



# POLICY BRIEF

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## Can a District-Level Teacher Salary Incentive Policy Improve Teacher Recruitment and Retention?

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**T**eacher quality is a powerful determinant of student achievement gains (Chetty et al., 2011; Rivkin, Hanushek, & Kain, 2005). However, urban school districts serving low-performing, low-income, and/or minority students tend to have less-qualified teacher workforces (Peske & Haycock, 2006). This disparity can be traced back to teacher recruitment and retention: urban school districts have a harder time recruiting teachers, and their retention rates are far lower than surrounding districts in the same labor market for teachers (Lankford, Loeb, & Wyckoff, 2002).

Salary differences may cause or worsen the challenges school districts face with teacher recruitment and retention. There is often wide variation in teacher salaries within a region (Boyd, Lankford, Loeb, & Wyckoff, 2003). This variation is evident in California. In the San Francisco Bay Area, for example, salaries range from \$47,701 to over \$98,000 for teachers with the same experience and education.<sup>1</sup> Making matters worse, as shown in Figure 1 below, students with the highest need often have teachers who are paid less. On average, Bay Area districts with the fewest students eligible for free or reduced price lunch pay their teachers with 10 years of experience \$68,625, while those with the most students

### Executive Summary

In this policy brief Heather Hough and Susanna Loeb examine the effect of the Quality Teacher and Education Act of 2008 (QTEA) on teacher recruitment, retention, and overall teacher quality in the San Francisco Unified School District (SFUSD). They provide evidence that a salary increase can improve a school district's attractiveness within their local teacher labor market and increase both the size and quality of the teacher applicant pool. They also provide evidence that targeted salary increases can increase the quality of new-hires. QTEA salary increases did not affect teacher retention, however, perhaps because the implementation of QTEA coincided with a major economic downturn that made many workers, including teachers, reluctant to leave their jobs.

As Hough and Loeb note, higher salaries can attract a stronger pool of teachers, but the district still must hire strategically from the pool and work to retain the high quality teachers they recruit. In addition, for a policy like QTEA to be effective, teachers must have confidence that the policy will remain in place. Frequent changes in budgets and leadership

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**Executive Summary (Cont.)**

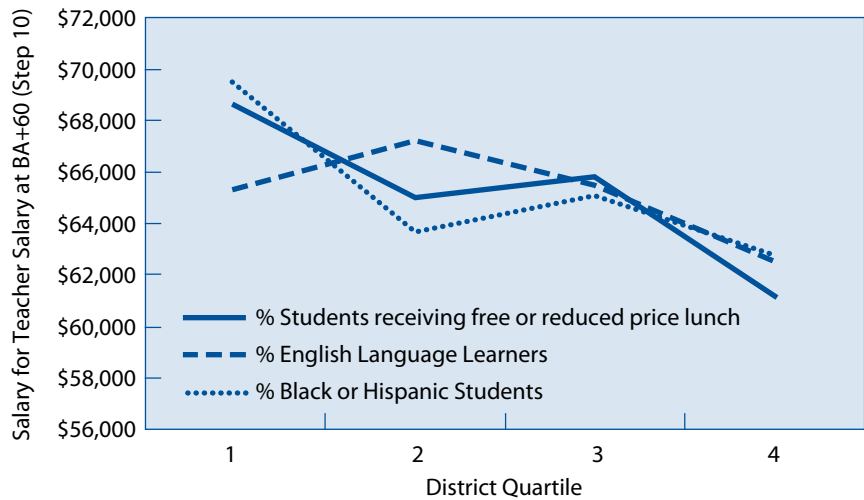
priorities in many districts have led teachers to expect the opposite.

The Local Control Funding Formula recently adopted in California can help to ensure that districts serving the most disadvantaged students have the money available to pay their teachers more, not less, than nearby districts that are considered easier places to work. The evidence presented in this policy brief suggests that adopting policies like QTEA that increase teacher salaries can make urban school districts more competitive with more prosperous nearby school districts, which can lead to improvements in the quality of their teaching force and in the outcomes of the students they serve.

eligible pay teachers with the same experience \$61,143 on average. This pattern also holds for districts that serve higher proportions of English Language Learners and Black and Hispanic Students.

In order to improve teacher recruitment and retention – and educational outcomes for students – an increasingly popular intervention for urban districts is raising teacher salaries and providing bonuses to teachers in difficult-to-staff schools or subjects (Koppich & Rigby, 2009; Milanowski, 2002). While there is evidence to suggest that teachers respond to compensation in deciding to become or remain teachers (e.g., Manski, 1987; Murnane, Singer, & Willett, 1989; Reed, Rueben, & Barbour,

**FIGURE 1.** Teacher salaries by student characteristics in the San Francisco Bay Area



Source: 2009-10 school year teacher salary data from the Education Data Partnership and student demographic data from the National Center for Education Statistics.

