Abstract Title Page
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Title:
Missed Opportunities in the Labor Market or Temporary Disruptions? How Late Teacher Hiring
Affects Student Achievement

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Abstract Body
Limit 4 pages single-spaced.

Background / Context:
　　　The hiring process in schools, as in any organization, serves multiple purposes. Most importantly, it is a job matching process in which teachers choose schools and schools choose teachers. Hiring is also the first step in a teacher's induction to her school, the district, and, for novices, to the profession. Thus, an effective hiring process can help set a teacher up for success by providing them with a good school match, a clear preview of the work required, and support to thrive. Unfortunately, in many U.S. school districts the hiring process is, as Liu and Johnson (2006) described, "late, rushed, and information-poor."

　　　In a study relying on nationally representative Schools and Staffing Survey data, Engel (2012) found that 34 percent of teachers hired in 1999-2000 were hired in the second half of summer, and another 11 percent were hired after the school year had begun. Urban districts and those serving large proportions of low-income students struggle the most to fulfill their staffing needs on time. Johnson et al. (2004) documented a 20-percentage point gap in the proportion of teachers hired late between low-income (28 percent) and high-income (8 percent) schools.

　　　A variety of causes contribute to these persistent late hiring patterns. In a widely-referenced study from The New Teacher Project on school district hiring practices, Levin and Quinn (2003) categorized the causes of late hiring into two broad domains: (1) human resources department capacity and (2) district staff and budget policies. They explained that, in many districts, human resources departments do not have clear and strategic hiring goals, have insufficient systems to project vacancies and track applicants, and offer candidates poor customer service and communication. District policies also contribute to hiring delays, as many districts permit teachers to notify their schools late in the spring if they plan to leave or transfer schools and give transferring teachers first priority to choose a position before a search can be opened to the external candidate pool. In addition, some principals are simply more effective than others at recruiting teachers and working with the district central staff to shepherd new hires through the human resources system.

Purpose / Objective / Research Question / Focus of Study:
　　　Whatever the reason for late teacher hiring, such delays may hurt students and schools. We posit three broad mechanisms: negative selection in the teacher labor market ("labor market effects"), temporary disruptions for students and teachers ("disruption effects"), and spillovers resulting from increased teacher turnover in the school. The first two of these mechanisms focus on the direct effect of late hiring on students in that teacher's classroom, while the last one reflects broader, indirect effects on students in the school.

　　　Most obviously, districts that hire late have a reduced pool of applicants from which to choose. They face what Levin and Quinn (2003) call "missed opportunities" to hire the most qualified candidates in the labor market. This "labor market effect" would mean that the teachers hired late are, on average, less effective than their peers. Late hiring can also have a temporal "disruption effect" on teachers and students. For example, teachers who are hired late may not have sufficient time to prepare for the start of the school year, while their students must deal with instability at the start of the year and a transition to a new teacher or classroom. Finally, late hiring can have negative spillover effects on other teachers and students in a school. For example, the lack of a good job match that comes from a delayed and ineffective hiring process can raise teacher turnover, which in turn can reduce student achievement (Ronfeldt et al., 2012).

While there are many reasons why late hiring may affect student achievement, no empirical studies have documented this effect in practice. We present the first estimates of the direct impact of late hiring on students' academic achievement. Furthermore, we shed light on two competing explanations for the struggles of late-hire teachers advanced in the literature – labor market effects and disruption effects. Finally, we examine broader consequences of late hiring on student achievement, including spillover effects that occur from increased teacher turnover. Specifically, we ask the following three research questions:

1. *Do the observable characteristics of teachers who are hired late and the schools that hire them differ from on-time hires?*
2. *Does late hiring reduce student achievement? If so, are labor market effects or disruption effects to blame?*
3. *Are teachers who are hired late more likely to switch schools or leave the school district?*

Setting, Sample, & Practice:

We use a comprehensive administrative dataset from a large, urban school district in the southern United States that includes student, teacher, and test records from the 1999-2000 to the 2009-10 school years. This district has over 130,000 students and nearly 9,000 teachers. During the period we studied, the district was growing rapidly, hiring hundreds of teachers in every year. The district used a hybrid model of teacher hiring, in which potential candidates could apply directly to individual schools or to the central office. Any candidates who applied to the central office were referred to schools that appeared to be good matches. School principals had much say over hiring decisions, but all candidates had to submit an official application to the central office before a formal offer could be extended.

