.002	0.694	0.132	0.436	0.953	<.001
Private v. trad public	4	4	1.718	0.541	0.207	0.135	0.946	0.009
Student disciplinary problem	5	5	1.179	0.164	0.074	0.019	0.309	0.026
Better work environment	6	6	0.589	-0.529	0.277	-1.073	0.015	0.057
Administrative support	12	12	0.825	-0.193	0.046	-0.284	-0.102	<.001
Teacher collaborations	3	3	0.908	-0.097	0.151	-0.393	0.200	0.522
Teacher leadership	3	3	1.019	0.019	0.092	-0.162	0.199	0.840
Professional development	2	2	0.773	-0.258	0.054	-0.364	-0.152	<.001
Induction/mentoring	10	10	0.811	-0.210	0.064	-0.335	-0.085	0.001
Classroom autonomy	5	5	0.926	-0.077	0.047	-0.169	0.015	0.100
Stay ratio	2	2	0.687	-0.375	0.308	-0.978	0.228	0.223
Panel D: School Resources								
Expend. support per teacher	2	2	0.940	-0.062	0.016	-0.093	-0.030	<.001
Class size	8	8	1.002	0.002	0.004	-0.005	0.009	0.544
Classroom assistant	2	2	1.156	0.145	0.212	-0.270	0.560	0.495

Teaching materials	2	2	0.960	-0.041	0.054	-0.147	0.065	0.447
Panel E: Student Body Characteristics								
Student achievement	14	14	0.983	-0.017	0.005	-0.026	-0.009	<.001
Percent Black	9	9	1.011	0.011	0.008	-0.004	0.027	0.145
Percent Hispanic	7	7	1.007	0.007	0.023	-0.038	0.051	0.766
Percent Minority	16	16	1.000	<.001	0.007	-0.013	0.013	0.993
Percent FRPL	18	18	1.004	0.004	0.003	-0.001	0.010	0.150
Poverty	6	6	1.474	0.388	0.144	0.106	0.669	0.007
Percent IEP/LEP	6	6	0.990	-0.010	0.013	-0.037	0.016	0.437
Panel F: Relational Demography								
Race/gender congruence	3	3	0.805	-0.217	0.186	-0.582	0.149	0.245
Panel G: Accountability								
Assessment impact	5	5	0.936	-0.066	0.032	-0.129	-0.003	0.040
Teacher effectiveness score	9	9	0.927	-0.075	0.025	-0.124	-0.026	0.003
Principal effectiveness score	2	2	1.214	0.194	0.143	-0.085	0.474	0.173
Merit pay	3	3	0.907	-0.098	0.106	-0.305	0.110	0.356
Merit pay (LPM)	10	14	.	-0.015	0.005	-0.026	-0.005	0.005
Panel H: Work Force								
Employment rate	2	2	1.004	0.004	0.006	-0.008	0.017	0.505
Retention bonus	2	2	0.939	-0.063	0.027	-0.116	-0.010	0.020
Non-teacher salary	4	4	0.923	-0.080	0.054	-0.186	0.025	0.135
Salary	29	29	0.984	-0.016	0.003	-0.022	-0.010	<.001
Union	4	4	0.680	-0.386	0.153	-0.685	-0.086	0.012

Note. Estimates assume dependent effect sizes with within study correlation of 0.5.



## APPENDIX C

### Chapter IV Appendix

Appendix Table 1. Definitions of School Organizational Characteristics Used in Regression Analysis

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Administrative support	On a scale of 1 = strongly disagree and 4 = strongly agree, teachers report on the school administration's behavior toward the staff is supportive and encouraging. Measure standardized for each wave.
Teacher cooperation	On a scale of 1 = strongly disagree and 4 = strongly agree, teachers report on the level of cooperative effort among the staff members. Measure standardized for each wave.
Student discipline problems	On a scale of 1 = never happens to 5 = happens daily, the principal reports of six kinds of student discipline problems: physical conflict, robbery or theft, vandalism, student use of alcohol, drug use, and possession of weapons. ( $\alpha=.569-.662$ )
Principal effectiveness	On a scale of 1 = strongly disagree and 4 = strongly agree, teachers report on the following: principal enforcement of school rules, principal communication to the staff, recognizing staff for accomplishments, and teacher satisfaction with how the principal manages the school; Measure standardized for each wave. ( $\alpha=.775-.802$ )

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Appendix Table 2. Descriptive Statistics of teacher characteristics, teacher qualifications, school organizational characteristics, school resources, and student body characteristics for public school teachers including charter schools

