Teacher Turnover in Wisconsin

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Abstract

Given the consistently-affirmed importance of teacher quality to student success, understanding teacher churn is crucial to formulating and evaluating teacher labor market policy. This paper replicates the analysis of Hanushek, Kain, and Rivkin (2004) over a longer and more recent time period in Wisconsin and confirms all of its major findings, namely that while inter-district pay differentials are a significant determinant of turnover, school quality measures are much better predictors of all three types of churn – within and between school districts and out of local public schools.

Introduction

Good teachers have large impacts on student achievement[1]. It is therefore imperative for public schools to be able to attract and retain high-quality teachers. Of preeminent concern for policymakers, then, is the strength of the various manipulable levers at their disposal for influencing teacher labor markets. More specifically, state education administrators would like to identify the policy implications of various tools on three types of teacher mobility: intra-district switching, where due to the collectively bargained nature of most teachers' salaries, only nonpecuniary considerations matter, inter-district switching, where teachers move to another school district in the same state, and exo-district switching, where teachers leave the public teaching workforce entirely[2].

[1] See, e.g., Rockoff (2004).

[2] Policies that affect the supply and quality of new teachers to the profession may also be of considerable importance to replenishing and improving the stock of teachers over time, but we do not consider these channels in this work. See Harris and Sass (2011), Wayne et al. (2008), and Boyd et al. (2009).

In this paper, we consider pecuniary and non-pecuniary predictors of various types of teacher churn in replicating the analyses of Hanushek, Kain, and Rivkin (2004) in a new context (Wisconsin) and time horizon (2000 - 2007). The headline results of Hanushek, Kain, and Rivkin (2004) were "that teacher mobility is much more strongly related to characteristics of the students, particularly race and achievement, than to salary, although salary exerts a modest impact once compensating differentials are taken into account." We confirm the pith of this conclusion, namely that student characteristics are a much better predictor of turnover than are wage differentials, though we come to different conclusions regarding more specific points. In fact, while we do find strong evidence that the socioeconomic makeup of a teacher's district predicts turnover (and that there is heterogeneity in this effect by teacher race), the evidence we find for the importance of wages and student achievement is far from compelling.

We explore to the extent possible potential contributors to this discrepancy in results; most salient are the differences between Texas, where Hanushek, Kain, and Rivkin (2004) conduct their study, and Wisconsin. Wisconsin is a largely rural state – its largest city/metropolitan area (in fact it is the only city considered to be "large" for NCES reporting purposes), Milwaukee, currently has roughly 600,000 residents (1,500,000 including the metropolitan area), making it around the 30th-largest city in the United States. By contrast, Texas has six cities larger than this, with El Paso being the nearest in size to Milwaukee. Though the non-urban parts of Texas are themselves sparsely populated and distinctly rural, the more uniform lack of major population centers in Wisconsin is likely to be reflected in considerably different preferences among local residents for various aspects of potential teaching positions.

Literature Review

Because the potential policy implications of turnover in the teaching profession (from human capital and equity/distributional perspectives both) are far-reaching and polypartisan, the literature on turnover-related topics in education is extensive. As relates to this paper, there are five broad (and often overlapping) categories of inquiry: the relationship between turnover and wages, which has tended to focus on "opportunity wages" outside of the field of education; the relationship between turnover, school demographics, and other nonpecuniary benefits, which has tended to focus on distributional inequalities–whether teachers with certain characteristics are more or less likely to be teaching certain disadvantaged groups; the relationship between turnover and teacher quality as measured by student performance, usually value added (VA); collective bargaining agreements in education, focusing by and large on the implications (or lack thereof) of seniority-preferential clauses; and the recent phenomenon of specific retention incentives, the provisioning of wage bonuses to teachers willing to teach in high-needs schools.

One of the earliest papers attempting to rigorously investigate turnover was a panel study of teachers in Michigan by Murnane and Olsen (1990), who used college degree field wages outside of education as opportunity wages, finding the expected lower exit rate for teachers with higher wages in teaching relative to the authors' defined alternative. Dolton and Van der Klaauw (1999) use panel data on university graduates in the United Kingdom to estimate a competing risks model of the decision to leave teaching entirely, finding results in line with Murnane and Olsen (1990). Returning to panel studies in the US, Loeb and Page (2000) use PUMS data to get an idea of teacher relative wages in many states and find that dropout rates fall when teacher relative wages are high. Stinebrickner (2002) also uses panel data (this time NLS-72) to track both teachers and non-teachers, focusing in particular on young teachers who leave the profession for long stints, and finds that the best predictor of female exit is recent childbearing, which is an important consideration for all work related to teacher turnover because such a high percentage (76 nationwide) of teachers are female. Lastly, Hanushek, Kain, and Rivkin (2004) focuses on teachers in Texas and emphasizes that the characteristics of students are much stronger factors in predicting teacher exit than are wages (while also affirming the statistical significance of pay).

While wages have been found consistently to have some measurable effect on teacher turnover, it is impossible to explain within-district migration (which constitutes a large portion of switching–as much as 50%) through wage-only channels because contracts are fixed at the district level. As such, another strand of literature has chosen to focus on the nonpecuniary aspects of the decision to take a teaching job–school environment/rapport, student enthusiasm, neighborhood characteristics, etc.–usually by directing attention to a single district so that any wage-based considerations are stifled, as is the case for Boyd et al. (2005) and Engel, Jacob, and Curran (2014). Boyd et al. (2005) track early-career teachers in New York City as they quit or transfer out of the city, and most importantly finds that commuting time is an important, often overlooked aspect of location preference. Engel, Jacob, and Curran (2014) leverages a unique data set from Chicago Public School job fairs which affords them a rather strong measure of teachers' demand for vacancies, neutralizing the influence of school administration's behavior on turnover (through poor match selection or other means). The authors contribute evidence that the school's neighborhood (perhaps due to ambient crime or other reputational effects good and bad) is a better predictor of teachers' preference than distance from home, going somewhat against the grain of Boyd et al. (2005). Scafidi, Sjoquist, and Stinebrickner (2007) examine statewide data from Georgia, but ignore wage effects, choosing instead to focus on disentangling the contributions of low student achievement and minority status to turnover; they find that minority status is the more salient associate of teacher exit.