We use two different samples of teachers, one for our descriptive analyses and one for our analyses of late hiring's effect on student achievement. For our descriptive analyses, we examine all teachers in the district. Here, we include more than 10,000 unique teachers over the 10-year panel. For our central analyses that examine the effects of late hiring on student achievement, we focus on teachers in grades four through eight in mathematics and English, with almost 4,000 unique teachers and more than 300,000 student-year records.

Research Design and Analysis:

Our preferred model examines the effect on student achievement of late hiring and allows the effect to differ in a teacher's first year in the district and in subsequent years (to disentangle the labor market and disruption effects), as follows:

$$
(1) \quad \begin{aligned}
Y_{it} = &\alpha_g[f(Y_{i,t-1})] + \beta_1 LATE_j + \beta_2 NEWHIRE_{jt} + \beta_3 LATExNEWHIRE_{jt} \\
&+ \gamma[f(EXPER_{jt})] + X_{it}'\delta + \overline{X_{jt}}'\varsigma + \overline{X_{st}}'\varphi + \theta_{gt} + \varepsilon_{it}
\end{aligned}
$$

for student i with teacher j in school s, grade g, and year t. In all models, we include a cubic polynomial of the student's previous year's test scores in both math and reading ($f(Y_{i,t-1})$) and grade-by-year fixed effects (θ_{gt}). We allow the effects of prior-year test scores to vary by the student's grade. We include the student demographic characteristics described above in the student-level control vector, X_{ijt}. We also include a vector of teacher-year-level means ($\overline{X}_{jt}$) and school-year-level means ($\overline{X}_{st}$) of these student demographic characteristics, to account for classroom and school composition effects. In all models, we also include controls for the teacher's experience level, specified as a full set of dummy variables, to account for any

differences in classroom experience between standard- and late-hired teachers.

Our primary predictors of interest are the main effect of being a late hire, the main effect of being a new hire, and their interaction. Linear combinations of the parameters associated with these predictors, β_1, β_2, and β_3, allow us to uncover the effect, relative to a teacher hired in earlier years, of being in the classroom of a newly-hired teacher who was hired on time (β_2) or hired late ($\beta_1+\beta_2+\beta_3$). We are primarily interested in comparisons between late- and standard-hired teachers in their first year. Thus, the parameter sum ($\beta_1 + \beta_3$) represents the total effect on student achievement of being assigned to a late-hired teacher's classroom (as opposed to a standard-hired teacher's classroom) in the year the teacher was hired late. Examining the individual parameters separately enables us to describe the mechanisms underlying any potential effect. Parameter β_1 represents the permanent effect of late hiring that is common to all years, including the teacher's first year in the district. Conversely, β_3 represents the effect on student achievement that *only* occurs in the year a teacher was hired late or the temporary "disruption effect." In the paper, we examine a range of threats to validity and find that our results are quite robust to these threats, including different specifications of our model.

Our third research question asks whether teachers who are hired late are more likely to switch schools or leave the school district. We answer this question by using discrete time survival analysis (DTSA) to estimate the "risk" that a late-hired teacher transfers schools or exits the district compared to a standard-hired teacher (Singer & Willett, 2003). We model the hazard (i.e. the conditional probability) of exiting the district using logistic regression, as follows:

$$\text{logit } h(EXIT_{jt}) = \tau_t \sum_{k=1}^{11} I_{t=k} + \phi LATE_j + \pi_t \sum_{k=2}^{11} (I_{t=k} x LATE_j)$$

Here, we examine the probability that teacher j exits the district in time t, conditional on having not left the district in previous years; we fit analogous models for transfer by substituting our outcome $TRANSFER_{jt}$ for $EXIT_{jt}$. We model time as a complexly flexible function of indicator variables, $\sum_{k=1}^{11} I_{t=k}$. The inclusion of the main effect of being a late-hired teacher and its interaction with the full set of time indicators allows us to estimate whether late-hired teachers have a greater probability of leaving the district after each year than their peers hired on time.