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
<i>Teacher Characteristics</i>					
Young teacher (age<=28)	0.14	0.14	0.15	0.12	0.13
Female	0.75	0.75	0.76	0.76	0.76
White	0.85	0.84	0.85	0.84	0.84
Black	0.08	0.08	0.07	0.07	0.07
Asian	0.02	0.02	0.02	0.02	0.02
American Indian	0.01	0.01	0.01	0.01	0.01
Hispanic	0.05	0.06	0.07	0.08	0.07
Prin-Tch gender congr	0.51	0.53	0.54	0.55	0.53
Prin-Tch race congr	0.80	0.80	0.79	0.78	0.79
<i>Teacher Qualifications</i>					
Has PhD	0.01	0.01	0.00	0.01	0.01
Has Master Degree	0.46	0.47	0.50	0.54	0.49
Advanced Graduate Cert.	0.02	0.02	0.02	0.02	0.02
Teach STEM subjects	0.13	0.13	0.14	0.15	0.14
Teach special ed.	0.10	0.13	0.12	0.13	0.12
Has standard/reg cert.	0.87	0.88	0.89	0.91	0.89
New teacher	0.11	0.10	0.11	0.07	0.10
<i>School organizational characteristics</i>					
Urban school	0.26	0.28	0.25	0.27	0.26
Suburban school	0.51	0.53	0.55	0.50	0.51
School enrollment	805	796	816	822	810
Union member	0.79	0.77	0.76	0.74	0.76
Secondary school	0.33	0.29	0.31	0.31	0.31
Combined elem/sec	0.02	0.05	0.04	0.06	0.04
Admin support (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Teacher cooperation (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Student discipline problem (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Principal effectiveness (std)	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Total principal exp	8.87	7.66	7.58	7.25	7.80
	(7.59)	(6.93)	(6.72)	(6.23)	(6.88)
Principal has PhD	0.11	0.10	0.10	0.12	0.11
Principal has MA or spec degree	0.88	0.89	0.89	0.87	0.88
Charter	0.01	0.01	0.02	0.03	0.02
<i>School Resources</i>					
Teacher salary per \$1,000	52.05	52.89	51.91	52.42	52.33
	(17.03)	(16.59)	(16.07)	(16.73)	(16.60)
Salary satisfaction	0.00	0.00	0.00	0.00	0.00
	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
Expenditure per student	8951.13	10019.42	10729.60	10619.30	10118.10
	(2887.28)	(3614.63)	(4158.56)	(6926.92)	(4766.28)
<i>Student Body Characteristics</i>					
Percent FRPL	34.66	41.10	41.47	47.77	41.50
	(28.17)	(29.30)	(28.48)	(29.21)	(29.18)
Percent minority	33.49	37.94	39.31	43.47	38.74
	(32.38)	(33.50)	(32.74)	(32.14)	(32.89)
Majority Black/Hispanic	0.23	0.28	0.28	0.30	0.28
Percent IEP	12.29	13.70	13.06	12.61	12.93
	(9.58)	(11.75)	(11.77)	(10.07)	(10.88)
Percent LEP	5.66	7.31	7.94	8.30	7.36
	(12.79)	(14.64)	(14.45)	(13.55)	(13.94)
Observations	39,170	39,240	33,420	33,970	145,780

Note. Nationally-representative weights are employed. Salary and expenditure have been adjusted to constant 2012 dollar. Observations have been rounded to the nearest 10 per IES compliance. Administrative support, teacher cooperation, student discipline problem, principal effectiveness, and satisfaction with salary were standardized for each wave accounting for sampling weights.

Appendix Table 3. Marginal effect estimates from multinomial logistic regression models of the influence of teacher characteristics on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Young (<=28 years)	0.049** (9.90)	0.055** (9.98)	0.047** (9.18)	0.047** (9.16)	0.050** (18.95)
Female	0.008+ (1.66)	-0.002 (-0.38)	-0.007 (-1.42)	0.000 (0.03)	-0.001 (-0.24)
Black	0.000 (0.03)	0.004 (0.45)	0.017+ (1.83)	0.024+ (1.93)	0.012* (2.23)
Asian	0.014 (0.73)	-0.010 (-0.70)	0.020 (1.08)	-0.019 (-1.02)	-0.001 (-0.14)
American Indian	-0.004 (-0.24)	-0.019 (-1.11)	-0.009 (-0.44)	-0.015 (-0.92)	-0.012 (-1.34)
Hispanic	0.023* (2.34)	-0.034* (-2.38)	-0.006 (-0.56)	0.017+ (1.67)	0.001 (0.17)
Prin-Tch gender congr	0.010* (2.10)	-0.003 (-0.58)	0.009+ (1.94)	0.003 (0.65)	0.004+ (1.75)
Prin-Tch race congr	0.008 (1.27)	-0.021** (-3.19)	-0.018** (-2.84)	-0.005 (-0.68)	-0.010** (-2.96)
Panel B: Leavers					
Young (<=28 years)	0.027** (4.56)	0.008 (1.18)	0.026** (4.43)	0.023** (3.61)	0.021** (6.71)
Female	0.004 (0.81)	-0.011* (-2.13)	-0.004 (-0.70)	0.003 (0.67)	-0.002 (-0.77)
Black	0.009 (0.94)	0.025* (2.45)	0.015 (1.63)	0.022+ (1.85)	0.018** (3.43)
Asian	-0.059** (-4.96)	-0.011 (-0.82)	0.018 (1.06)	-0.044* (-2.42)	-0.022** (-2.62)
American Indian	-0.002 (-0.17)	-0.002 (-0.11)	-0.004 (-0.30)	-0.007 (-0.39)	-0.002 (-0.24)
Hispanic	-0.014 (-1.23)	-0.013 (-0.85)	0.001 (0.12)	-0.026* (-2.13)	-0.014* (-2.10)
Prin-Tch gender congr	0.012** (2.60)	0.002 (0.40)	-0.006 (-1.21)	0.002 (0.48)	0.003 (1.17)
Prin-Tch race congr	-0.019** (-3.00)	-0.007 (-0.97)	-0.004 (-0.60)	-0.017* (-2.45)	-0.012** (-3.44)
N	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 4. Marginal effect estimates from multinomial logistic regression models of the influence of teacher qualifications on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
PhD	0.025 (1.17)	0.088** (3.14)	0.007 (0.26)	-0.007 (-0.31)	0.031* (2.25)
Master	-0.004 (-0.90)	-0.012* (-2.29)	0.001 (0.29)	0.010+ (1.86)	-0.001 (-0.54)
Adv Grad Cert	-0.005 (-0.25)	0.002 (0.11)	0.005 (0.30)	0.001 (0.08)	0.001 (0.10)
Teach STEM subjects	-0.010 (-1.60)	-0.022** (-3.43)	-0.005 (-0.97)	-0.003 (-0.58)	-0.010** (-3.25)
Teach special ed	0.030** (4.47)	0.023** (3.37)	0.021** (3.26)	0.004 (0.60)	0.019** (5.65)
Standard/reg. cert	-0.017* (-2.53)	-0.025** (-3.04)	-0.015* (-2.26)	-0.009 (-1.33)	-0.017** (-4.60)
New teacher	0.042** (6.74)	0.031** (3.64)	0.043** (6.16)	0.053** (8.64)	0.043** (11.88)
Panel B: Leavers					
PhD	0.030 (1.33)	-0.018 (-0.81)	0.073** (3.47)	0.027 (1.17)	0.034** (2.83)
Master	0.004 (0.81)	0.003 (0.65)	-0.000 (-0.04)	0.005 (0.95)	0.002 (0.93)
Adv Grad Cert	0.002 (0.09)	0.025+ (1.92)	0.005 (0.40)	-0.016 (-1.00)	0.006 (0.76)
Teach STEM subjects	0.004 (0.64)	-0.003 (-0.46)	0.017** (2.73)	0.001 (0.16)	0.005 (1.58)
Teach special ed	0.008 (1.05)	0.005 (0.74)	0.020** (2.87)	0.009 (1.05)	0.010** (2.71)
Standard/reg. cert	-0.019** (-2.96)	-0.039** (-5.67)	-0.021** (-3.25)	-0.004 (-0.48)	-0.023** (-6.47)
New teacher	0.020** (2.88)	0.011 (1.51)	0.017* (2.43)	0.025** (3.29)	0.019** (5.14)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 5. Marginal effect estimates from multinomial logistic regression models of the influence of school organizational characteristics on movers and leavers for public school teachers