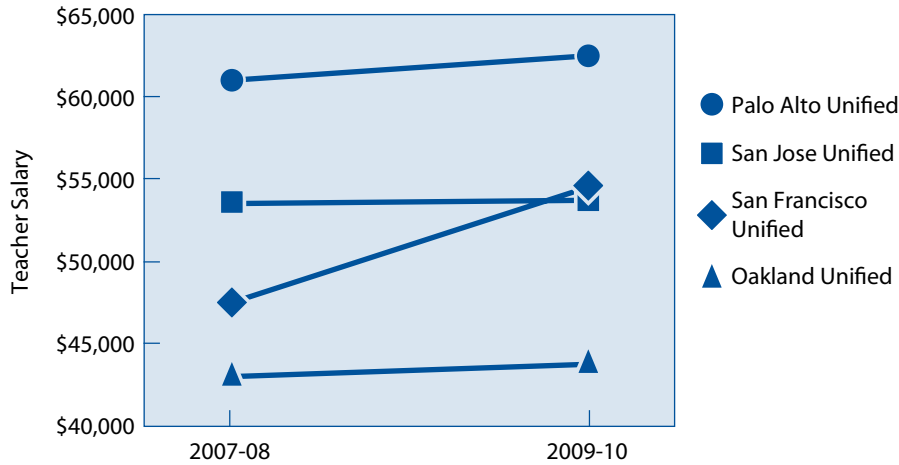
2006), there is little empirical research on the effectiveness of compensation as a way to improve teacher recruitment or retention for specific school districts.

This study assesses the effect of a salary increase on teacher recruitment, retention, and overall teacher quality in the San Francisco Unified School District (SFUSD).<sup>2</sup> Specifically, we examine the effect of the Quality Teacher and Education Act of 2008 (QTEA), which introduced an overall salary increase of \$500-\$6,300, varying by placement on the salary schedule; a \$2,000 bonus for teaching in a hard-to-staff school; and retention bonuses of \$2,500 after the 4th year of teaching and \$3,000 after the 8th year of teaching.<sup>3</sup> As shown in Figure 2, the overall salary increase was much larger than surrounding districts during the same time period. For teachers with two years of prior experience, between 2007-08 and 2009-10 SFUSD salaries rose a great deal com-

pared to other districts and surpassed the salaries of some mid-salary local districts such as San Jose Unified School District (SJUSD). For example, SFUSD salaries were more than \$6,370 lower than SJUSD’s for teachers with two prior years of experience before QTEA, and salaries were \$660 higher after QTEA. However, while SFUSD became more competitive compared to a higher-salary district like Palo Alto, the salaries remained significantly lower in SFUSD, even after QTEA.

The goal of salary incentives such as those provided through QTEA is to improve teacher quality – and student achievement – through recruiting and retaining the best teachers. Thus, in this study, we investigate whether QTEA improved teacher recruitment and retention both overall and for the highest quality teachers. To study QTEA’s effect, we combine nine years of administrative data linking teachers, students, and schools with

**FIGURE 2.** Salaries of local school districts before and after QTEA, for teachers with 2 prior years of experience



Source: School district salary schedules from 2007-08 and 2009-10.

survey responses from teachers and applicants to SFUSD from the time period 2004-05 through 2010-11. We use these data to answer the following questions:

- Teacher recruitment:
  - To what extent did the applicant pool change as a result of QTEA?
  - To what extent did the quality of new-hires change as a result of QTEA?
- Teacher retention:
  - To what extent did teacher retention improve as a result of QTEA?
  - To what extent did the retention of highly-effective teachers improve after QTEA?

QTEA implementation corresponded with a downturn in the economy that could impact teacher recruitment and retention even in the absence of the policy. QTEA was first implemented in the 2008-09 school year; in this year,

unemployment rates in the Bay Area went from 5.6 percent to 9.6 percent. During this time, school districts, including SFUSD, laid off teachers in record numbers (Anderson, 2010). Fewer available jobs in other schools or professions could change teachers' decisions about whether to look for other positions or which positions to consider. In order to separate the effect of the economy from the "QTEA effect," we use natural variation in the distribution of QTEA's salary increases in the following way. Some teachers stood to gain more in salary increases and bonuses than others. For example, the salary gains from QTEA for teachers with five years of experience were substantially greater than those with six years of experience, while the effect of the economy was probably quite similar for teachers with five and six years of teaching experience. Thus, if we detect differences in recruitment or retention of teachers with five years of experience compared to those with six years of experience, we can attribute

this difference to QTEA. We consider those teachers who stood to gain most from each of QTEA's compensation increases to be "targeted" by QTEA. Across each of QTEA's compensation areas, our analytical approach is to compare the behavior of teachers who were targeted by QTEA to teachers who were arguably similar in the way that they would be affected by the economy, but not targeted by QTEA.

### Did the Salary Increases Improve Teacher Recruitment?

We explore both how the teacher applicant pool and the cohorts of new-hires improved as a result of the overall teacher salary increase in SFUSD.<sup>4</sup> Specifically, we ask whether more applicants applied to SFUSD, whether applicants were drawn by the higher salary, and whether changes in the applicant pool led to improvements in the quality of new-hires.

Applicants usually apply to multiple districts simultaneously, and each applicant has preferences as to where to apply.<sup>5</sup> Compensation is one factor that applicants are likely to consider. The increases in salary from QTEA may have motivated some teachers to apply to SFUSD who would not have otherwise because the combination of features – such as salary, working conditions and location – were not appealing enough before the introduction of the policy but were with the increased salary.<sup>6</sup> In this way, if QTEA was effective in attracting teacher applicants, we would expect those teachers who were targeted by QTEA to apply to SFUSD in larger numbers after the introduction

of the policy. Our first analyses ask just this: did targeted teachers increase their applications to SFUSD after the introduction of QTEA?

