Does it Pay to Pay Teachers More? Evidence from Texas

Matthew D. Hendricks
November 2013

What We Studied

This study presents robust evidence on the relationship between teacher pay and turnover using detailed panel data from Texas. While controlling for changes in district and local labor market characteristics, I estimate an overall turnover elasticity of −1.4 and show that the effect is largest for inexperienced teachers, declines with experience, and disappears around 19 years of experience. Combining these results with what we know about the relationship between teacher value-added and experience, I show that paying teachers more improves student achievement through higher retention rates. The results also suggest that adopting a flat salary schedule may be a cheap way to improve student performance. I find no evidence that pay effects vary by the teacher's gender or subject taught.

Important questions that continually confront education policy makers are how much should we pay teachers and how should we shape the teacher salary schedule. Conventional wisdom suggests that paying teachers more will likely improve student outcomes by attracting and retaining better teachers or by influencing current teachers' effort choices. While the potential for a relationship be-tween teacher pay and student achievement exists, current research fails to make a strong connection. The focus of this research is to pro-vide evidence on this relationship so that policy makers can make better decisions regarding the level of teacher pay and the shape of the pay schedule.

Prior studies of the relationship between teacher pay and student outcomes often show null or even negative effects (Hanushek, 1997, 2003). For example, in surveys of the literature prior to 1995, Hanushek (2003,1997) reports that of 119 estimates of the relationship between teacher pay and student performance only 20% are positive and statistically significant, while 7% are negative and 73% are insignificant. A more recent study by Loeb & Page (2000) might provide the best evidence of a relationship between student performance, as measured by dropout rates and college enrollment, and teacher pay. However, even their estimates are likely biased since they cannot control for all time-varying district or state characteristics that may be correlated with changes in teacher pay.

A major reason for a lack of strong evidence in this area stems from the fact that estimating the direct causal link between district salary schedules and student achievement is challenging. First, one must control for changes in district characteristics that may be correlated with changes in student achievement and changes in the salary schedule. This is difficult even when one has access to panel data, since many time-varying district characteristics are unobserved, such as parental support and comprehensive measures of student quality. Second, a change in teacher pay today is likely to influence student outcomes in current and future periods. For example, raising teacher pay may have an immediate impact on the quality of the school, but it is not clear whether that effect will show immediately in student outcomes or if the effect will appear 10 years into the future, as Loeb & Page (2000) model it. If the positive effects of pay increases do not reveal themselves until several years into the future, the task of adequately controlling for changes in district-level characteristics in the periods between a pay increase and the time that the pay increase manifests itself becomes even more difficult.

Overall, the current evidence of a relationship between teacher pay and turnover is too weak to inform policy regarding changes in the salary schedule. To better inform policy, we need a study that provides more robust and detailed estimates of the base pay effect. In particular, given what we know about the relationship between student performance and teacher experience, if we uncover how pay effects vary with teacher experience, we can better understand how changes in teacher pay may be related to student performance.

This study contributes to the literature by providing the most robust and detailed estimates to date regarding the relationship between teacher pay and turnover. A large and detailed panel dataset allows this work to overcome many of the difficulties encountered by previous researchers. With this data I am able to estimate teacher pay effects while flexibly controlling for changes in district characteristics and changes in local labor markets.

I find strong evidence of a negative causal relationship between teacher pay and turnover. My estimates suggest that a 1% increase in teacher pay reduces teacher turnover by 0.16 percentage points. In terms of elasticity, this suggests that a 1% increase in teacher pay reduces the turnover rate by 1.4%. Further, this pay elasticity is largest (in absolute value) for less experienced teachers and begins to decrease rapidly after around 7–8 years of experience. The effect disappears for teachers with around 19 or more years of experience. I find no evidence that pay effects vary by the teacher's subject taught or gender.

Combining these results with our knowledge of the teacher experience–productivity profile, I show that increasing teacher pay improves student performance by retaining more teachers, which increases the average experience of teachers in the district. I also show that districts may improve student performance by adopting a flat salary schedule, but this result depends on strong assumptions about teacher selection and effort that have not been tested. In terms of size, I show small effects of paying higher teacher salaries, but I argue that these estimates are likely lower bounds on the pay effect since I focus on only the retention effects of a pay increase. Increasing teacher pay is also likely to improve student performance through mechanisms not considered in this study.