Findings / Results:

We find that most teachers are hired by the beginning of the school year; however, of teachers who start in the fall, 18% are hired after the school year starts. Late-hired teachers differ from their peers in the district in several ways. In Table 1, we present the characteristics of standard and late hires. We find a greater proportion of male and African-American teachers among late hires than among on-time hires. Furthermore, late-hired teachers are both older on average (by 3.6 years) and more likely to have entered the profession by alternative routes (by 11 percentage points) than teachers hired on-time. Teachers who are hired late also tend to work in different types of schools than their peers who are hired on-time. In Table 2, we present the characteristics of schools in which teachers work, by the timing of their hire. On average, the schools with more late hires are lower-performing, serve greater proportions of African-American students and have higher rates of absenteeism.

Importantly, late-hired teachers also tend to cluster in certain schools. In Figure 1, we present the proportion of each school's new hires that were hired late across the ten-year period that we study. We find that nearly 10% of all schools in the district are able to hire all of their teachers before the beginning of the school year. By contrast, 30% of schools hire more than one

of every five new hires after the school year starts. We find that 20% of the district's schools account for 53% of the total number of late hires. Late-hiring is more prevalent in middle and high schools than in elementary schools, where only 13% of teachers are hired late.

We find strong evidence that being assigned to a classroom with a teacher hired after school starts in the fall reduces student achievement. Students in classrooms with late-hired teachers underperform those with other new teachers hired over the summer by 0.045 standard deviations in reading ($p<0.001$) and 0.057 standard deviations in mathematics ($p<0.001$). We present these results in the first row of each panel in Table 3; the first column includes our preferred specification, where we control for school-level average characteristics in addition to student-level and classroom-level demographics.

Interestingly, we find that the mechanism underlying these effects differs by subject. In math, the labor market effect appears to dominate, while in reading the disruption effect is most important. In math, teachers who were hired late continue to underperform their peers by 0.045 standard deviations ($p<0.001$) after their first year. This suggests that math teachers who are hired after the beginning of the school year are less effective teachers, on average, than their peers who secure jobs before the start of the school year. We find only suggestive evidence of a first-year disruption effect in math on the order of 0.012 SD, although this effect is not statistically significant. By contrast, the disruption effect appears to account for all of the effect of late hiring in reading. Late-hired English teachers perform no different than standard-hired teachers after their first year, as evidenced by our near zero estimate of the labor market effect.

Finally, we find that late-hired teachers are much less likely to stay in the district than standard-hired teachers, and those who remain are more likely to transfer schools. We present our results on teacher retention from our discrete-time survival analysis models in Table 4. We show our results from teacher exits in the top panel and teacher transfers in the bottom panel. For example, the second row (labeled "After 2nd Year") suggests that, among all teachers who stayed in the district for a second year, 19.8% of on-time hires did not return for a third year, compared to 23% of late hires (a 3.2 % point difference). In the bottom panel, we present analogous findings from our analysis of teacher transfers. We illustrate these differences in Figure 2.

Conclusions:

Teacher hiring is a critical, but often overlooked, element of the larger human capital pipeline in education. In district we study, nearly 20% of teachers are hired in the fall after the school year begins. Ultimately, students pay the price for these delays. When students are assigned to teachers who have been hired after the school year starts, their achievement suffers compared to their peers assigned to other newly hired teachers. Furthermore, teachers who are hired late leave their schools and the district at much greater rates than their peers hired on time. These turnover patterns contribute to late-hiring's effects on student achievement. When teachers leave the district, they are replaced by new hires, many of whom are novice teachers. On average, these teachers are less effective at raising student achievement than teachers who remain in the district. And, the instability caused by turnover disrupts the school organization and reduces student achievement (Ronfeldt et al, 2011).

Our findings suggest that simply attempting to recruit stronger candidates after the school year has begun will not eliminate the negative consequences of late hiring. Instead, schools and districts must also work to limit the disruption caused by late hiring. Targeting extra support to late-hired teachers cannot solve all of the challenges posed by late hiring, but it can help districts limit the negative effects of this practice, at least in the near term.

Appendices
Not included in page count.

Appendix A. References

Engel, M. (2012). The timing of teacher hires and teacher qualifications: Is there an association? *Teachers College Record, 114*(12).