We also want to know whether the applicants who were drawn to the district as a result of QTEA were of higher quality. Quality is difficult to measure directly, so we looked for indirect measures to understand quality changes. Interviews with SFUSD district staff and stakeholders about the passage of the policy revealed they were hopeful that QTEA would attract teachers who previously only applied to higher paying school districts (Hough & Loeb, 2009). Why might drawing applicants from higher paying districts be beneficial for SFUSD? Or, stated another way, why might applicants who formerly applied to higher paying districts, on average, be higher quality teachers? Simply, the idea behind attracting teachers by raising salaries is that teachers have some sense of how good they are, and they apply to districts where the compensation package – the combination of salary, working conditions, location and perhaps other factors – fits their ability (Weiss, 1980). In teacher labor markets, workers are generally not compensated directly for their productivity; rather, the primary way for teachers to increase their compensation is to switch districts, since there is dramatic variation in teacher salaries across districts even within the same labor market (Boyd et al., 2003). Teachers of higher quality or with skills that are in short supply such as high school math and special education specialties will have a bet-

ter chance of getting a more appealing job. A district able to attract teachers from more appealing districts is a district offering a competitive package. By seeing whether teachers who formerly would only have applied to more appealing districts now apply to SFUSD, we can get a sense of whether the applicant pool has improved in quality. Of course, this is not a clean measure of quality, but it is a proxy worth considering. In the second part of our analysis, we ask whether the average salaries of the other districts that applicants applied to was higher for targeted applicants after QTEA.<sup>7</sup>

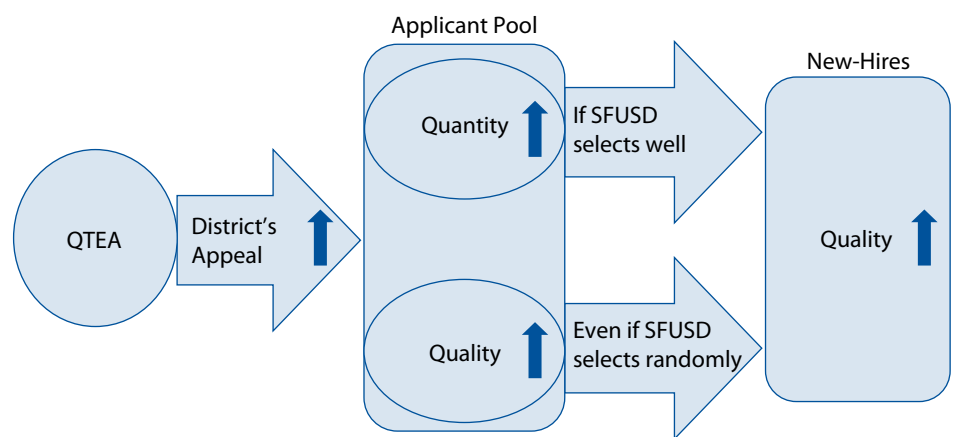
We propose that both the size and the quality of the applicant pool could have improved as a result of the salary increase embedded in QTEA. If either scenario is true, the quality of new-hires in the district could increase accordingly. First, if the *size* of the applicant pool increases, there would

be more candidates in the pool, which would lead to an increase in the quality of new-hires if the district selects teachers well.<sup>8</sup> Second, if the *quality* of the applicant pool increases, the quality of new-hires should increase even if the district hires teachers at random. Figure 3 provides a visualization of this process.

### Changes to the applicant pool

In isolating the causal effect of QTEA, our goal is to identify applicants who were similarly affected by economic changes but differently affected by QTEA.<sup>9</sup> The natural variation in the distribution of teacher salary increases across teachers at different levels of experience and education provides this identification. As shown in Figure 4, teachers with five or fewer years of prior experience stood to gain an 8-13 percent salary increase as a result of

**FIGURE 3.** How QTEA might affect teacher quality

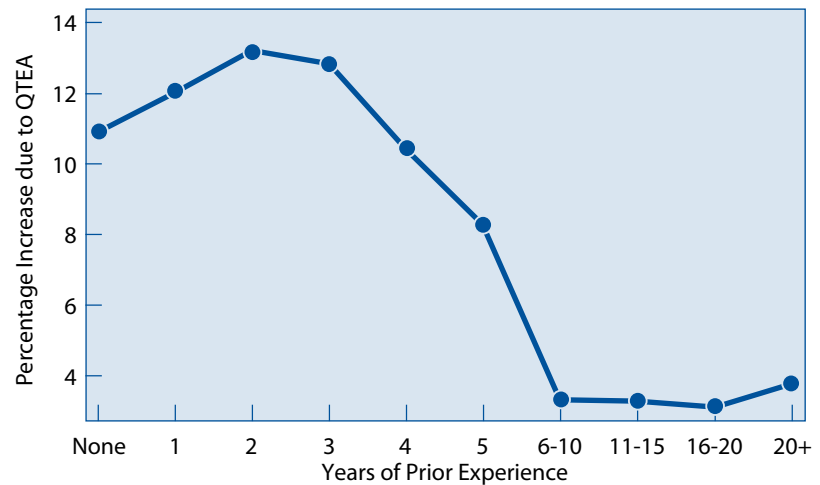


QTEA, while those with six or more years of experience stood to gain substantially less.<sup>10</sup>

We consider teachers “targeted” by QTEA’s overall salary increases if they would have gained 6 percent or more over SFUSD’s prior salary as a result of the policy.<sup>11</sup> We can observe the way that applicants who were targeted for the increases behaved both before and after the implementation of QTEA in comparison to those who were not targeted. We then can attribute to QTEA’s salary increases the differential changes we see in teacher recruitment for the targeted group.