The key element missing from all of the above studies is perhaps the most important consideration in the issue of teacher turnover–teacher quality. None of the studies above have student-teacher matched data, and so are unable to directly associate student outcomes with any given teacher. If, with respect to any measure of quality you would like, we find that transitioning teachers are identical to their replacements, the issue of teacher turnover is not, in fact, much of an issue. Thus, the recent trend in the literature to incorporate measures of teacher quality (in large part made possible by a trend towards administrative records allowing students to be linked to teachers and tracked over time) in considerations of teacher turnover has made big strides in addressing the most policy-relevant questions to be asked. The most common and widely accepted measure of teacher quality is VA[3] (in its various guises), and the literature has begun to incorporate such measures into studies of teacher

[3] The most commonly cited expositions on value-added, its validity, and so on are probably Rivkin, Hanushek, and Kain (2005), an extensive exploration of the predictive powers of empirical Bayes VA measures; and Chetty, Friedman, and Rockoff (2014a) and Chetty, Friedman, and Rockoff (2014b), the largest-scale study of long-term inferences based on VA.

turnover. Hanushek and Rivkin (2010) consider VA as a measure of teacher productivity, and ask if common results of labor search theory (namely that turnover falls with tenure and that turnover is negatively associated with match-specific productivity) continue to hold in the education labor market. In fact, the authors find that the teachers most likely to switch schools are those with low measured match quality, and especially that those who leave teaching entirely are those with the lowest match quality. The results are more pronounced for schools with high proportions of low-SES students, which has strong policy implications, as it appears the best teachers in high needs schools are the least likely to change jobs. Goldhaber, Gross, and Player (2007) performs a similar analysis with the longitudinal data of North Carolina and comes to similar conclusions, strengthening the robustness of the results. Lastly, Goldhaber, Lavery, and Theobald (2015) examine the inequity in the distribution of teacher quality by high-needs groups in Washington state, and find that for all three measures of quality (teacher experience, licensure exam score, and VA), the distribution of teachers favors the less needy (as measured by free/reduced-price lunch status, minority status, and low prior academic achievement).

The aforementioned papers have tended to keep the collective bargaining aspect of salary determination for teachers out of the spotlight, if largely for reasons of data restrictions. Nevertheless, it stands to reason to believe that the rigid structure of union-negotiated contracts could serve to contribute in a large way to teacher turnover. Ballou and Podgursky (2002) give much descriptive evidence of the shape of the wage-tenure profile, rooted in a data set collected by the Department of Defense and published by the AFT. They find that seniority premia in education largely mirror those in more traditional white collar professins, that steeper profiles are associated with less turnover, and that district financial and demographic conditions alone are insufficient to explain variation in contracts. Another common (and recently quite controversial, as evidenced by the contention in the ongoing contract negotiations in Philadelphia) feature of union-negotiated teacher contracts are seniority priviliges–preferential treatments granted to teachers in voluntary and involuntary transfers. Moe (2006) codes contracts from 158 districts in California according to the strength of seniority rights therein guaranteed to teachers and finds that such rights are associated with the distribution of teachers across schools (measuring quality as experience and certification) in a way that serves to harm minorities. Revisiting California with a slightly different sample and definition of the "determinacy" of the contracts with respect to seniority, Koski and Horng (2007) come to the opposite conclusion–that there is no such relationship. As a rebuttal, Anzia and Moe (2014) pin the difference in results on the exclusion in Moe (2006) of small school districts, where it appears that the entrenchment of bureaucracy falters and the rigidity of contract language wane, a claim which they support by repeating their analysis with the inclusion of an interaction for district size–indeed, for small districts the result of Koski and Horng (2007) holds, while the insight of Moe (2006) holds in larger districts. Cohen-Vogel, Feng, and Osborne-Lampkin (2013) use data from Florida and their results align with those of Koski and Horng (2007) (though they neglect to nuance their results by district size).

Finally, an emerging strand of literature is looking at the potential for transfer bonuses and retention incentives to positively affect student outcomes. Fulbeck (2014) analyzes a scheme in place in Denver whereby teachers who choose to transfer to high-needs schools (low-performing) are given recurring bonus pay, and those initially stationed there are given retention incentives. She concludes that recipients of incentives are significantly less likely to switch jobs, as driven by a reduction in district exit rates and especially by teachers whos incentive payments exceed $5,000. Glazerman et al. (2013) evaluate the Talent Transfer Initiative, a randomized controlled trial conducted in 10 districts whereby high-performance teachers were given $20,000 over the course of two years as reward for transferring the identified high-needs schools, and conclude that there were significant effects on teacher retention as well as on student outcomes.

Data

The State of Wisconsin's Department of Public Instruction (DPI) releases annual Salary, Position & Demographic reports through the WISEstaff data collection system, and these reports represent "a point-in-time collection of all staff members in public schools as of the 3rd

Friday of September...” (Public Instruction 2017), which serve as the primary source of data on teachers in this paper. Data are available at the position-teacher level cross-sectionally, with each entry corresponding to one of possibly several positions held by each school district employee. Identifiers in each file permit unique identification of an employee within a given year, but this identifier does not follow teachers between years. To overcome this substantial hurdle to identifying teacher mobility, data are first fed through the matching algorithm described in further detail in the appendix. Essentially, we are aided by the presence of various imperfect identifiers which are more stable over time, most crucially teachers' first and last names and years of birth. By building on these covariates and incorporating some limited fuzzy matching techniques, we construct a panel of teachers spanning the 1994-95 academic year (AY) through AY2015-16.[4]

As noted in the companion paper, the introduction of Wisconsin Act 10 introduced a substantial structural break in the labor market for Wisconsin teachers, so we include only data from 2000-2010 to avoid conflating the effects of this policy on teacher turnover, a topic covered in more detail in the companion paper and elsewhere, with the earlier functioning of the labor market (i.e., we do not want to mix the results from distinct equilibria of the teacher labor market, but would prefer to analyze the pre- and post-Act-10 markets separately). We drop all employees who are not full-time, full-year regular teachers of a major core subject (all-purpose elementary teachers or English/Math) at a single regular public school with a Bachelor's or Master's degree and fewer than 50 years' recorded experience; taken together, these restrictions eliminate 82% of employees, the lion's share of which come from eliminating substitutes/support staff and teachers non-core subjects[5]. We then eliminate teachers with missing information on their subsequent school or district and teachers with instability in their recorded ethnicity, as well as teachers not categorized as white, black, or Hispanic, eliminating a further 0.2% of all employees[6]. Finally, we drop teachers' multiple positions

[4] For brevity, we herein refer to academic years by the spring year, e.g., AY2003-04 will be simply 2004.