Variables	(1)	(2)	(3)	(4)	(5)
	Wave: 2000	Wave: 2004	Wave: 2008	Wave: 2012	Pooled
Panel A: Movers					
Urban	0.005 (0.71)	0.009 (1.14)	0.008 (1.15)	0.015* (2.33)	0.010** (2.81)
Suburban	0.012* (2.29)	0.007 (1.06)	0.010* (1.98)	0.002 (0.45)	0.008** (3.04)
Enrollment per 1,000	-0.019** (-4.38)	-0.013* (-2.57)	-0.012** (-2.81)	-0.022** (-4.98)	-0.017** (-7.08)
Union	-0.013* (-2.44)	-0.019** (-3.10)	-0.018** (-2.97)	-0.016** (-2.65)	-0.017** (-5.61)
Secondary	-0.014** (-3.16)	-0.021** (-3.80)	0.000 (0.03)	0.000 (0.05)	-0.009** (-3.56)
Combined elem/sec	-0.016* (-2.23)	-0.020* (-2.27)	-0.009 (-1.51)	-0.011 (-1.45)	-0.014** (-3.45)
Admin support	-0.009** (-3.25)	-0.000 (-0.00)	-0.006+ (-1.88)	-0.008** (-2.88)	-0.006** (-3.78)
Teacher cooperation	-0.011** (-4.69)	-0.011** (-3.82)	-0.010** (-4.37)	-0.007** (-2.63)	-0.010** (-7.70)
Student disc problem	0.000 (0.12)	0.003 (1.34)	-0.002 (-1.20)	0.003* (2.13)	0.001 (1.02)
Principal effectiveness	0.002 (0.69)	-0.001 (-0.40)	0.000 (0.00)	-0.001 (-0.21)	0.000 (0.08)
Principal experience	-0.001** (-2.96)	0.000 (0.26)	-0.001+ (-1.73)	-0.001+ (-1.93)	-0.001** (-3.06)
Principal has PhD	0.029 (1.22)	0.041+ (1.91)	0.057** (2.91)	0.002 (0.09)	0.027* (2.11)
Principal has MA	0.027 (1.18)	0.036+ (1.78)	0.068** (3.69)	-0.002 (-0.09)	0.027* (2.19)
Panel B: Leavers					
Urban	0.022** (3.48)	0.018** (2.69)	0.005 (0.71)	0.024** (3.72)	0.018** (5.24)
Suburban	0.010+ (1.76)	0.014+ (2.40)	-0.002 (-0.28)	0.019** (3.48)	0.011** (3.94)
Enrollment per 1,000	-0.012** (-3.13)	-0.011* (-2.38)	-0.000 (-0.12)	-0.010* (-2.35)	-0.009** (-3.99)
Union	-0.012* (-2.17)	-0.024** (-3.77)	-0.014* (-2.38)	-0.007 (-1.15)	-0.015** (-4.77)
Secondary	0.003 (0.61)	0.012* (2.40)	0.001 (0.28)	0.003 (0.57)	0.005* (1.97)
Combined elem/sec	0.005 (0.57)	0.002 (0.22)	0.009 (1.19)	-0.004 (-0.45)	0.003 (0.67)
Admin support	-0.008** (-2.79)	-0.007* (-2.34)	-0.005+ (-1.83)	-0.005 (-1.56)	-0.006** (-4.29)
Teacher cooperation	-0.007* (-2.52)	0.001 (0.40)	-0.001 (-0.25)	-0.001 (-0.45)	-0.002 (-1.25)
Student disc problem	0.006** (3.31)	0.005** (3.31)	0.004* (2.55)	-0.001 (-0.30)	0.004** (4.60)
Principal effectiveness	-0.002 (-0.66)	-0.001 (-0.45)	-0.003 (-0.79)	-0.010** (-2.69)	-0.004* (-2.37)
Principal experience	-0.000 (-1.05)	-0.000 (-0.47)	-0.001+ (-1.86)	-0.000 (-0.99)	-0.000+ (-2.44)
Principal has PhD	-0.002 (-0.07)	0.027 (1.50)	0.022 (0.67)	0.007 (0.29)	0.011 (0.85)
Principal has MA	-0.013 (-0.54)	0.022 (1.30)	0.007 (0.21)	-0.014 (-0.62)	-0.002 (-0.12)
N	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 6. Marginal effect estimates from multinomial logistic regression models of the influence of school resources on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Salary per \$1,000	-0.002** (-12.14)	-0.002** (-12.68)	-0.002** (-9.46)	-0.002** (-8.48)	-0.002** (-21.17)
Salary satisfaction	-0.000 (-0.10)	0.003 (1.12)	0.003 (1.32)	0.001 (0.31)	0.002+ (1.65)
Dist exp for educ Per \$1,000,000	0.000+ (1.89)	0.000** (3.20)	0.000* (2.07)	0.000 (0.70)	0.000* (2.26)
Panel B: Leavers					
Salary per \$1,000	-0.000* (-2.45)	-0.000* (-2.35)	-0.000 (-0.76)	0.000 (0.62)	-0.000* (-2.22)
Salary satisfaction	-0.000 (-0.01)	-0.001 (-0.42)	0.003 (1.39)	-0.001 (-0.48)	0.001 (0.38)
Dist exp for educ Per \$1,000,000	0.000* (1.99)	0.000 (1.62)	0.000** (2.96)	0.000 (1.18)	0.000* (2.21)
N	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 7. Marginal effect estimates from multinomial logistic regression models of the influence of student body characteristics on movers and leavers for public school teachers