Johnson, S.M., Kardos, S.M., Kauffman, D., Liu, E., & Donaldson, M.L. (2004). The support gap: New teachers' early experiences in high-income and low-income schools. *Education Policy Analysis Archive, 12*.

Liu, E., & Johnson, S.M. (2006). New teachers' experiences of hiring: Late, rushed, and information-poor. *Educational Administration Quarterly, 42*(3), 324-360.

Levin, J., & Quinn, M. (2003). Missed opportunities: How we keep high-quality teachers out of urban classrooms. New York: The New Teacher Project.

Ronfeldt, M., Lankford, H., Loeb, S., & Wyckoff, J. (2011). How teacher turnover harms student achievement. National Bureau of Economic Research Working Paper No. 17166.

Singer, J.D., & Willett, J.B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York; Oxford University Press.

Appendix B. Tables and Figures

Figure 1. Distribution of the percentage of new hires in a school who were hired late, across schools in the district.
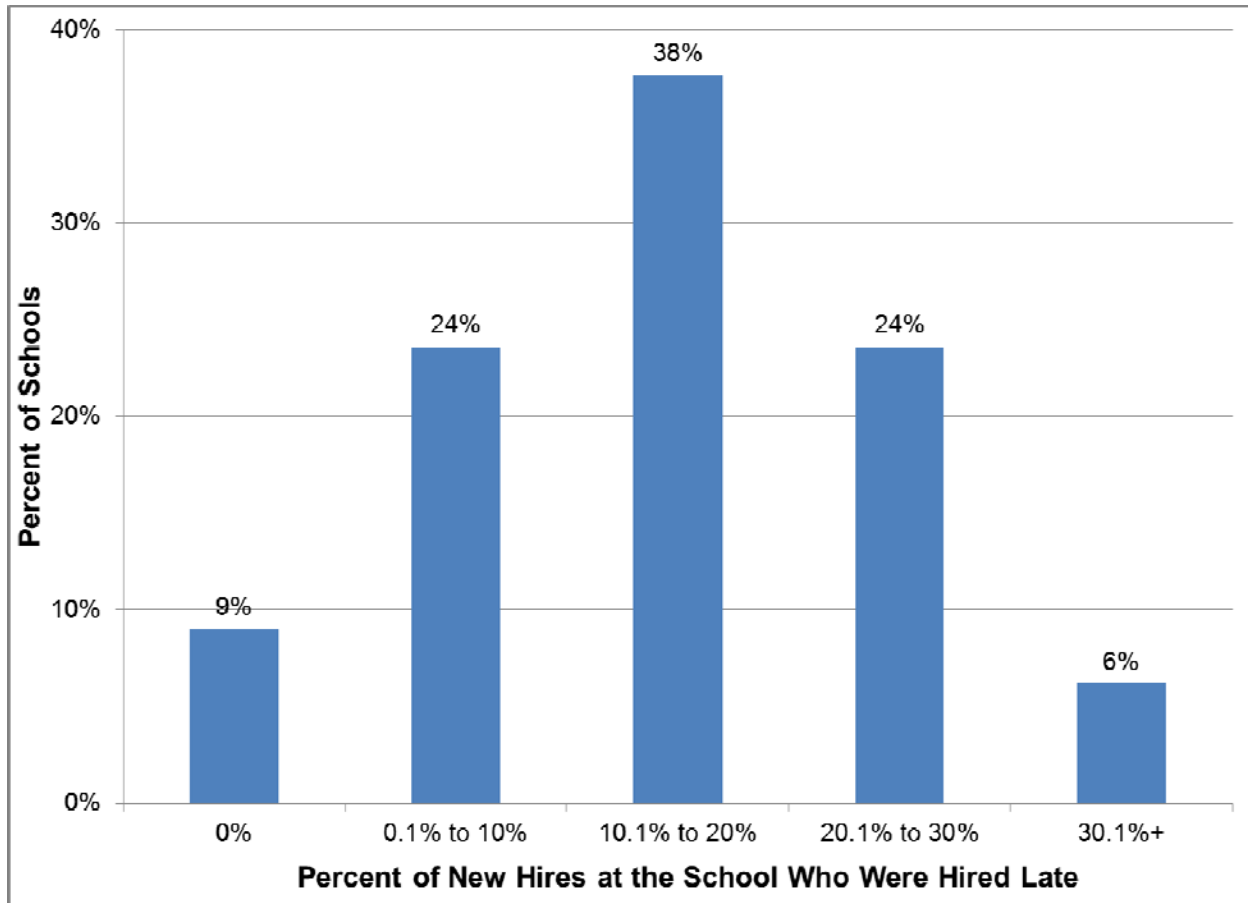
Figure 2. Estimated hazard probability of leaving the district (top panel) and estimated survival probability of remaining in the district (bottom panel), by year for standard and late-hired teachers.
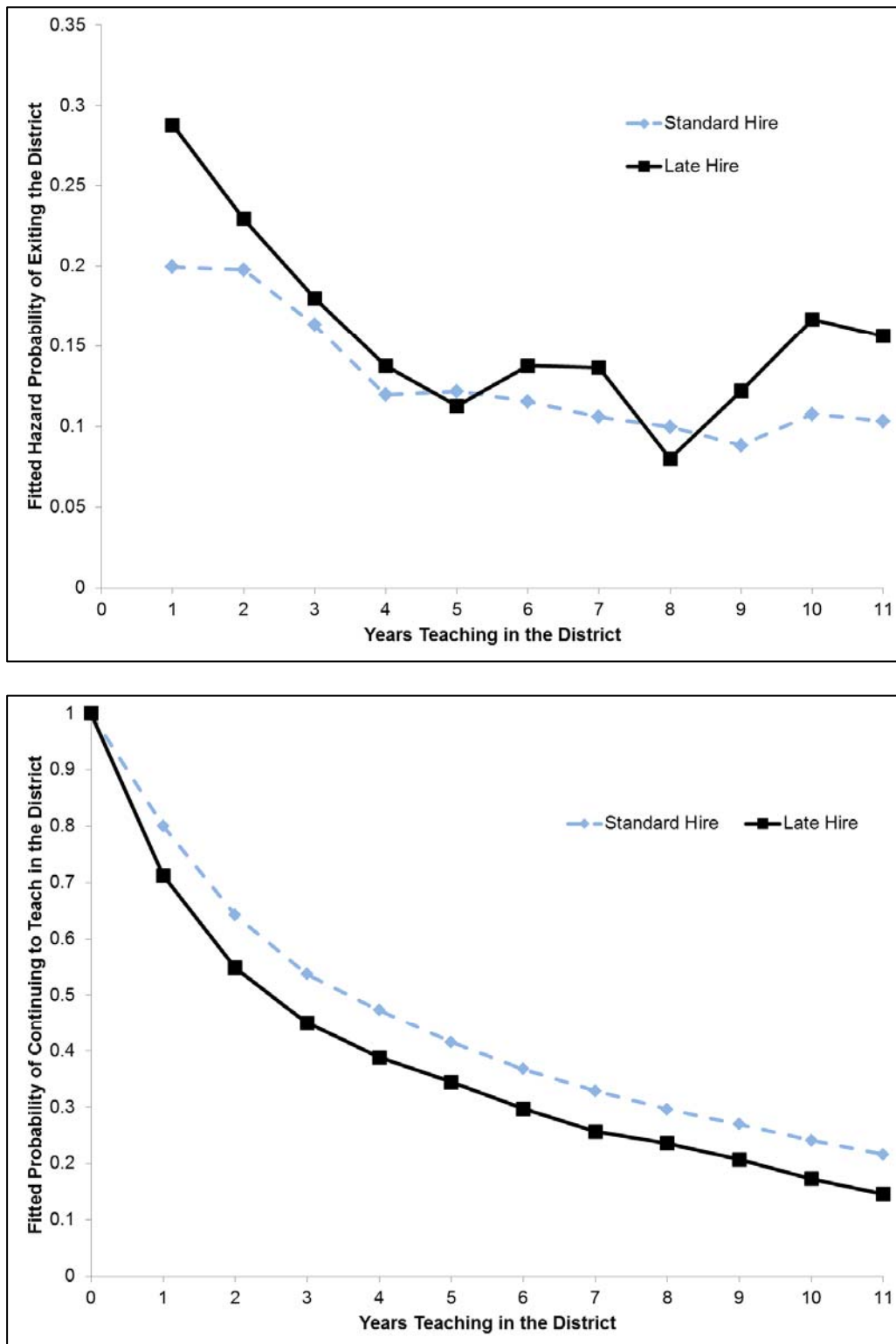
Table 1. Average characteristics of late-hired and standard-hired teachers in the district.