[5] We also eliminate any teacher who appears in any role besides “Teacher” in any year. In particular, this eliminates a nontrivial number of educators who either begin their career with an “ease-in” period or end it with a “soft retirement” period, during which they act as a substitute teacher before or after a career otherwise focused on teaching. Such teachers often have part-time roles at several local schools, which introduces sufficient ambiguity in the definition of mobility so as to obscure interpretation of results, so we opt for a stricter definition of full-time teaching than is completely necessary.

[6] Wisconsin teachers are predominantly white (97%).

by keeping only the highest-intensity position for each teacher, as measured by full-time equivalency, resulting in a final count of 268,187 teacher-year observations.

This data is also used for the incorporation of counterfactual salary calculations, by incorporating the salary schedules estimated in the companion paper. Details of the fit procedure can be found there, but essentially salary schedules are computed as monotonicity- and concavity-constrained median-targeted splines (Ng and Maechler 2007) for each level of certification (Bachelor's or Master's degree) in each district in each year[7]. Data sparsity led this procedure to be unreliable in many cases, so ultimately around 28% of teachers have missing salary information[8], mostly in rural districts or other districts with only one or two schools and a small number of students.

We supplement the DPI teacher salary data set in several ways to incorporate data about other characteristics of schools and districts in Wisconsin. To get school- and district-level measures of socioeconomic makeup (percentage of students who are black or Hispanic or eligible for free/reduced lunches) and community type/urbanicity, we tap the Universe Surveys from the National Center for Education Statistics' Common Core of Data, which provide this information on a yearly basis for all years in the study[9]. At the district level, we also use this data to compute class size and the size of the student body.

Lastly, we turn to DPI's public data again to get school- and district-level performance metrics. While Hanushek, Kain, and Rivkin (2004) were able to obtain school- and district-level average scale scores on a standardized test in Texas, such a metric is not publicly available in Wisconsin for all years. Instead, we calculate student proficiency rates for each

[7]One difference is that the salaries included in the payscales estimation were less restrictive with respect to included subject areas. This was done since contracts are collectively bargained at the district level for all teachers, with scant mention of subject area in wage determination.

[8]More specifically, we eliminate district-years featuring less than 20 teachers, less than 7 distinct levels of observed experience, or less than 5 unique values of the two measures of pay (salary and fringe benefits) in either degree track. HKR include like-minded restrictions, but combine teachers of different certification within an experience level.

[9]The method of recording urbanicity by the Common Core switched from being "metropolitan-centric" to being "urban-centric" for Wisconsin from 2006 (Sable 2009). We map the codes corresponding codes to match those used by HKR as well as possible, and use the data file from 2006, which has both types of code for all US districts, to confirm that this correspondence is by and large working as intended. For a small number of districts/schools with missing urbanicity codes in certain years, we use information from other years to inform urbanicity.

school and district as the percentage of test-takers deemed to be at grade level in mathematics or reading in a given year on the Wisconsin Knowledge and Concepts Examination (WKCE), which is administered to 4th, 8th, and 10th-grade students.

Results

	Percent of Teachers Who				
Teacher Experience	Remain in Same School	Change Schools Within District	Switch Districts	Exit Wisconsin Public Schools	Number of Teachers
1-3 years	84.6	9.7	5.7	8.0	34,908
4-6 years	88.9	8.2	2.9	5.0	33,757
7-11 years	91.1	7.4	1.4	2.8	53,180
12-30 years	93.9	5.6	0.5	3.2	125,229
>30 years	96.0	3.7	0.3	17.7	21,113
All	91.7	6.7	1.6	5.1	268,187

Table 1: Year-to-year Transitions of Teachers by Experience, 2000-08

Table 1 replicates Table 1 of Hanushek, Kain, and Rivkin (2004) (HKR), and as HKR found in Texas, most turnover in Wisconsin is happening within districts and out of the profession. In Wisconsin, the fraction of teachers transitioning among districts is vanishingly small after a "burn-in" period of roughly 6 years – only 0.7% of such teachers do so (compared with 3.1% for the comparable group in HKR), but is still relatively higher among the youngest teachers – roughly twice as high for the "probationary" teachers (1-3 years' experience) as for teachers with 7-11 years' experience in both states.

By contrast, movement patterns within districts in the two states are very similar, lending weight to teachers "earning their stripes" within a district to be able to choose the best schools as a privilege of seniority. As expected, we also observe a U-shaped pattern in teachers exiting Wisconsin public schools, which jives with two types of quits. Early-career quitters who change to private schools, change state of residence, or change professions, and late-career quitters who retire – this is epecially evident among teachers with more than 30 years' experience, a group which sees a mass exodus of fully 20 percent of its teachers annually. Results not included here break down the exit rates by experience level, where this dichotomy is even more dramatic – first-year exit rates are about 9 percent and quickly level off at around 2 percent before spiking again past around 25 years.

As examined further below, the low rate of switches between districts appears to be owing to the generally more rural nature of Wisconsin vis-à-vis. Texas. To wit, Milwaukee is the only major urban area in the state, and its population (2010 Census) of 594,833 would rank 7th in Texas. This means that two major types of movers in the HKR data – Large Urban - Large Urban and Suburban - Large Urban – are limited within the state to ending up in a relatively minor metropolitan area. HKR don't provide any results disaggregated by city, precluding any attempts to compare these numbers more comparably to those that would obtain from eliminating the largest cities in Texas.