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Percent FRPL	0.000** (4.24)	0.000 (1.57)	0.000** (2.62)	-0.000 (-0.09)	0.000** (3.66)
Percent FRPL missing indicator	0.018 (1.57)	-0.017 (-1.07)	0.002 (0.14)	-0.017 (-1.19)	0.001 (0.10)
Percent minority	-0.000 (-0.57)	0.000 (1.52)	0.000 (1.56)	0.000 (1.59)	0.000* (2.21)
Majority Black/Hispanic students	0.001 (0.09)	-0.010 (-0.97)	-0.011 (-1.10)	0.012 (1.28)	-0.002 (-0.42)
Percent IEP	-0.001* (-2.55)	0.000+ (1.96)	-0.000 (-0.12)	0.000 (0.23)	0.000 (0.23)
Percent LEP	0.000 (0.13)	-0.000 (-0.16)	-0.000 (-0.33)	-0.000 (-0.13)	-0.000 (-0.15)
Panel B: Leavers					
Percent FRPL	0.000 (0.12)	-0.000 (-0.76)	0.000 (0.15)	-0.000 (-1.57)	-0.000 (-0.96)
Percent FRPL missing indicator	0.009 (0.88)	0.012 (0.97)	0.008 (0.46)	-0.003 (-0.19)	0.007 (1.15)
Percent minority	0.000* (2.16)	0.001** (3.63)	0.000** (2.74)	0.001** (3.62)	0.000** (6.03)
Majority Black/Hispanic students	-0.002 (-0.20)	0.001 (0.15)	-0.001 (-0.10)	-0.007 (-0.75)	-0.002 (-0.37)
Percent IEP	0.000 (1.27)	-0.000 (-0.96)	0.000 (0.94)	-0.000 (-0.07)	-0.000 (-0.02)
Percent LEP	0.000 (0.72)	-0.000 (-1.50)	-0.000 (-0.95)	-0.000 (-0.22)	-0.000 (-1.24)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 8. Marginal effects from saturated models of multinomial logistic regression estimates of the determinants of movers and leavers for public school teachers

Variables	(1)	(2)
	Mover	Leaver
Young (<=28 years)	0.026** (8.56)	0.012** (3.14)
Female	-0.009** (-3.37)	-0.001 (-0.47)
Black	0.005 (0.96)	0.008 (1.49)
Asian	-0.003 (-0.32)	-0.024** (-2.86)
American Indian	-0.015+ (-1.76)	-0.005 (-0.61)
Hispanic	-0.003 (-0.59)	-0.019** (-2.89)
Princ-Tch gender congruence	0.001 (0.48)	0.002 (0.85)
Princ-Tch race congruence	-0.005 (-1.59)	-0.005 (-1.51)
PhD	0.039** (3.02)	0.031** (2.67)
Master	0.013** (5.33)	0.004 (1.30)
Adv Grad Cert	0.009 (1.19)	0.006 (0.80)
Teach STEM subjects	-0.005+ (-1.69)	0.004 (1.32)
Teach special ed	0.018** (5.68)	0.010** (2.73)
Standard/reg. cert	-0.007* (-1.99)	-0.019** (-5.52)
New teacher	0.015** (4.17)	0.013** (3.10)
Urban	0.006+ (1.70)	0.007+ (1.87)
Suburban	0.010** (3.74)	0.009** (2.97)
Enrollment per 1,000 students	-0.013** (-5.67)	-0.009** (-4.16)
Union	-0.009** (-3.19)	-0.013** (-4.28)
Secondary	-0.008** (-3.47)	0.004 (1.48)
Combined	-0.017** (-4.31)	0.001 (0.29)



Admin support	-0.007** (-4.72)	-0.006** (-4.43)
Teacher cooperation	-0.007** (-6.09)	-0.001 (-0.61)
Student disc problem	-0.000 (-0.38)	0.003** (3.66)
Principal effectiveness	-0.001 (-0.91)	-0.005** (-2.83)
Principal experience	-0.000* (-2.32)	-0.000+ (-1.82)
Principal has MA	0.029* (2.48)	0.012 (0.93)
Principal has PhD	0.028* (2.49)	0.001 (0.04)
Salary per \$1,000	-0.001** (-14.93)	-0.000 (-0.44)
Salary satisfaction	0.004** (3.46)	0.002+ (1.76)
Disc exp for educ Per \$1,000,000	0.000+ (1.67)	0.000 (1.17)
Percent FRPL	0.000 (0.82)	-0.000 (-1.01)
Percent FRPL missing indicator	0.000 (0.06)	0.005 (0.82)
Percent minority	0.000** (2.84)	0.000** (4.49)
Majority Black/Hispanic students	-0.004 (-0.89)	-0.002 (-0.40)
Percent IEP	-0.000 (-0.09)	-0.000 (-1.05)
Percent LEP	-0.000 (-0.43)	-0.000 (-0.59)
<i>N</i>	139,170	

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are marginal effects from multinomial logistic regression models at the means. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

+  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 9. Saturated models of multinomial logistic regression estimates of the determinants of movers and leavers for public school teachers including charter schools