How We Analyzed the Data

This study employs administrative data from the Texas Education Agency (TEA) which cover the years 1996–2012. The data is a teacher-level longitudinal file containing over 5 million teacher-by-year observations that identify teacher experience, degree, full-time equivalence (FTE), base pay, district affiliation, subject taught, and gender.

From this data, I construct teacher turnover rates for teachers with a bachelor's degree that vary by district, year, and experience. To create this turnover measure, I adopt the following definition of the turnover rate for teachers with experience e in district j during year t (turnoverjte): turnoverjte is the percent of full-time equivalent teachers employed by district j in year t with experience e that are no longer employed by district j in year (t + 1). This turnover definition does not distinguish between different types of turnover, such as teachers leaving the district for a different district or leaving the profession completely or temporarily taking a leave of absence. This definition of turnover simply measures the percentage of teachers who leave a district for any reason.

Naturally, this definition of turnover does not allow one to observe turnover rates in 2012, so the sample used in the analysis is restricted to years 1996–2011. Also, in order to observe a turnover rate in a district-by-year-by-experience cell, there must be at least one teacher observation within the cell. I restrict the analysis to districts that have at least one full-time teacher in each of the 336 year-by-experience cells defined by the years 1996–2011 (16 years) and experience levels 0–20 (21 experience levels). There are 165 districts in the sample that employ at least one full-time teacher in each of these 336 experience-by-year cells, and therefore satisfy this restriction. The sample that I analyze thus contains 55,440 district-by-year-by-experience observations of turnover rates.

Using the individual teacher pay data, I also reconstruct each district's salary schedule for teachers holding a bachelor's degree over the years 1996–2011. To do so, I collapse teacher base salary to 55,440 district-by-year-by-experience observations of the median base salary of full-time teachers employed within the cell.

What We Discovered

In terms of policy, the results presented here suggest that subject specific base pay changes are not likely to perform better in terms of reducing turnover rates relative to broader base pay changes that apply to teachers of all subject areas. However, the results imply that base pay increases that are targeted to less experienced teachers would be more cost effective in reducing turnover than general pay in-creases. Also, a flat salary schedule in which teachers make the same salary regardless of experience would perform better in terms of retaining teachers than the typical salary schedule which awards pay increases for each year of experience. Below, I discuss the implications for student achievement growth if districts were to shift their salary schedule through base pay increases, adopt a flatter schedule, or do both.

Before I can link teacher pay to student achievement, I first provide a brief summary of what we know about the relationship between teacher experience and student achievement. There is a large amount of literature and consensus on this topic. The evidence suggests that teachers improve with experience, in terms of their value-added to student performance on standardized exams. Each study reveals a similar experience–productivity profile. Teacher performance improves dramatically in the first 4 years of teaching and then levels off in subsequent years. The average profile suggests that a student assigned to an experienced teacher (4+ years of experience) gains, on average, 0.08 standard deviations more over the school year than she would gain had she been assigned to a new teacher.

It is important to note that these studies estimate within-teacher productivity profiles, in that they show the expected productivity gains of an individual teacher over her career. This is important because the productivity growth is not a result of correlation between fixed teacher quality and experience, since their models include teacher fixed-effects. Therefore the profile is not simply the result of attrition by less able teachers, but rather average productivity gains by the typical teacher.

One concern for bias in these profiles, however, is that the sample is not a random draw of all teachers. These profiles are identified using teachers that have more than one productivity (value added) observation, and as such the sample is restricted to teachers who continue to teach for more than 1 year. In the context of this study, we want to know the productivity profile for all teachers, which could be different than the profile for teachers who remain in the district for at least 2 years.

Papay & Kraft (2011) test this possible source of bias by comparing initial growth rates of teachers who remain in the district to teachers who eventually leave. They find no evidence that teachers who stay have differing growth trajectories than teachers who leave. By combining this average profile with the experience-specific marginal effects of base pay on turnover, I am able to simulate the impact of alternative salary schedules on student performance. From the distributions shown one can see that when a teacher leaves the district, the average teacher hired to replace her is likely to be less experienced. In fact, the distributions suggest that the average teacher who leaves the district has 6.2 years of experience and is re-placed by a teacher with, on average, 1.8 years of experience. In terms of productivity, this suggests that each time a teacher is lost to turnover, on average, each student that will be taught by her replacement will gain 0.015 standard deviations less in achievement over the school year relative to what he or she would have gained had the incumbent teacher been retained.