Table 2 replicates HKR Table 2, and supports its most important conclusions. HKR argue that there is little support for the idea that scores of young teachers are using large urban schools as a training ground before "settling down" with easier assignments in the suburb, based on the general low level of turnover from Large Urban districts. We affirm the scarcity of transitions from districts in Milwaukee, while also noting that such a path is certainly present, as evidenced by the majority of those who do leave Large Urban districts ending up in a Surburban district in both settings. HKR also observe that the likelihoods of remaining in the same school and of quitting are roughly the same for urban and suburban teachers, an observation which we can confirm in Wisconsin. We further note that while Table 2 only presents a cross-sectional picture, the career-long trend reaffirms this – only 3.4% of teachers starting their careers at a large urban district ever work at a suburban district. Lastly, we echo the suggestion of HKR that this phenomenon cannot be driven *per se* by demand-side constraints – in our time period of observation, we observe only 967 urban teachers change districts, whereas 2,879 teachers were hired in suburban districts, though of course this does not rule out arguments based for example on stricter screening of applicants transferring from urban districts.

	Percent of Teachers Who Move to				Number Teachers Changing Districts	Percent of Origin Teachers	Change in Share of Teachers 2000-06
Origin Community	Large Urban	Small Urban	Suburban	Rural			
I. All teachers							
Large Urban	11.2	18.8	51.1	18.8	471	1.8	-0.6%
Small Urban	3.3	19.6	39.9	37.2	496	1.0	0.1%
Suburban	3.2	14.3	49.6	33.0	1,062	1.5	4.2%
Rural	0.5	10.4	20.9	68.1	2,351	1.9	-3.7%
II. Probationary teachers (1-3 years experience)							
Large Urban	10.6	21.8	47.6	20.0	272	4.1	
Small Urban	4.8	18.7	39.6	36.9	235	3.8	
Suburban	2.9	13.9	46.7	36.5	451	5.0	
Rural	0.3	11.0	22.4	66.2	1,034	7.9	

Table 2: Destination Community Type for Teachers Changing Districts, by Origin Community Type and Teacher Experience Level

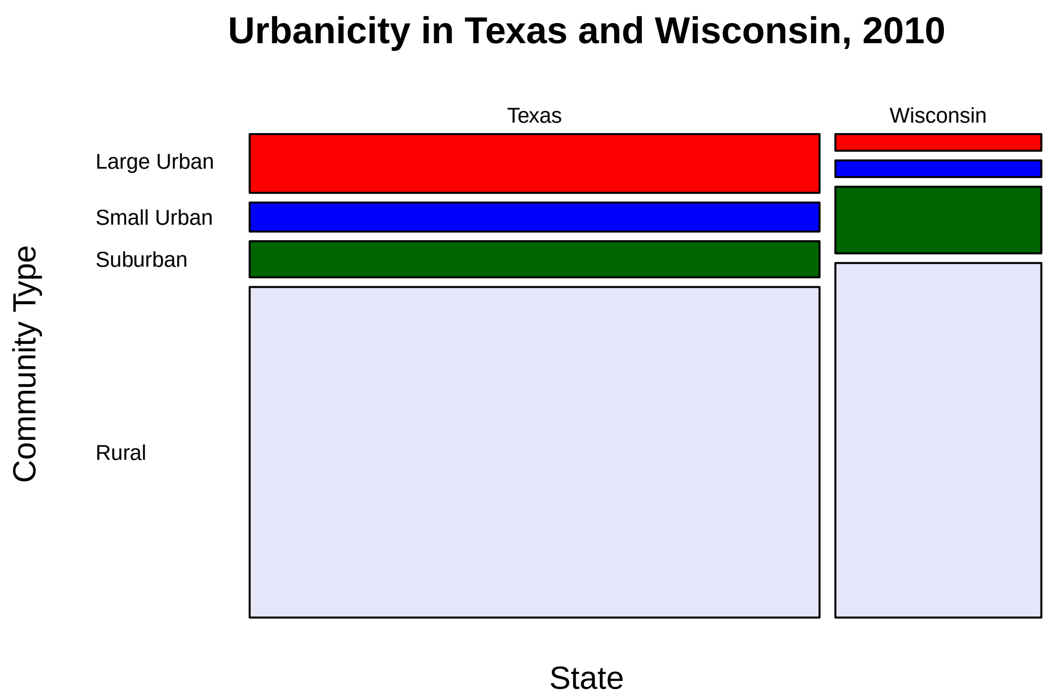

Figure 1: Comparison of the Prevalence of Different Community Types

As mentioned in the discussion of Table 1, the major difference with respect to quantities observed in Texas appears to be driven in differences in the urban landscape between Texas and Wisconsin[10]. This is supported by the overall similarity of magnitudes of transition rates to community types besides Large Urban in the two papers. Figure 1 depicts this difference in landscape by comparing the distribution of community types in Texas and Wisconsin (bar widths reflect the relative quantity of districts in Texas and Wisconsin). While both states are majority-rural, the non-rural part of Texas is comparatively urbanized, whereas more than NaN% of Wisconsin districts are non-urban.

Returning to Table 1, we see that, as in HKR, the "stickiest" community type is Rural – over 60% of Rural teachers remain Rural in both papers, and even fewer Rural Wisconsin teachers end up in a big city than is the case for Texas. This may reflect the similarity in prevalence of rural districts in the two states. Lastly, we also find broad similarity in the community type transition patterns of younger teachers as compared to all teachers.

[10]We also note a difference in the relative shift in population between the two states – Texas observed dramatic changes in its community type distribution over the period of study of only 4 years, while Wisconsin only saw some movement from Rural to Suburban communities.