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Young (<= 28 years)	1.499** (4.25)	1.548** (4.47)	1.612** (4.56)	1.689** (4.69)	1.590** (9.03)
Female	0.936 (-0.78)	0.820* (-2.36)	0.823* (-2.28)	0.870+ (-1.67)	0.861** (-3.53)
Black	0.867 (-0.92)	0.991 (-0.06)	1.233 (1.32)	1.325 (1.31)	1.101 (1.13)
Asian	1.155 (0.47)	0.837 (-0.86)	1.448 (1.26)	0.599 (-1.60)	0.926 (-0.56)
American Indian	0.887 (-0.51)	0.701 (-1.43)	0.822 (-0.60)	0.689 (-1.29)	0.770+ (-1.81)
Hispanic	1.282 (1.55)	0.560** (-2.69)	0.837 (-0.92)	1.163 (0.82)	0.917 (-0.90)
Princ-Tch gender congruence	1.115 (1.51)	0.915 (-1.29)	1.116 (1.46)	1.026 (0.33)	1.026 (0.68)
Princ-Tch race congruence	1.196+ (1.82)	0.771** (-2.71)	0.817* (-1.98)	0.983 (-0.16)	0.919 (-1.64)
PhD	1.829+ (1.69)	4.384** (3.92)	1.207 (0.38)	1.133 (0.32)	1.977** (3.17)
Master	1.278** (3.11)	1.133 (1.55)	1.289** (2.97)	1.426** (3.97)	1.262** (5.52)
Adv Grad Cert	1.121 (0.35)	1.293 (1.06)	1.215 (0.77)	1.078 (0.32)	1.166 (1.18)
Teach STEM subjects	0.979 (-0.21)	0.792** (-2.59)	0.958 (-0.48)	1.006 (0.07)	0.930 (-1.57)
Teach special ed	1.608** (4.56)	1.380** (3.27)	1.531** (3.92)	1.097 (0.81)	1.374** (5.97)
Standard/reg. cert	0.871 (-1.38)	0.846 (-1.51)	0.830+ (-1.70)	0.935 (-0.57)	0.869* (-2.57)
New teacher	1.304* (2.46)	1.077 (0.62)	1.392** (2.77)	1.605** (3.93)	1.312** (4.56)
Urban	1.149 (1.24)	1.058 (0.49)	1.080 (0.67)	1.251+ (1.78)	1.125* (2.00)
Suburban	1.369** (3.54)	1.165 (1.64)	1.279** (2.69)	1.049 (0.55)	1.203** (4.15)
Enrollment per 1,000 students	0.780** (-3.68)	0.855* (-2.15)	0.862* (-2.02)	0.678** (-5.02)	0.793** (-6.35)
Union	0.917 (-1.05)	0.842* (-2.00)	0.825+ (-1.92)	0.814+ (-1.91)	0.845** (-3.55)
Secondary	0.843* (-2.17)	0.746** (-3.64)	1.019 (0.23)	0.973 (-0.35)	0.880** (-3.23)

Combined	0.838 (-1.58)	0.663** (-3.32)	0.874 (-1.29)	0.799+ (-1.69)	0.777** (-4.01)
Admin support	0.839** (-3.92)	0.972 (-0.66)	0.889* (-2.15)	0.837** (-3.92)	0.886** (-5.10)
Teacher cooperation	0.874** (-3.59)	0.887** (-3.08)	0.860** (-3.95)	0.919+ (-1.95)	0.884** (-6.21)
Student disc problem	0.994 (-0.18)	1.016 (0.53)	0.941* (-2.03)	1.047+ (1.66)	0.998 (-0.13)
Principal effectiveness	0.991 (-0.18)	0.953 (-0.97)	0.961 (-0.69)	0.965 (-0.71)	0.969 (-1.20)
Principal experience	0.989* (-2.25)	1.003 (0.58)	0.992 (-1.36)	0.989+ (-1.91)	0.994* (-2.40)
Principal has MA	1.555 (1.34)	1.446 (1.59)	1.672+ (1.85)	0.900 (-0.36)	1.329+ (1.92)
Principal has PhD	1.468 (1.23)	1.303 (1.26)	2.009** (2.75)	0.858 (-0.57)	1.306+ (1.94)
Charter	1.299 (1.60)	0.776 (-1.58)	0.785 (-1.42)	0.711* (-2.10)	0.815* (-2.36)
Salary per \$1,000	0.973** (-7.97)	0.972** (-9.57)	0.978** (-6.19)	0.977** (-5.73)	0.975** (-14.34)
Salary satisfaction	1.033 (0.86)	1.071+ (1.88)	1.084* (2.05)	1.051 (1.23)	1.066** (3.33)
Disc exp for educ Per \$1,000,000	1.000 (1.10)	1.000* (2.22)	1.000 (1.16)	1.000 (-0.32)	1.000 (1.57)
Percent FRPL	1.005* (2.46)	1.000 (-0.07)	1.005* (2.05)	0.998 (-1.34)	1.001 (1.03)
Percent FRPL missing indicator	1.315 (1.58)	0.848 (-0.77)	1.038 (0.18)	0.768 (-1.28)	1.007 (0.07)
Percent minority	1.001 (0.58)	1.006* (2.46)	1.003 (1.27)	1.004 (1.41)	1.004** (3.08)
Majority Black/Hispanic students	0.966 (-0.24)	0.811 (-1.41)	0.842 (-1.09)	1.108 (0.63)	0.931 (-0.92)
Percent IEP	0.988** (-3.00)	1.004+ (1.70)	0.998 (-0.61)	0.999 (-0.29)	1.000 (-0.27)
Percent LEP	0.999 (-0.35)	0.999 (-0.32)	0.998 (-0.46)	0.999 (-0.17)	0.999 (-0.54)
Panel B: Leavers					
Young (<= 28 years)	1.366** (2.84)	0.892 (-0.99)	1.405** (2.94)	1.407** (2.89)	1.227** (3.56)
Female	1.085 (1.06)	0.855* (-2.01)	0.978 (-0.24)	0.992 (-0.09)	0.969 (-0.76)
Black	1.007 (0.05)	1.156 (0.99)	1.040 (0.26)	1.324 (1.61)	1.136 (1.60)
Asian	0.413**	0.844	1.211	0.489**	0.698**