One caveat is that some of the targeted group is quite different from the non-targeted and so we limit our analyses only to teachers in the two groups who were likely to be similar except for their treatment under QTEA. In particular, QTEA’s salary increases are a function of teaching experience, which could be related to how teachers are affected by the economy. Very inexperienced teachers are most affected by QTEA, but they also may be most affected by changes in the economy: new teachers may have problems securing their first positions, and teachers with very few years of experience are most often affected by layoffs. Thus, to isolate the QTEA effect, and to ensure that we compare teachers who would be similarly affected by the economy, we exclude first- and second-year teachers (applicants who have zero or one year of prior experience at the time of application) and applicants with more than 15 years of teaching experience, whose

**FIGURE 4.** Percent increase in salary from QTEA, by years of experience



Source: SFUSD BA+60 salary schedules, comparing 2009-10 salaries to 2008-09 (before QTEA).

retirement decisions may be affected by the economy. Teachers with 2-15 years of prior experience should be similarly affected by the economy (for example, they would not have been laid off by the district), but they are very differently affected by QTEA’s overall salary increase.<sup>12</sup> Thus, if we observe more or better applicants specifically in those targeted steps on the salary schedule, then we can attribute that change to QTEA.<sup>13</sup>

To study the effect of QTEA on the applicant pool, we combined surveys from applicants and teachers in 2008 and 2010 with SFUSD’s administrative data to build a dataset representing applicant cohorts from 2004-05 to 2010-11 (our sample size is 1,611 teachers, weighted to represent all 6,767 applicants to the district during this time period).<sup>14</sup> The questions asked on these surveys enable the identification of the percentage increase in salary each applicant would have gained above the old SFUSD salary

schedule as a result of QTEA, as well as to calculate the average salary of the other districts to which applicants applied.

**Did the size of the applicant pool increase?** To study whether the size of the applicant pool increased as a result of QTEA, we investigate change in the proportion of targeted teachers in the pool. An increase in the proportion of targeted applicants after QTEA would suggest that the salary increase was effective in attracting more teachers who were targeted by the salary increases.

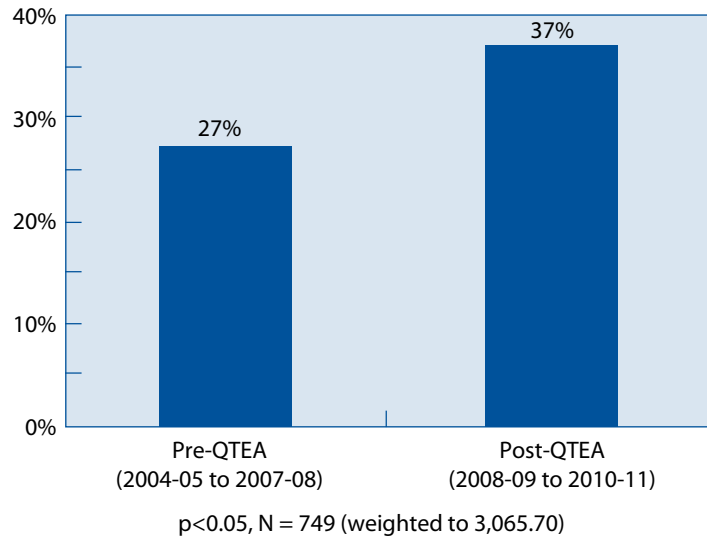
We find that QTEA’s higher salary increased the size of the applicant pool. As shown in Figure 5, before QTEA 27 percent of the applicants were in the targeted group, whereas after QTEA 37 percent of the applicants were in the targeted group. This increase in the proportion of targeted applicants relative to non-targeted applicants indicates that more applicants were

drawn to the district by the QTEA salary increases.

**Were applicants drawn from higher salary districts?** To study whether applicants were drawn from higher salary districts after QTEA, we compare the average salary of the other districts applied to (in addition to SFUSD) for each applicant in cohorts before and after QTEA. When applicants apply to school districts, they often apply to many simultaneously.<sup>15</sup> On the survey, applicants listed all the local districts they applied to at the same time they applied to SFUSD. To compare districts across time, we use the salary-level of each district for mid-career teachers (BA + 60, Step 10) in 2007-08 (regardless of the year applied). We use this information to determine the average salary of the districts that each applicant included in his/her search.

To separate the effect of QTEA from the effect of the economy, we use a *difference-in-differences* approach, comparing the difference in the average salaries of other districts applied to for targeted applicants before and after QTEA to the difference in the average salaries of other districts applied to for non-targeted applicants before and after QTEA. If other district salaries rise after QTEA for non-targeted applicants in the same way that they rise for targeted teachers, we would conclude that some other mechanism caused the rise we see for targeted teachers, not QTEA. However, an increase for targeted applicants as compared to the trend represented by the non-targeted applicants would mean that QTEA

**FIGURE 5.** Proportion of targeted applicants before and after QTEA



had attracted applicants by the higher salary.