	Men by Experience Class			Women by Experience Class			All Teachers 0-9 Years
	1-3 years	4-6 years	7-11 years	1-3 years	4-6 years	7-11 years	
Base year salary (log)	-0.012	0.021	0.034	-0.006	0.023	0.014	0.005
	(0.008)	(0.012)	(0.014)	(0.005)	(0.009)	(0.009)	(0.003)
Adjusted salary (log)	-0.004	0.008	0.019	-0.004	0.015	0.013	0.004
	(0.006)	(0.009)	(0.012)	(0.004)	(0.007)	(0.007)	(0.003)
Percent proficient	3.4%	2.6%	3.1%	4.0%	3.7%	4.1%	3.8%
	(0.7%)	(0.9%)	(1.2%)	(0.4%)	(0.6%)	(0.7%)	(0.3%)
Percent Hispanic	-0.9%	-0.2%	-0.9%	-1.1%	-1.3%	-1.0%	-1.0%
	(0.4%)	(0.4%)	(0.5%)	(0.2%)	(0.3%)	(0.3%)	(0.1%)
Percent black	-2.9%	-1.0%	-3.1%	-5.0%	-2.8%	-4.3%	-3.9%
	(0.8%)	(1.0%)	(1.4%)	(0.5%)	(0.7%)	(0.9%)	(0.3%)
Percent subsidized lunch	-6.0%	-3.9%	-5.2%	-6.5%	-4.5%	-5.3%	-5.7%
	(1.1%)	(1.5%)	(1.9%)	(0.6%)	(1.0%)	(1.1%)	(0.4%)

Table 3: Average Change in Salary and District Student Characteristics (and Standard Deviations) for Teachers Changing Districts, by Gender and Experience

Table 3 replicates Table 3 of HKR, and confirms its most important insights. Raw salary differentials predict teacher mobility, but the pay differential is not on average very large – only about $200, or 0.4% higher than the counterfactually expected wage that would have obtained had the district-switching teacher remained in their current district. This premium declines with age for both male and female teachers, eventually dipping negative (though this estimate is imprecise/underpowered due to the limited quantity of teachers changing districts after 6 years).

Attempting to isolate the influence of district characteristics on wage effects, HKR suggest comparing the differential leverage of residual wages to get a more focused estimate of the association between wages and mobility[11]. We run a similar regression using the payscales estimated in the companion paper, but evaluate separate regressions not just for each level of experience, but also for each certification track. This leads to a boost in the overall fraction of explained variance from 60% cited by HKR to 87% here; as in HKR, other included covariates are consistently significant, suggesting their strong independent correlation with salary levels.

As in HKR, we find the demographic-independent wage differentials to be even more important than the uncontrolled raw wages, with the predicted wage improvement roughly doubling to 0.4%. In contrast to HKR, however, we find a positive relationship between experience and residual wage differentials, with mid-career district switchers experiencing 2-3% higher wages upon arrival to their new employer, by contrast to the null relationship for probationary teachers. This pattern is consistent across the dimension of certification which was ignored by HKR, suggesting the opposite result cannot be attributed to bias introduced by movement patterns of Bachelor's- vs. Master's-certified instructors.

Student demographic differentials are very important for predicting teacher turnover, a finding which held in Texas as it does in Wisconsin. Most important in all experience classes and for both genders are the measures of student performance and student poverty – district switchers end up at schools with 4% more students at grade level overall, an effect which is stronger for

[11]HKR mention they failed to adjust the standard errors associated with the adjusted wage differentials to account for the fact that they involve residuals from a regression. We explored accounting for this by bootstrapping the regression through resampling teachers and recalculating residuals, but confirm that little changes as a result.

female teachers and for young teachers. They also end up on average with about 7% fewer students (school-wide) eligible for subsidized lunch. While this finding would need to be bolstered with experimental or quasi-experimental evidence, it hints at the potentially limited scope of teacher labor market policies intended to ameliorate teacher supply problems in hard-to-serve districts – schools can much more easily exert influence over their compensation policies than they can dictate their student bodies, but the latter is more efficacious (see Fulbeck 2014 and Glazerman et al. (2013)).

	District Average Characteristics		Campus Average Characteristics	
	Large Urban to Suburban	Suburban to Suburban	Large Urban to Suburban	Suburban to Suburban
Base year salary (log)	-0.068	0.011	—	—
	(0.016)	(0.007)		
Adjusted salary (log)	-0.020	0.003	—	—
	(0.012)	(0.007)		
Average Student Characteristics				
Percent proficient	37.1%	1.3%	35.6%	0.5%
	(0.8%)	(0.5%)	(1.7%)	(0.6%)
Percent Hispanic	-13.0%	-0.6%	-10.7%	-0.8%
	(0.5%)	(0.2%)	(2.0%)	(0.3%)
Percent black	-53.2%	-0.6%	-54.3%	-0.7%
	(0.9%)	(0.4%)	(2.5%)	(0.4%)
Percent subsidized lunch	-58.3%	-2.0%	-59.6%	-2.0%
	(1.3%)	(0.5%)	(1.5%)	(0.7%)

Table 4: Average Change in Salary and in District and Campus Student Characteristics (and Standard Deviations) for Teachers with 1-10 Years of Experience Who Change Districts, by Community Type of Origin and Destination District

Table 4, which parallels Table 4 of HKR, is the first analysis where the mechanisms of the teacher labor market appear to be working differently from those found in Texas. In particular, while HKR find Large Urban - Suburban district switchers penalize themselves in pay but are rewarded in demographic-adjusted pay, Wisconsin teachers lose out on both measures when leaving Large Urban districts, and in fact are even worse off in residual pay than they are in nominal pay. This difference can at least partially be attributed to HKR's exclusion of certification as a conditioning variable, as the pattern here differs substantially by degree. While district switchers with a Bachelor's degree experience a .8% nominal and

3.8% residual drop in wages, Master's degree switchers experience a 6% nominal, but only a 3% residual drop in wages.