	(-5.08)	(-0.94)	(0.71)	(-2.65)	(-2.94)
American Indian	0.938	0.886	0.830	0.796	0.903
	(-0.32)	(-0.46)	(-0.82)	(-0.75)	(-0.79)
Hispanic	0.762	0.670*	0.898	0.670*	0.746**
	(-1.62)	(-2.03)	(-0.57)	(-2.12)	(-3.04)
Princ-Tch gender congruence	1.213**	1.006	0.921	1.021	1.035
	(2.77)	(0.09)	(-1.11)	(0.28)	(0.94)
Princ-Tch race congruence	0.839+	0.983	0.991	0.845	0.911+
	(-1.91)	(-0.16)	(-0.08)	(-1.59)	(-1.79)
PhD	1.509	0.884	3.298**	1.500	1.673**
	(1.24)	(-0.40)	(3.41)	(1.13)	(2.90)
Master	1.142+	1.080	1.036	1.079	1.074+
	(1.75)	(0.99)	(0.42)	(0.86)	(1.73)
Adv Grad Cert	1.028	1.583*	1.026	0.834	1.123
	(0.11)	(2.53)	(0.12)	(-0.75)	(1.08)
Teach STEM subjects	1.061	0.901	1.307*	1.056	1.074
	(0.68)	(-1.10)	(2.47)	(0.62)	(1.48)
Teach special ed	1.098	1.128	1.441**	1.169	1.197**
	(0.87)	(1.16)	(3.22)	(1.26)	(3.12)
Standard/reg. cert	0.776**	0.594**	0.723**	0.952	0.730**
	(-2.68)	(-5.35)	(-3.09)	(-0.41)	(-6.11)
New teacher	1.173	1.216+	1.184	1.343*	1.238**
	(1.33)	(1.69)	(1.36)	(2.22)	(3.49)
Urban	1.264*	1.049	0.951	1.311*	1.130*
	(2.37)	(0.46)	(-0.43)	(2.45)	(2.27)
Suburban	1.160+	1.215*	0.982	1.278**	1.165**
	(1.68)	(2.33)	(-0.19)	(2.84)	(3.52)
Enrollment per 1,000 students	0.825**	0.841**	0.979	0.812**	0.849**
	(-3.33)	(-2.60)	(-0.31)	(-2.84)	(-4.90)
Union	0.857*	0.743**	0.814*	0.885	0.816**
	(-1.97)	(-3.38)	(-2.18)	(-1.24)	(-4.39)
Secondary	1.065	1.115	0.958	1.023	1.055
	(0.82)	(1.40)	(-0.46)	(0.27)	(1.30)
Combined	1.011	1.040	1.030	0.923	0.995
	(0.08)	(0.36)	(0.26)	(-0.58)	(-0.09)
Admin support	0.874**	0.908*	0.894*	0.913+	0.897**
	(-3.20)	(-2.45)	(-2.53)	(-1.86)	(-4.95)
Teacher cooperation	0.917*	1.023	0.989	0.986	0.979
	(-2.24)	(0.61)	(-0.26)	(-0.34)	(-1.07)
Student disc problem	1.076**	1.060**	1.044+	0.986	1.045**
	(2.92)	(2.70)	(1.74)	(-0.42)	(3.63)
Principal effectiveness	0.952	0.958	0.935	0.835**	0.922**
	(-1.12)	(-0.96)	(-1.25)	(-3.16)	(-3.19)
Principal experience	0.997	0.999	0.990+	0.995	0.995*
	(-0.59)	(-0.14)	(-1.86)	(-0.85)	(-2.02)
Principal has MA	0.967	1.441+	1.660	1.112	1.245

	(-0.10)	(1.95)	(1.36)	(0.39)	(1.47)
Principal has PhD	0.838	1.295	1.353	0.849	1.049
	(-0.55)	(1.58)	(0.85)	(-0.66)	(0.35)
Charter	1.806**	1.508**	1.924**	1.188	1.455**
	(3.68)	(3.10)	(4.36)	(1.20)	(4.99)
Salary per \$1,000	0.995 <sup>+</sup>	0.994*	1.000	1.000	0.997 <sup>+</sup>
	(-1.80)	(-2.01)	(-0.03)	(0.07)	(-1.73)
Salary satisfaction	1.042	1.007	1.078 <sup>+</sup>	1.040	1.044*
	(1.14)	(0.19)	(1.89)	(0.84)	(2.16)
Disc exp for educ	1.000	1.000	1.000*	1.000	1.000
Per \$1,000,000	(0.31)	(0.28)	(2.57)	(0.43)	(1.57)
Percent FRPL	1.000	0.999	1.001	0.997 <sup>+</sup>	0.999
	(-0.00)	(-0.59)	(0.52)	(-1.76)	(-0.95)
Percent FRPL missing indicator	1.146	1.197	1.078	1.059	1.109
	(0.92)	(1.19)	(0.30)	(0.30)	(1.18)
Percent minority	1.003	1.008**	1.005*	1.007*	1.006**
	(1.16)	(3.47)	(2.10)	(2.50)	(4.70)
Majority Black/Hispanic students	0.957	0.992	1.005	0.913	0.977
	(-0.32)	(-0.05)	(0.04)	(-0.62)	(-0.32)
Percent IEP	1.002	0.994	1.001	0.999	0.999
	(0.55)	(-1.32)	(0.35)	(-0.48)	(-0.79)
Percent LEP	1.004	0.996	0.998	1.000	0.999
	(1.11)	(-1.06)	(-0.51)	(-0.08)	(-0.52)
<i>N</i>	39,170	39,240	33,420	33,970	145,780

Note. Nationally-representative weights are employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$

Appendix Table 10. Saturated models of multinomial logistic regression estimates of the determinants of movers and leavers for public school teachers without sampling weights