Given this benefit of retention, I examine four pay policies that may influence retention and student achievement: maintaining the original salary schedule, awarding a 5% salary increase so that each cell on the schedule is increased by 5%, adopting a flat salary schedule that has the same total payroll next period as the original schedule, and combining the 5% pay increase with a flat schedule. The total payroll in the policy that combines the flat schedule and 5% increase is the same as the schedule with the 5% pay increase.

Using the estimated marginal effects of pay on turnover rates, I simulate the effects of these salary schedules on student achievement growth. Throughout the simulation, I assume that the distribution of new hires does not change with the salary schedule. By doing so, I focus on the retention effects of a salary schedule change and ignore any

selection effects. A salary increase (an upward shift in the salary schedule) likely improves the distribution of new district hires by attracting more experienced teachers to the district and potentially attracting teachers with a higher fixed ability. Since I ignore these potential benefits in the simulation, these results can be viewed as lower bounds. I leave a thorough investigation of these potential selection effects to future research.

If the district maintains its original salary schedule, then the distribution of teachers in the district does not change and teacher productivity remains constant. With this policy, relative teacher value-added is 0.067, which implies that the average teacher in the district adds 0.067 standard deviations more to student achievement than a first-year teacher. Paying teachers more does have a payoff, although the effects are small. A 5% increase in the salary schedule improves average teacher value-added by 0.0005 standard deviations within 3 years and 0.0007 within 10 years. This additional productivity is roughly equivalent to what the average teacher gains annually in value-added between her fifth and seventh year of experience.

Adopting a flatter salary schedule also improves teacher productivity slightly, and by extension student performance. By combining a 5%salary increase with a flat schedule, the district further increases average teacher value-added. This simulation suggests that there is a payoff in terms of retention effects if the district pays teachers more. There also may be a payoff for adopting a flat salary schedule, although there is a risk that the flat schedule would have a negative impact on the distribution of new district hires, in that they would be less experienced on average. There is also a risk that a flat schedule would reduce teacher morale and effort, particularly among veteran teachers. If this occurs, the positive retention effects of adopting a flat schedule could be erased.

The overall impact of increasing the salary schedule, although shown to be positive here, is likely to be larger than the simulation suggests. This simulation captures only retention effects of a pay increase. In addition to retaining more experienced teachers, a pay increase is likely to improve the distribution of new teacher hires (a selection effect), improve teacher morale and, by extension, potentially increase teacher productivity. Also, raising teacher pay reduces teacher turnover, which has been shown to have positive effects on student achievement beyond its impact on teacher experience (Ronfeldt et al., 2013).

Conclusion

This study shows five major results. First, it provides robust evidence that an increase in base teacher pay reduces teacher turnover. The over-all elasticity is about –1.4. Second, the pay effect is largest for less experienced teachers, decreases with experience, and disappears once a teacher reaches about 19 years of experience. Third, the teacher pay effect does not vary substantially across the teacher's subject taught or gender. Fourth, by increasing teacher pay, districts will likely see an improvement in student performance because the average experience of teachers will increase. Finally, a flat salary schedule performs well in terms of retaining a more productive distribution of teachers. If a flat schedule does not alter the distribution of new teacher hires and does not influence the effort choices of veteran teachers, then adopting a flat schedule may be a cheap way to improve student achievement.

This study focuses on the retention effects of teacher pay policies. To better understand the overall impact of teacher pay on student achievement, researchers should attempt to estimate the effect of teacher pay on teacher selection and effort. It is likely that higher pay will also improve student performance through these mechanisms, but evidence on this is scarce. A better understanding of these mechanisms will also help us predict the overall effects of adopting a flat salary schedule which, based on retention effects alone, appears to be an effective policy.