The other results of HKR are confirmed in even more dramatic fashion. There is strong evidence of selection on the student performance metric, which does vary quite widely in suburban districts. Teachers leaving Milwaukee tend to end up at districts with 37% more students deemed to be at grade level on the state standardized test. On the other hand, teachers leaving Large Urban districts (i.e, Milwaukee) for the suburbs experience a precipitous drop of 53% black students and 60% subsidized lunch eligibility. This is practically a tautological result, as the student demographics outside of urban areas in Wisconsin are pretty uniformly non-minority – about 90% of suburban districts have fewer than 10% black students, and more than 60% have fewer than 2% black students, whereas Milwaukee is about 62% black. Similarly, teachers leaving Milwaukee for the suburbs have little choice but to end up in a district with far fewer economically disadvantaged students – whereas 71% of Milwaukee Public Schools students are eligible, the median percentage in suburban schools is 11%.

This phenomenon is reflected further in the suburban-to-suburban moves, which reflect little change in the ethnic/racial makeup of student bodies, since a dramatic shift would demonstrate very strong influence of this factor. We also find evidence of selection into economically better-off districts among suburban switchers, but the magnitude of this difference is attenuated with respect to that reported by HKR. We do not find patterns of selection on student performance as strongly as was found in HKR. This may be a reflection of the crudeness of the proficiency measure as compared to the more variable raw scale score measures used by HKR. Lastly, we confirm the finding of HKR that there does not appear to be evidence that teachers are able to select into the more desirable schools within their target districts – The differences in campus-level characteristics are almost identical to the differences in district-level characteristics. This is likely a reflection of supply-side constraints, as the choicest appointments in a district may be awarded to long-serving serving teachers (promotion from within), as well as suburban districts perhaps having only a small number of schools at which to teach a given grade level/subject.

	Between District Moves		Within District Moves	
	Black Teachers	Hispanic Teachers	Black Teachers	Hispanic Teachers
Percent proficient	5.0%	4.5%	2.7%	2.4%
	(8.1%)	(4.4%)	(1.0%)	(1.4%)
Percent Hispanic	0.4%	-13.7%	-0.1%	-4.1%
	(1.9%)	(9.0%)	(1.1%)	(2.2%)
Percent black	-16.4%	4.0%	-0.5%	-1.3%
	(10.3%)	(3.3%)	(1.7%)	(1.9%)
Percent subsidized lunch	-10.8%	-8.6%	-1.9%	-2.1%
	(13.6%)	(7.7%)	(0.8%)	(1.0%)
Number of teachers	32	25	429	191

Table 5: Average Change in District and Campus Student Characteristics (and Standard Deviations) for Black and Hispanic Teachers with 1-10 Years of Experience who Change Campuses

HKR examine the state of Texas, which features substantially more ethnic heterogeneity than does Wisconsin. As a result, they are better-equipped to identify heterogeneity in preferences by teacher ethnicity. Wisconsin, however, only has 1,695 of its 41,959 teachers non-white, so our results are underpowered relative to HKR. Table 5 presents these results, which parallel HKR Table 5. Given how few observations we have of black or Hispanic teachers switching districts, we eschew any temptation to interpret these results. Only black switchers within districts provide enough records to interpret meaningfully; in Wisconsin, we find (in contrast to white within-district switchers) black teachers tend to migrate to economically better-off and higher-performing schools (white teachers only tend to select on the latter characteristic).

To the end of examining heterogeneity in the impact of school and district characteristic differentials on teacher mobility, HKR present their Table 6, which breaks down the three exit rates for each (weighted) quartile of the covariate distribution. We replicate that analysis here in Table 6. Saliently, our results for the correlation of school characteristics for within-district movers are nearly identical to those found in Texas, which gives a stronger indication that we have identified some fundamental nonpecuniary mechanisms driving sorting among schools in a district.

Differences with respect to the results in Texas begin to emerge for the other destinations of school leavers (other districts and other professions). As noted in Table 1, overall rates

Quartile of Distribution	Probability Teachers Move to New School within District	Probability Teachers Move to New District	Probability Teachers Exit Public Schools
Residual salary			
Highest	—	1.2%	5.0%
3rd	—	1.4%	5.5%
2nd	—	1.4%	5.6%
Lowest	—	1.5%	5.1%
Percent proficient			
Highest	6.1%	1.5%	5.1%
3rd	6.4%	1.9%	5.2%
2nd	6.8%	1.4%	5.1%
Lowest	7.5%	1.6%	5.0%
Percent eligible for reduced-price lunch			
Highest	7.9%	1.6%	5.8%
3rd	7.1%	1.4%	4.6%
2nd	6.5%	1.8%	4.8%
Lowest	5.2%	1.7%	5.2%
Percent Black			
Highest	6.7%	1.5%	6.5%
3rd	6.0%	1.3%	4.8%
2nd	7.2%	1.7%	4.8%
Lowest	6.9%	2.1%	4.3%
Percent Hispanic			
Highest	6.9%	1.4%	6.2%
3rd	6.0%	1.7%	4.9%
2nd	6.7%	1.6%	4.7%
Lowest	7.2%	1.9%	4.5%

Table 6: School Average Transition Rates by Distribution of Residual Teacher Salary and Student Demographic Characteristics (data weighted by number of teachers in school)

of switching districts are quite low compared to Texas and national averages; conditional on this, the patterns of movement by quartile of residual salary exhibit a similar pattern to that in Texas, with teachers in the lowest quartile about 35% more likely to change districts than teachers in the highest residual pay quartile. By contrast to HKR, however, who found the opposite association, we find the same trend (at attenuated magnitudes) with respect to leaving Wisconsin public schools, suggesting salary considerations are also important for teachers considering options outside of public school teaching (or in other states).

We also find fairly strong patterns in quitting associated with subsidized lunch eligibility and with the ethnic makeup of schools, with teachers at the most economically advantaged schools 15% less likely to exit teaching; similar numbers obtain for both the quantity of black and of Hispanic students. For teachers moving within districts, however, we observe the opposite pattern, which is difficult to explain *prima facie*, and suggests the presence of confounding factors distorting the patterns away from what should be expected.

Having identified some key patterns in moments of the data, we now move on to try and separate the confounding effects of each of these and other factors in affecting teacher turnover with the aim of identifying more fundamentally the association between salient district and school characteristics on teacher turnover. Table 7 provides the main coefficients of interest from a simple linear probability regression model predicting leaving a district (i.e., either switching districts or exiting teaching); this corresponds to HKR Table 7.