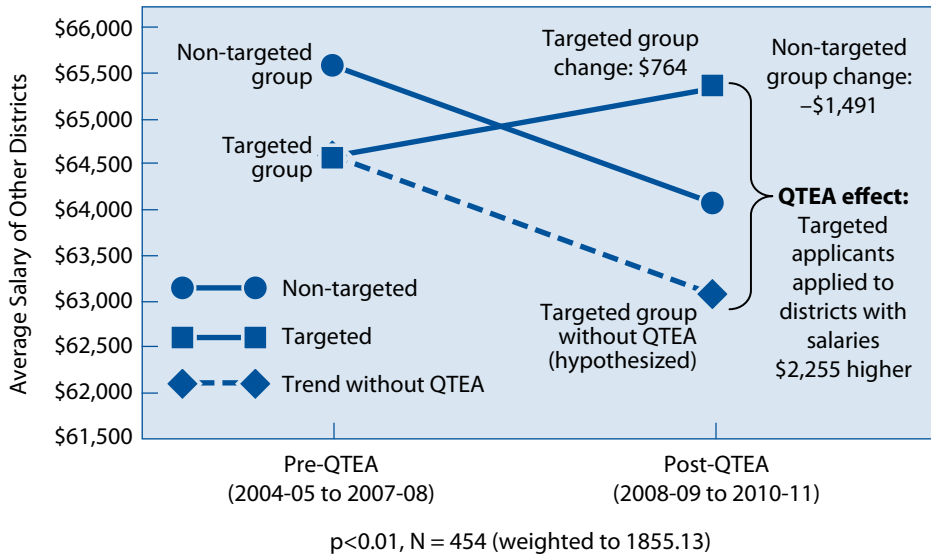
We find that targeted applicants applied to higher-paying school districts than they would have in the absence of QTEA. As shown in Figure 6, for the non-targeted group the average salary of other districts applied to decreased after QTEA, likely due to the downturn in the economy. The targeted group applied to lower salary districts than the non-targeted group before QTEA, probably because they have slightly fewer years of teaching experience. However, for the targeted group the average salary of other districts applied to *increased* after QTEA. The true “QTEA effect” is the difference between the targeted group’s actual average salary and the hypothesized outcome if QTEA had not been implemented and the targeted group had experienced the same effects as the non-targeted group. The dashed line shown in Figure 6 shows this hypothetical outcome. Thus, for targeted applicants, the aver-

age salaries of other districts applied to were \$2,255 higher than they would have been in the absence of QTEA. In other words, after QTEA some applicants included SFUSD in their job search because they prefer districts with higher salaries and now consider SFUSD to be more competitive with higher-paying school districts.

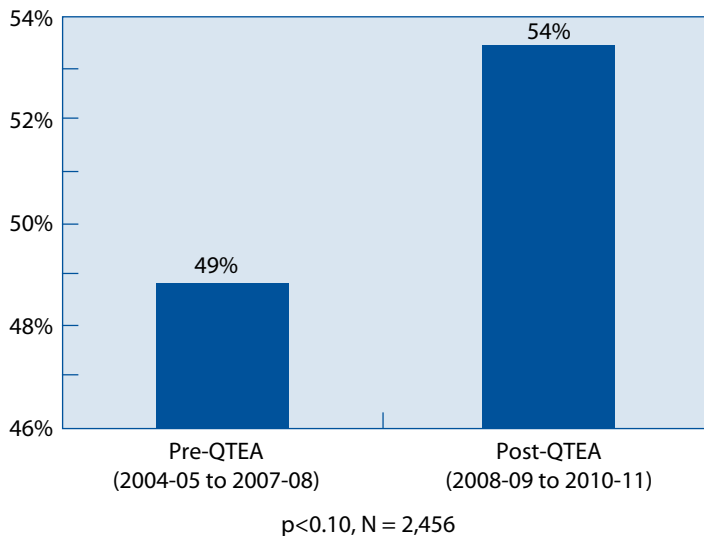
**Changes in the quality of new-hires**

Following from the analysis of the applicant pool, we investigate whether observed changes in the applicant pool resulted in improvements in the cohorts of new-hires after QTEA. To do so, we use a dataset containing all SFUSD teachers linked to students and schools over the time period 2004-05 through 2010-11. The population of interest here is new-hires in each year (N = 2,456). From this dataset we are able to identify the percentage increase in salary that each new-hire would have gained as a result of QTEA, as well as to calculate a measure of “teacher quality.”

**FIGURE 6.** Increase in the average salary of other districts applied to for targeted applicants



**FIGURE 7.** Proportion of new-hires in targeted group before and after QTEA



Because the teachers are working in the district we can get a more direct, though still imperfect, measure of quality for those teachers whose students took standardized tests. In particular, we estimate each teacher's contribution to student achievement in each year using models that are common in the research literature and in practice.<sup>16</sup> These scores represent individual teacher contribu-

tions in their first year of teaching to students' achievement, based on their students' test scores and controlling for the students' prior achievement and background characteristics.<sup>17</sup>

First, we investigate whether there are more targeted new-hires after the introduction of QTEA. An increase in the proportion of new-hires in the

targeted group would provide a first indication that these targeted applicants are of higher quality, since they were ultimately hired. We find that after the introduction of QTEA, the proportion of new-hires in the targeted group did increase, but the effect was lagged. As shown in Figure 7, in the time period before QTEA implementation, 49 percent of the new-hires were in the targeted group; in 2009-10 and beyond, 54 percent of the new-hires were in the targeted group.<sup>18</sup>