References

Akerlof, George A., 1982. Labor contracts as partial gift exchange. Q. J. Econ. 97 (4), 543–569.
Burdett, Kenneth, 1978. A theory of employee job search and quit rates. Am. Econ. Rev. 68 (1), 212–220.
Clotfelter, Charles, Glennie, Elizabeth, Ladd, Helen, Vigdor, Jacob, 2008. Would higher salaries keep teachers in high-poverty schools? Evidence from a policy intervention in North Carolina. J. Public Econ. 92 (5–6), 1352–1370.
Clotfelter, Charles, T., Ladd, Helen F., Vigdor, Jacob L., 2011. Teacher mobility, school segregation, and pay-based

policies to level the playing field. Educ. Financ. Policy 6 (3), 399–438.
Costrell, Robert M., Podgursky, Michael, 2009. Peaks, cliffs, and valleys: the peculiar incentives in teacher retirement systems and their consequences for school staffing. Educ. Financ. Policy 4 (2), 175–211.
Costrell, Robert M., Podgursky, Michael, 2010. Distribution of benefits in teacher retirement systems and their implications for mobility. Educ. Financ. Policy 5 (4), 519–557. Dolton, Peter, von der Klaauw, Wilbert, 1995. Leaving teaching in the UK: a duration analysis. Econ. J. 105 (429), 431–444.
Dolton, Peter, von der Klaauw, Wilbert, 1999. The turnover of teachers: a competing risks explanation. Rev. Econ. Stat. 81 (3), 543–550.
Griliches, Zvi, Hausman, Jerry A., 1986. Errors in variables in panel data. J. Econ. 31 (1), 93–118.
Hanushek, Eric A., 2003. The failure of input-based schooling policies. Econ. J. 113 (485), F64–F98.
Hanushek, Eric A., Kain, John F., Rivkin, Steven G., 2004. Why public schools lose teachers. J. Hum. Resour. 39 (2), 326–354.
Harris, Douglas N., Sass, Tim R., 2011. Teacher training, teacher quality and student achievement. J. Public Econ. 95 (7), 798–812.
Hendricks, Matthew D., 2013. Identification with imperfect proxies. Working Paper. Imazeki, Jennifer, 2005. Teacher salaries and teacher attrition. Econ. Educ. Rev. 24 (4), 431–449.
Jackson, C. Kirabo, 2010. Match quality, worker productivity, and worker mobility: direct evidence from teachers. National Bureau of Economic Research Working Paper, 15990.
Loeb, Susanna, Page, Marianne E., 2000. Examining the link between teacher wages and student outcomes: the importance of alternative labor market opportunities and non-pecuniary variation. Rev. Econ. Stat. 82 (3), 393–408.
Murnane, Richard J., Randall, J., Olsen, 1989. The effect of salaries and opportunity costs on duration in teaching: evidence from Michigan. Rev. Econ. Stat. 71 (2), 347–352.
Murnane, Richard J., Randall, J., Olsen, 1990. The effects of salaries and opportunity costs on length of stay in teaching: evidence from North Carolina. J. Hum. Resour. 25 (1), 106–124.
Papay, J.P., Kraft, M.A., 2011. Productivity returns to experience in the teacher labor market: methodological challenges and new evidence on long-term career growth. Working Paper.
Podgursky, Michael, Monroe, Ryan, Watson, Donald, 2004. The academic quality of public school teachers: an analysis of entry and exit behavior. Econ. Educ. Rev. 23 (5), 507–518.
Rickman, Bill D., Parker, Carl D., 1990. Alternative wages and teacher mobility: a human capital approach. Econ. Educ. Rev. 9 (1), 73–79.
Rockoff, Jonah E., 2004. The impact of individual teachers on student achievement: evidence from panel Data. Am. Econ. Rev. 94 (2), 247–252.
Ronfeldt, Matthew, Loeb, Susanna, Wyckoff, James, 2013. How teacher turnover harms student achievement. Am. Educ. Res. J. 50 (1), 4–36.
Shapiro, Carl, Stiglitz, Joseph E., 1984. Equilibrium Unemployment as a Worker Discipline Device. Am. Econ. Rev. 74 (3), 433–444.

The full version of this article can be found in its entirety at https://doi.org/10.1016/j.jpubeco.2013.11.001.