By contrast to the strength of such results implied in earlier results, the importance of student achievement has dwindled in the regression specification. Only for probationary teachers does district-level average proficiency independently predict turnover (to the tune of a 6 percent drop). The same goes for base salary differentials – in contrast to HKR, we find little evidence of an independent influence of salary on turnover rates, for males nor for female teachers[12]. This does not appear to be due to imprecision – the magnitude of HKR's standard errors follows closely those found for the Wisconsin data, despite our smaller sample sizes.

[12] HKR also mention results not printed in their paper suggesting a paucity of evidence suggesting class size is an important factor in teacher turnover decisions; we give tepid support to this statement, as class size does indeed appear to be related to turnover, but somewhat weakly and only for younger teachers.

	Teacher Experience				
	1-3 years	4-6 years	7-11 years	12-30 years	>30 years
First year base salary (log)	0.01	-0.10^{**}	-0.05^{**}	0.01	-0.15^{*}
	(0.03)	(0.04)	(0.02)	(0.01)	(0.06)
First year base salary (log) * female	-0.06	0.08^{*}	0.05^{*}	-0.02	0.17^{**}
	(0.03)	(0.03)	(0.02)	(0.01)	(0.06)
Campus average student characteristics					
Percent proficient	-0.04	0.01	-0.00	-0.01	-0.08
	(0.05)	(0.04)	(0.02)	(0.01)	(0.07)
Percent eligible for subsidized lunch	-0.06	-0.08^{**}	-0.07^{***}	-0.02^{*}	0.11^{*}
	(0.03)	(0.03)	(0.02)	(0.01)	(0.05)
Percent Black	0.06	0.23^{***}	0.14^{***}	0.09^{***}	0.09
	(0.05)	(0.04)	(0.03)	(0.02)	(0.07)
Percent Hispanic	0.13^{*}	0.19^{***}	0.06^{*}	-0.03	-0.28^{**}
	(0.06)	(0.05)	(0.03)	(0.02)	(0.09)
Interactions					
Black * percent Black	-0.19^{*}	-0.19	-0.01	-0.00	-0.16
	(0.10)	(0.10)	(0.06)	(0.04)	(0.13)
Hispanic * percent Black	-0.21^{**}	-0.21^{**}	-0.11	-0.09^{*}	0.12
	(0.07)	(0.07)	(0.06)	(0.04)	(0.38)
Black * percent Hispanic	0.03	-0.31	-0.25	0.00	-0.71
	(0.31)	(0.30)	(0.15)	(0.11)	(0.44)
Hispanic * percent Hispanic	0.51	-0.36	-0.12	0.20	0.92
	(0.33)	(0.31)	(0.23)	(0.20)	(1.05)
Observations	28,248	27,123	42,329	95,711	15,070

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 7: Estimated Effects of Starting Teacher Salary and Student Demographic Characteristics on the Probability that Teachers Leave School Districts, by Experience (linear probability models; Huber-White standard errors in parentheses)

HKR also found little independent evidence in favor of student economic status factoring in to teachers' mobility decisions, but in fact this is the source of our strongest effects. As mentioned above, it is possible that the crude nature of the proficiency measure is only weakly identified, and that some of the unaccounted for part of student performance is being captured in other coefficients, especially subsidized lunch eligibility. Even more compelling would be to associate student performance (and other school/district-level characteristics) more finely with the set of students actually faced by a given teacher.

The results in HKR about the differential effects of student body makeup are largely similar to those we find in Wisconsin. White and nonwhite teachers have opposite and significant correlations between the quantity of minority students in their origin district and their likelihood of leaving it. These results tend to modulate towards zero with experience, regardless of teacher or student race category, and suggest a degree of assortative matching on ethnicity among districts in Wisconsin (though the patterns for whites differ sharply from those of nonwhites, the patterns for black and Hispanic teachers are hard to distinguish).

To account in a rudimentary way for district-specific hiring policies, HKR move on to their Table 8 which repeats Table 7 with district fixed effects. HKR note that the patterns in responsiveness to wages are the same, though attenuated; that coefficients involving student ethnicity are qualitatively unaffected; and that schools with high achievement continue to exhibit lower propensities for turnover. Our results, presented in Table 8, are similar in that they closely resemble the results without fixed effects, but with noted attenuation and weaker precision.

The most notable difference relative to table 7 is the weakening of results regarding the importance of student characteristics for white teachers. While partially attributable to a decline in precision, this adjustment suggests much of the discovered correlation between student characteristics and exit probability for white teachers can be chalked up to district-to-district heterogeneity in preferences or hiring policies.

Finally, the conflation of switching districts and exiting teaching may mask important heterogeneity between these two choices. To separate these competing exit risks, HKR

	Teacher Experience				
	1-3 years	4-6 years	7-11 years	12-30 years	>30 years
First year base salary (log)	-0.01	-0.11^{**}	-0.06^{**}	0.01	-0.21^{**}
	(0.03)	(0.04)	(0.02)	(0.01)	(0.07)
First year base salary (log) * female	-0.06	0.08^{*}	0.05^{**}	-0.02	0.18^{**}
	(0.03)	(0.03)	(0.02)	(0.01)	(0.06)
Campus average student characteristics					
Percent proficient	-0.17^{*}	-0.09	-0.05	-0.00	-0.04
	(0.08)	(0.07)	(0.04)	(0.02)	(0.12)
Percent eligible for subsidized lunch	0.07	-0.02	-0.04	-0.02	-0.16
	(0.09)	(0.06)	(0.04)	(0.03)	(0.12)
Percent Black	0.41	0.40	0.41^{*}	0.04	-0.55
	(0.30)	(0.29)	(0.19)	(0.10)	(0.46)
Percent Hispanic	-0.26	0.02	-0.16	-0.03	-0.23
	(0.20)	(0.17)	(0.09)	(0.06)	(0.28)
Interactions					
Black * percent Black	-0.19	-0.24^{*}	-0.05	-0.00	-0.15
	(0.10)	(0.10)	(0.06)	(0.04)	(0.13)
Hispanic * percent Black	-0.19^{**}	-0.21^{**}	-0.10	-0.09^{*}	0.07
	(0.07)	(0.07)	(0.06)	(0.04)	(0.38)
Black * percent Hispanic	-0.01	-0.13	-0.08	0.02	-0.84
	(0.32)	(0.32)	(0.17)	(0.12)	(0.46)
Hispanic * percent Hispanic	0.50	-0.30	-0.02	0.21	0.40
	(0.34)	(0.30)	(0.23)	(0.21)	(1.07)
Observations	28,248	27,123	42,329	95,711	15,070