Variables	(1) Wave: 2000	(2) Wave: 2004	(3) Wave: 2008	(4) Wave: 2012	(5) Pooled
Panel A: Movers					
Young (<= 28 years)	1.751** (9.06)	1.686** (8.83)	1.709** (8.62)	1.635** (7.51)	1.693** (17.08)
Female	0.949 (-0.99)	0.939 (-1.30)	0.800** (-4.39)	0.925 (-1.46)	0.899** (-4.17)
Black	0.891 (-1.11)	1.095 (0.99)	1.001 (0.01)	0.947 (-0.47)	0.986 (-0.27)
Asian	1.150 (0.89)	0.910 (-0.71)	1.359+ (1.77)	0.646* (-2.05)	1.015 (0.19)
American Indian	0.911 (-0.64)	0.683** (-2.71)	0.775 (-1.58)	0.832 (-0.90)	0.774** (-3.29)
Hispanic	1.129 (1.11)	0.816+ (-1.69)	1.041 (0.35)	1.022 (0.19)	1.003 (0.06)
Princ-Tch gender congruence	1.074 (1.52)	0.998 (-0.04)	0.989 (-0.23)	0.965 (-0.75)	1.004 (0.19)
Princ-Tch race congruence	1.115+ (1.71)	0.852** (-2.72)	0.907 (-1.52)	0.901 (-1.50)	0.942+ (-1.88)
PhD	1.471+ (1.69)	1.985** (2.72)	1.201 (0.58)	1.118 (0.38)	1.406** (2.58)
Master	1.217** (4.00)	1.138** (2.84)	1.310** (5.70)	1.384** (6.28)	1.245** (9.16)
Adv Grad Cert	0.943 (-0.31)	1.101 (0.67)	1.152 (0.83)	1.224 (1.25)	1.108 (1.26)
Teach STEM subjects	1.037 (0.63)	1.037 (0.64)	1.060 (1.01)	0.994 (-0.10)	1.036 (1.24)
Teach special ed	1.428** (5.55)	1.326** (4.82)	1.450** (5.81)	1.180* (2.42)	1.342** (9.29)
Standard/reg. cert	0.776** (-4.12)	0.841** (-2.58)	0.865* (-2.10)	0.852* (-2.15)	0.833** (-5.46)
New teacher	1.367** (4.57)	1.147* (1.97)	1.249** (3.13)	1.526** (5.61)	1.302** (7.47)
Urban	1.187* (2.48)	1.164* (2.36)	1.186* (2.44)	1.059 (0.77)	1.162** (4.40)
Suburban	1.357** (5.49)	1.111* (1.98)	1.151* (2.51)	1.016 (0.28)	1.159** (5.44)
Enrollment per 1,000 students	0.766** (-5.40)	0.792** (-4.94)	0.811** (-4.00)	0.720** (-6.00)	0.773** (-10.22)
Union	0.887* (-2.35)	0.878** (-2.66)	0.892* (-2.17)	0.875* (-2.26)	0.882** (-4.79)
Secondary	0.849** (-2.99)	0.773** (-4.89)	0.923 (-1.42)	0.846** (-2.99)	0.844** (-6.29)

Combined	0.923 (-0.92)	0.687** (-4.79)	0.785** (-3.08)	0.725** (-3.75)	0.772** (-6.42)
Admin support	0.871** (-5.01)	0.955+ (-1.73)	0.872** (-4.84)	0.879** (-4.26)	0.899** (-7.57)
Teacher cooperation	0.928** (-3.05)	0.908** (-4.27)	0.905** (-4.12)	0.948* (-2.01)	0.920** (-6.82)
Student disc problem	1.020 (1.03)	1.002 (0.13)	0.985 (-0.92)	1.071** (3.73)	1.015+ (1.67)
Principal effectiveness	0.941* (-1.99)	0.927** (-2.61)	0.973 (-0.88)	0.934* (-2.05)	0.941** (-3.90)
Principal experience	0.993* (-2.34)	0.999 (-0.21)	0.991** (-2.91)	0.991* (-2.38)	0.994** (-3.77)
Principal has MA	0.751 (-1.58)	1.308 (1.27)	0.908 (-0.39)	1.261 (0.82)	1.004 (0.03)
Principal has PhD	0.839 (-1.05)	1.169 (0.77)	0.997 (-0.01)	1.119 (0.41)	0.994 (-0.06)
Salary per \$1,000	0.977** (-10.31)	0.974** (-13.70)	0.976** (-11.28)	0.975** (-10.81)	0.976** (-23.09)
Salary satisfaction	1.000 (-0.01)	0.999 (-0.04)	1.001 (0.03)	1.048+ (1.84)	1.013 (1.16)
Disc exp for educ Per \$1,000,000	1.000 (1.47)	1.000 (1.43)	1.000 (0.76)	1.000 (1.07)	1.000* (2.23)
Percent FRPL	1.003** (2.86)	0.999 (-0.93)	1.002 (1.48)	1.000 (0.17)	1.001 (1.56)
Percent FRPL missing indicator	0.992 (-0.07)	1.037 (0.31)	1.043 (0.28)	0.842 (-0.95)	0.980 (-0.32)
Percent minority	1.000 (-0.00)	1.003+ (1.92)	1.003* (2.10)	1.005** (3.40)	1.003** (3.64)
Majority Black/Hispanic students	1.008 (0.08)	0.894 (-1.28)	0.896 (-1.23)	0.931 (-0.77)	0.931 (-1.60)
Percent IEP	0.995** (-2.83)	1.000 (0.02)	1.000 (-0.26)	1.001 (0.38)	0.999 (-1.27)
Percent LEP	0.999 (-0.38)	1.002 (1.22)	1.001 (0.50)	1.001 (0.39)	1.001 (0.96)

Panel B: Leavers

Young (<= 28 years)	1.354** (4.76)	0.985 (-0.23)	1.261** (3.38)	1.209** (2.59)	1.189** (5.15)
Female	0.995 (-0.10)	0.905* (-2.21)	0.999 (-0.02)	1.046 (0.86)	0.975 (-1.06)
Black	0.987 (-0.14)	1.122 (1.37)	1.107 (1.03)	1.107 (0.96)	1.082+ (1.67)
Asian	0.669** (-2.60)	0.892 (-0.88)	1.158 (0.82)	0.785 (-1.25)	0.864+ (-1.86)
American Indian	0.933	0.748* (1.22)	1.030 (0.50)	0.828 (0.39)	0.877+ (0.96)