Second, we investigate whether the quality of new-hires increased after the introduction of QTEA. An increase in the quality of new-hires overall would provide additional evidence that QTEA had been effective in improving the applicant pool, since the overall quality of new-hires increased. Specifically, we investigate whether the quality of new-hires (in their first year) in Math and English Language Arts (ELA) is higher after QTEA than before. For this analysis it would not make sense to compare the quality of targeted and non-targeted teachers because the district selected teachers from each of these groups, likely based on their quality. However, we can ask whether the quality of new-hires overall appears to have improved as a result of QTEA. Due to complications in comparing teachers' scores across years, we compare first-year teachers' scores in the period before and after QTEA to the scores of a stable reference group of experienced teachers who were present during the whole time period.<sup>19</sup>

We find that the quality of new-hires as measured by student achievement gains increased after QTEA in ELA, but not Mathematics. Because the model employed compares new-hires before and after QTEA to a stable reference group, the results of the model show both how the quality of new-hires differs from the reference group and how the quality of new-hires changed after QTEA. As shown in Figure 8, new-hires generally have lower quality scores than teachers in the reference group. However, the quality of new-hires increased during the implementation of QTEA. For teachers hired in 2009-10, their quality scores were 0.34 of a standard deviation higher than teachers hired in the time period 2004-05 through 2007-08.<sup>20</sup>

### Did the Salary Increases Improve Teacher Retention?

We also explore whether retention rates improved during the period of QTEA implementation, whether retention

rates improved for targeted teachers, and whether retention rates specifically improved for highly-effective teachers. To do so, we employ a dataset containing all SFUSD teachers linked to students and schools over the time period 2002-03 through 2010-11. Over this nine year time-frame, 6,024 unique individuals served as teachers in SFUSD. From this dataset we are able to observe whether teachers leave, stay, or transfer in each school year, and to identify which QTEA salary incentives each teacher was targeted for. Again here, we calculate a measure of teacher quality which estimates each teacher’s contribution to student achievement in each year.

A first look into the effect of QTEA on teacher retention in SFUSD simply describes the return rates for all teachers before and after implementation of the policy. As shown in Figure 9, both school-level and district-level retention seemed to have been increasing in the time period leading up to QTEA imple-

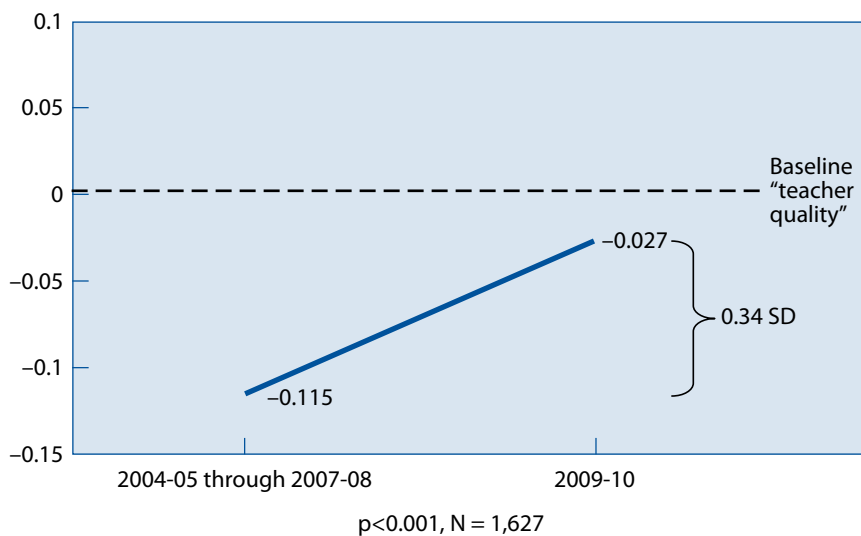
mentation, with a possible jump in the first year of implementation, followed by a decline, which could be explained by the record number of layoff notices given to teachers for the 2009-10 school year. This pattern could be consistent with QTEA improving retention, but given the economic changes, the patterns should not be considered as evidence of the effects of QTEA. For causal interpretations, we must isolate the QTEA effect by comparing the change in retention behavior for teachers who were targeted for each of the salary incentives compared to those not targeted.

### Improvements in teacher retention as a result of QTEA

To isolate the effect of each salary incentive on teacher retention, we again create a sample of teachers who were arguably similar in the way they were affected by the economy, but different in the way they were affected by QTEA. We then isolate the QTEA effect on teacher retention by comparing the change in retention rates for teachers who were targeted for salary increases to those who were not targeted.<sup>21</sup> We use a different comparison group to study the effect of each compensation incentive:

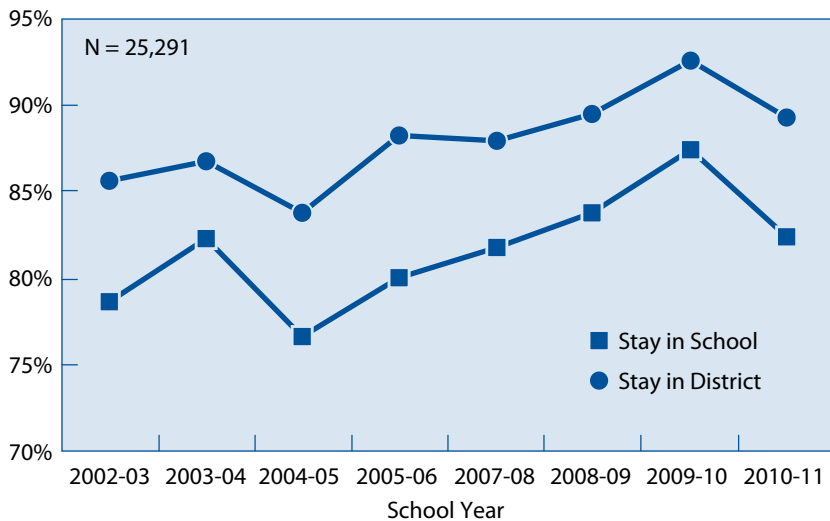
**Overall salary increase.** In keeping with the earlier analyses, teachers targeted by QTEA’s overall salary increases are those who stood to gain 6 percent or more in the following year as a result of the policy, compared to the salary they would have received in the absence of QTEA. To ensure that the analysis compares teachers

**FIGURE 8.** Change in “quality” of new-hires (ELA)





**FIGURE 9.** School- and district-level return-rates



who would be similarly affected by the economy but differently affected by QTEA, we exclude first- and second-year teachers and those with more than 15 years of teaching experience. As discussed above, new teachers and those with many years of experience should not be included, as they are likely to be differentially impacted by economic changes. However, teachers with 3-16 years of experience should be similarly affected by the economy, but they are very differently affected by QTEA's overall salary increase. Thus, any changes in retention rates for teachers who are "targeted" for the salary increases compared to those who were not targeted can be attributed to QTEA.

**Retention bonus.** Teachers in their 4th and 8th year of service are targeted for the retention bonus and receive the stipend if they return the next year. In this analysis, we limit the sample to teachers with three to five years of service within SFUSD, as those with four years of service are targeted for

the bonus, and individuals with three or five years of service within SFUSD should be similarly affected by the economy.<sup>22</sup> In this way, an increase in retention rates for teachers in their 4th year compared to those with 3 or 5 years of service can be attributed to QTEA.

**Hard-to-staff school bonus.** We employ a matching strategy to create a comparison group of schools that are similar to the schools designated "hard-to-staff" in all ways except for the fact that some were designated to receive the bonuses. This approach is possible because some similar schools were designated "hard-to-staff" while others were not. There were 25 schools designated hard-to-staff and 71 non-hard-to-staff schools. Our sample of matches includes 16 hard-to-staff schools and 14 matches, spread across school levels.<sup>23</sup> By comparing retention rates in hard-to-staff schools to their matches, we are able to isolate the effect of the bonus on teacher retention in hard-to-staff schools.

The pattern of results for this causal analysis shows that QTEA had little if any effect on retention: teachers targeted by QTEA's salary increases did not have a differential increase in retention rates above the overall trend. In the two years after QTEA implementation, average retention rates district-wide were high. As shown in Figure 9, over 85 percent of teachers stayed in their schools and over 90 percent of teachers stayed in the district; there was no discernible difference between targeted and non-targeted teachers. These results should be considered in the context of the economy. A policy that works for retention when the economy is strong may be unnecessary for retention when jobs are scarce. Retention overall simply was high in SFUSD in the first years of QTEA and policies to increase retention did not have much attrition to address.

#### ***Retention rates for highly-effective teachers***

We also investigate whether retention rates of highly-effective teachers increased after the introduction of QTEA, again employing a difference-in-differences approach.<sup>24</sup> Specifically, we investigate whether retention rates of highly-effective teachers in ELA and/or Math increased after QTEA relative to less effective teachers. As shown in Figure 10, we find that, before and after QTEA was implemented, teachers with high levels of contribution to student achievement (in both ELA and Math) were more likely to return to their schools the next year than their less effective peers. Although the return rate for these effective teachers

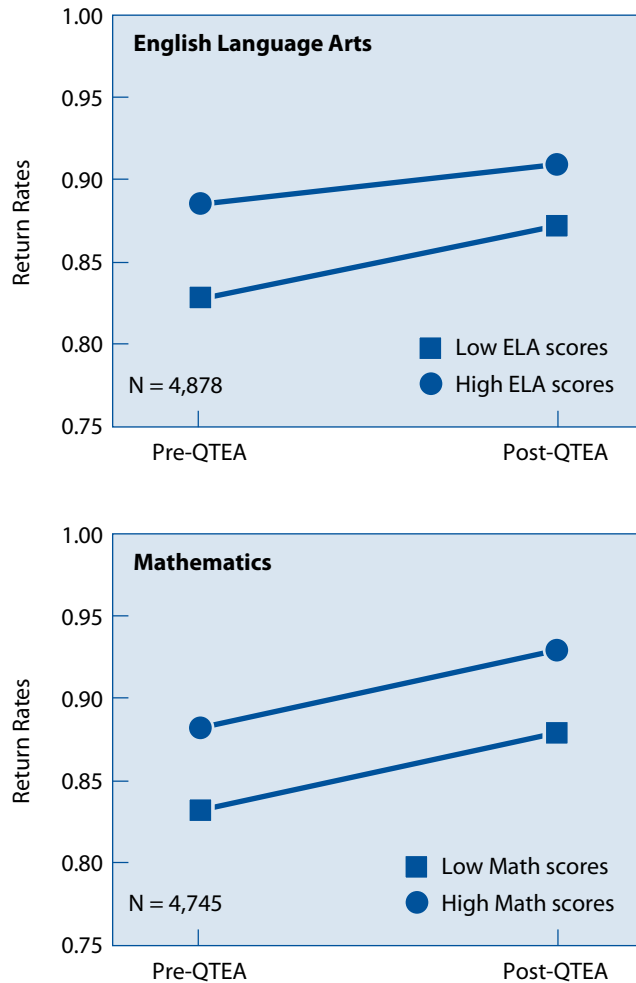
increased after QTEA, it also increased for the less effective teachers at about the same rate, suggesting that QTEA was not responsible for changing the behavior of more effective teachers.