Teacher Characteristic	Standard Hires	Late Hires	Difference
Male	21.5%	26.8%	5.3% ***
African-American	20.0%	28.3%	8.3% ***
Asian	1.4%	1.4%	0.0%
Hispanic	3.3%	3.8%	0.5%
Alternative Pathway	25.8%	36.5%	10.7% ***
Math License	10.2%	7.9%	-2.3% **
English Language Arts License	15.1%	11.9%	-3.2% ***
Masters Degree	23.0%	18.7%	-4.3% ***
Novice (1st salary step)	50.1%	54.8%	4.7% ***
Age	31.6	35.2	3.6 ***

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$. N=10,616.

Table 2. Average characteristics of the schools in which standard-hired and late-hired teachers teach.

School Characteristic	Standard Hires	Late Hires	Difference
Average math score (previous year)	-0.07	-0.12	-0.05 ***
Average reading score (previous year)	-0.10	-0.14	-0.04 ***
School met AYP	34.8%	28.8%	-6.0% ***
Average days absent	9.08	10.09	1.01 ***
% Poverty	49.3%	50.8%	1.5% ~
% LEP Students	9.8%	9.5%	-0.3%
% SPED Students	10.1%	10.1%	0.0%
% Asian Students	4.3%	4.4%	0.1%
% Hispanic Students	10.8%	10.0%	-0.8% **
% African-American Students	46.0%	48.4%	2.4% ***

Note: *p<0.05, **p<0.01, ***p<0.001.

Table 3. Effect of late teacher hiring on student achievement, in math (top panel) and reading (bottom panel), from different specifications of equation (1).

	Late-Hired vs. Standard-Hired Teachers			
	Preferred Model	School Fixed Effects	School-Grade-Year Fixed Effects	Student Fixed Effects
Mathematics				
1st Year	-0.057 ***	-0.051 ***	-0.044 ***	-0.042 ***
	(0.013)	(0.013)	(0.012)	(0.012)
"Labor Market Effect"	-0.045 ***	-0.033 ***	-0.026 ***	-0.039 ***
	(0.008)	(0.008)	(0.007)	(0.008)
"Disruption Effect"	-0.012	-0.019	-0.018	-0.003
	(0.016)	(0.015)	(0.014)	(0.014)
Observations	367,139	367,264	367,264	367,221
Reading				
1st Year	-0.045 ***	-0.036 **	-0.030 **	-0.037 **
	(0.012)	(0.010)	(0.011)	(0.012)
"Labor Market Effect"	0.006	0.009	0.004	-0.002
	(0.006)	(0.006)	(0.006)	(0.006)
"Disruption Effect"	-0.051 ***	-0.045 ***	-0.034 **	-0.035 **
	(0.013)	(0.012)	(0.013)	(0.013)
Observations	311,070	311,159	311,159	311,144
School-level averages	X			X
Grade-by-year fixed effects	X	X		X
Teacher experience controls	X	X	X	X

Notes: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Standard errors clustered by school-by-grade-by-year reported in parentheses.

Table 4. Fitted hazard probabilities of exiting the district (top panel) or transferring schools within the district (bottom panel) for standard-hired and late-hired teachers, by year in the district.

Years in District	Average for Standard Hires	Difference for Late Hired Teachers		
		Overall	Controlling for Experience	Controlling for School Fixed Effects
Exit the District				
After 1st Year	0.200	0.088 ***	0.087 ***	0.077 ***
After 2nd Year	0.198	0.032 *	0.033 **	0.027 *
After 3rd Year	0.163	0.017	0.016	0.031
After 4th Year	0.120	0.018	0.017	0.001
Transfer Schools within the District				
After 1st Year	0.051	0.019 **	0.016 ***	0.022 ***
After 2nd Year	0.083	0.002	0.003 *	0.003 *
After 3rd Year	0.075	-0.012	-0.006	-0.010
After 4th Year	0.085	-0.011	-0.006	-0.004

Notes: ~ p<0.10, *p<0.05, **p<0.01, ***p<0.001.