	(-0.52)	(-2.17)	(0.19)	(-0.94)	(-1.76)
Hispanic	0.891	0.863	0.915	0.836	0.877*
	(-1.11)	(-1.35)	(-0.72)	(-1.54)	(-2.34)
Princ-Tch gender congruence	1.142**	1.098*	0.985	0.988	1.058*
	(3.06)	(2.25)	(-0.33)	(-0.26)	(2.55)
Princ-Tch race congruence	0.851**	0.934	1.003	0.936	0.923**
	(-2.89)	(-1.21)	(0.04)	(-0.98)	(-2.66)
PhD	1.129	1.246	2.516**	1.262	1.421**
	(0.60)	(0.89)	(4.31)	(0.95)	(3.15)
Master	1.218**	1.187**	1.051	1.005	1.119**
	(4.32)	(3.82)	(1.02)	(0.10)	(4.77)
Adv Grad Cert	1.048	1.375**	1.342+	0.883	1.180*
	(0.30)	(2.67)	(1.95)	(-0.72)	(2.28)
Teach STEM subjects	1.014	0.979	1.100+	0.999	1.028
	(0.27)	(-0.40)	(1.66)	(-0.02)	(0.99)
Teach special ed	1.077	1.130*	1.078	0.966	1.070*
	(1.13)	(2.07)	(1.08)	(-0.49)	(2.06)
Standard/reg. cert	0.663**	0.594**	0.645**	0.857*	0.667**
	(-7.12)	(-8.52)	(-6.66)	(-2.05)	(-12.88)
New teacher	1.200**	1.521**	1.194*	1.302**	1.311**
	(2.60)	(5.98)	(2.37)	(3.14)	(7.36)
Urban	1.109	1.002	0.899	1.132+	1.032
	(1.62)	(0.03)	(-1.53)	(1.74)	(0.98)
Suburban	1.080	1.085	0.934	1.105+	1.051+
	(1.43)	(1.56)	(-1.22)	(1.82)	(1.85)
Enrollment per 1,000 students	0.874**	0.890**	0.894*	0.816**	0.866**
	(-3.22)	(-2.88)	(-2.46)	(-4.07)	(-6.66)
Union	0.781**	0.780**	0.768**	0.792**	0.781**
	(-5.10)	(-5.21)	(-4.95)	(-4.02)	(-9.64)
Secondary	1.084	1.107+	1.043	0.993	1.070*
	(1.49)	(1.95)	(0.72)	(-0.12)	(2.53)
Combined	1.178+	1.015	1.000	0.951	1.045
	(1.92)	(0.19)	(0.01)	(-0.62)	(1.14)
Admin support	0.861**	0.915**	0.849**	0.839**	0.869**
	(-5.64)	(-3.53)	(-6.04)	(-5.86)	(-10.42)
Teacher cooperation	0.948*	1.004	1.003	0.983	0.983
	(-2.31)	(0.16)	(0.13)	(-0.64)	(-1.38)
Student disc problem	1.047**	1.032*	1.029+	0.993	1.029**
	(2.67)	(2.30)	(1.93)	(-0.29)	(3.69)
Principal effectiveness	0.946+	0.958	0.953	0.948	0.952**
	(-1.95)	(-1.49)	(-1.53)	(-1.56)	(-3.26)
Principal experience	1.000	1.000	0.992*	0.995	0.997+
	(-0.08)	(-0.05)	(-2.27)	(-1.43)	(-1.91)
Principal has MA	0.900	1.075	1.214	1.028	1.044
	(-0.60)	(0.36)	(0.78)	(0.11)	(0.41)
Principal has PhD	0.877	0.979	1.174	0.903	0.979



	(-0.79)	(-0.11)	(0.67)	(-0.41)	(-0.21)
Salary per \$1,000	0.994**	0.996 <sup>+</sup>	1.001	0.996 <sup>+</sup>	0.997**
	(-3.40)	(-1.92)	(0.48)	(-1.69)	(-3.26)
Salary satisfaction	1.000	1.008	1.053*	1.046 <sup>+</sup>	1.026*
	(-0.01)	(0.37)	(2.19)	(1.75)	(2.28)
Disc exp for educ	1.000*	1.000	1.000	1.000	1.000 <sup>+</sup>
Per \$1,000,000	(2.09)	(1.45)	(0.63)	(0.33)	(1.91)
Percent FRPL	1.000	1.000	1.002 <sup>+</sup>	0.997*	1.000
	(0.34)	(-0.12)	(1.71)	(-2.30)	(-0.16)
Percent FRPL missing indicator	1.080	1.009	1.053	0.978	1.047
	(0.85)	(0.08)	(0.36)	(-0.15)	(0.80)
Percent minority	1.001	1.007**	1.003*	1.007**	1.004**
	(0.88)	(4.84)	(2.13)	(4.44)	(6.34)
Majority Black/Hispanic students	1.082	0.975	1.127	0.938	1.034
	(0.93)	(-0.32)	(1.37)	(-0.72)	(0.79)
Percent IEP	0.998	0.994**	0.997 <sup>+</sup>	0.999	0.997**
	(-1.06)	(-3.28)	(-1.92)	(-0.65)	(-3.55)
Percent LEP	0.999	0.997 <sup>+</sup>	0.997	0.999	0.998*
	(-0.45)	(-1.67)	(-1.48)	(-0.53)	(-2.19)
<i>N</i>	36,770	38,240	32,390	31,770	139,170

Note. Nationally-representative weights are not employed. All models include wave and state fixed effects. Point estimates are odds ratios from multinomial logistic regression. T-statistics using heteroskedastic-robust standard errors are in parentheses. Observations have been rounded to the nearest 10 per IES compliance.

<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ , \*\*  $p < 0.01$