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 8: Estimated Effects of Starting Teacher Salary and Student Demographic Characteristics on the Probability that Teachers Leave School Districts with District Fixed Effects, by Experience (linear probability models; Huber-White standard errors in parentheses)

	Teacher Experience				
	1-3 years	12-30 years	4-6 years	7-11 years	>30 years
I. Switch Districts					
First year base salary (log)	0.60	1.31	0.12	-1.44	-0.62
	(0.58)	(1.08)	(0.88)	(0.74)	(2.82)
First year base salary (log) * female	-1.09	-0.98	-0.66	0.53	1.25
	(0.57)	(1.04)	(0.86)	(0.79)	(3.21)
Percent proficient	-0.66	0.06	-0.54	-1.16	2.71
	(0.66)	(1.18)	(0.90)	(0.99)	(3.25)
Percent eligible for subsidized lunch	-0.36	-1.88^{*}	-1.34^{*}	-2.64^{***}	-0.71
	(0.44)	(0.87)	(0.63)	(0.72)	(2.59)
Percent Nonwhite	0.21	4.30^{***}	2.82^{***}	3.19^{***}	3.75
	(0.44)	(0.75)	(0.60)	(0.66)	(2.17)
Nonwhite * percent Nonwhite	-2.03^{**}	2.43	-4.43^{***}	-3.65^{*}	-2.80
	(0.74)	(2.03)	(0.87)	(1.47)	(3.64)
II. Exit Teaching					
First year base salary (log)	-0.02	0.17	-2.49^{***}	-1.16^{*}	-0.84^{*}
	(0.49)	(0.43)	(0.59)	(0.59)	(0.40)
First year base salary (log) * female	-0.41	-0.27	2.56^{***}	1.37^{*}	0.93^{*}
	(0.49)	(0.43)	(0.63)	(0.62)	(0.42)
Percent proficient	-0.02	-0.18	0.38	0.47	-0.49
	(0.58)	(0.43)	(0.67)	(0.69)	(0.48)
Percent eligible for subsidized lunch	-0.62	-0.54	-1.38^{**}	-2.02^{***}	0.68^{*}
	(0.39)	(0.30)	(0.48)	(0.51)	(0.33)
Percent Nonwhite	1.27^{***}	0.87^{**}	2.97^{***}	2.45^{***}	-0.50
	(0.35)	(0.27)	(0.43)	(0.45)	(0.32)
Nonwhite * percent Nonwhite	-1.02^{*}	-0.62	-1.93^{***}	-1.41^{**}	-1.51^{*}
	(0.43)	(0.39)	(0.44)	(0.47)	(0.64)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 9: Multinomial Logit Estimated Effects of Teacher Salary and Student Demographic Characteristics on the Probabilities That Teachers Switch School Districts or Exit Teaching Relative to Remaining in Same District

construct Table 9, which gives coefficients from a multinomial logit model with three choices – remain in district, switch districts, and exit teaching. We repeat that analysis here, with the caveat that, given the sparsity in racial variation present among Wisconsin teachers, we are unable to identify the full model specified by HKR and mirrored above in Tables 7 and 8. In light of this, and in light of the apparent similarity in Wisconsin in the behavior of black and Hispanic teachers described above, we specify the multinomial logit model in terms of a more parsimonious coefficient set. Namely, we distinguish between white and nonwhite teachers and white and nonwhite students (instead of among white, black, and Hispanic students and teachers).

We continue to see little evidence favoring the salience of wage considerations for Wisconsin teachers; the strongest suggestions found here point to the importance of wages for older male teachers in exiting teaching, a result which is generally opposed to that found by HKR in Texas, where salaries were generally important, but only for the propensity to change districts. Also as in the regression specifications, the prominence of student proficiency found by HKR fails to make a notable appearance in Wisconsin.

With respect to the importance of student demographics, our results again point to the same effects found in Texas. White teachers seem to be spurred to change districts or exit teaching by highly black student populations; the reverse is true of nonwhite teachers, who can be drawn to remain in high-minority districts. Subsidized lunch eligibility's strong effect observed in the combined specification is found here to be concentrated more among those leaving teaching than those changing districts.

Conclusion

That salary incentives appear to play such a limited role in driving teacher churn is bound at first glance to be a disappointment for policymakers. The most powerful predictors of turnover in educators in Wisconsin are all basically beyond the control of administrators, who have no readily-manipulated direct lever for assigning students to schools[13]. HKR found school quality (as measured by average standardized test performance) to be of key importance for attracting/retaining teachers, but we found no evidence that student proficiency (as measured by attainment levels on standardized tests) is a factor in the turnover decision for Wisconsin teachers. Regardless, manipulating school performance is famously difficult, and is in fact the original goal administrators often have in mind when they turn to labor market policies in the first place, so that telling administrators they can improve teacher retention by improving student performance amounts essentially to circular reasoning.

The upside is that this paper is far from settling the debate about welfare-maximizing teacher turnover policies. Limitations in our data prevent us from associating to teachers anything but crude measures of their productivity; measures such as experience, certification, and race are famously poor predictors of teacher quality measures such as value-added. We are thus unable to provide any input to the question of whether *high-quality* teachers have patterns of mobility which resemble that of the teaching population as a whole, or whether heterogeneity in their preferences can be used to devise appropriate policies.

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[13]There is evidence (e.g., Richards 2014) that catchment area manipulation (educational gerrymandering) is being used by some schools to select their student populations, but the equilibrium outcome of the strategic interactions of districts competing for the most "desirable" students is far from clear.

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