### Conclusions

Our analyses provide evidence that a salary increase can improve a school district’s attractiveness within their local teacher labor market and increase both the size and quality of the teacher applicant pool. It provides further evidence that these changes can increase the quality of new-hires. The fact that we are able to detect change in such a short time provides an indication that compensation increases, even of relatively small size, can be used as a lever for redistributing teachers in the short run. We do not know the long run effect. Either SFUSD could continue to attract a more competitive pool, or other districts may respond with salary increases of their own.

QTEA salary increases did not affect teacher retention, raising some questions about the role of compensation in improving retention, especially during an economic downturn. While overall teacher retention did increase in the district in the time period after QTEA, teachers who were targeted for overall salary increases did not have a *differential* increase in retention rates. There are two possible interpretations of this finding. First, the lack of effects in this case may have resulted from the unusual economic situation during which QTEA was first implemented. When the economy is struggling, retention may simply not be a

**FIGURE 10.** Within-school return-rates, by teacher effectiveness



problem – most workers do not want to leave. As a result, while the salary increases may have retained teachers in other circumstances, they did not at this particular time. Alternately, relatively small salary increases may not be an effective tool for raising retention rates.

These findings underscore the importance of district personnel practices in improving the quality of the teacher workforce. Higher salaries can attract a stronger pool; the district then needs to hire strategically and work to retain

the high quality teachers they recruit. Beyond personnel management, in order for a policy like QTEA to be effective, it is important that teachers can count on it to be in place each year. Due to fluctuations in budgets and leadership priorities, teachers in many districts have come to expect the opposite (Hess, 1998). Even in the first years of QTEA implementation, SFUSD experienced budgetary distress, and teachers were not sure whether they would have jobs in 2010-11, much less whether QTEA’s salary incentives would be fulfilled.<sup>25</sup> Such uncertainty

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could certainly interfere with teachers' response to QTEA and such policies more generally. This problem is not unique to SFUSD; policy churn is related to both changes in goals and leadership and budget uncertainty, as state funds are reduced dramatically and in ways that school districts cannot predict (Balu, 2011).

State policymakers can play an important role in the success of policies such as QTEA. Stable revenues allow districts to be bolder in their policy interventions. Furthermore, the state can ensure that districts serving the most disadvantaged students have the money available to pay their teachers more, not less, than the districts that are considered easier places to work.<sup>26</sup> A more equitable funding scheme with long-term stability would enable school districts serving our state's disadvantaged students to offer higher salaries with certainty over time. Our work provides evidence that urban school districts that raised teacher salaries could become more competitive with local school districts, leading to improvements in the quality of their workforce. Given the known importance of teacher quality in improving student outcomes, policies like this, if employed strategically, have the potential to improve teacher quality for urban school districts as well as the outcomes of the students they serve.

## Endnotes

- 1 This analysis combines data for the 2009-10 school year from the Education Data Partnership (<http://www.ed-data.k12.ca.us>) and the National Center for Education Statistics (<https://nces.ed.gov/ccd/bat>), comparing salaries for teachers with 10 years of experience and 60 additional education credits for all 153 districts with salary data of the 186 public school districts in the Combined Statistical Area of San Jose-San Francisco-Oakland. The significance of salary differences is tested across quartiles defined by the percentage of students eligible for free and reduced price lunch [ $F(3, 149) = 4.91, p=0.003$ ], classified as English Language Learners [ $F(3, 149) = 1.91, p=0.13$ ], or identified as Black or Hispanic [ $F(3, 149) = 4.28, p=0.006$ ].
- 2 This policy brief is based on the analysis in full technical reports (Hough, 2012a, 2012b).
- 3 QTEA also introduced targeted incentives in hard-to-fill subjects and a number of initiatives in teacher support and accountability. For more detail on QTEA's provisions, see Hough (2009), Hough & Loeb (2009) and Hough, Loeb & Plank (2011).
- 4 We do not consider the effect of the hard-to-staff school bonus or the retention bonus, as these incentives would not directly affect applicants' decisions to apply to the SFUSD central office.
- 5 Previous research has documented the many factors that come into play when teachers are choosing positions. In addition to salary, teachers value geographic location (Boyd, Lankford, Loeb, & Wyckoff, 2005) and the demographic characteristics and achievement of the students they would be teaching (Hanushek, Kain, & Rivkin, 2004; Scafidi, Sjoquist, & Stinebrickner, 2007). Teachers are also drawn to on-the-job characteristics such as class size, school facilities, and the availability of technology and support staff (Buckley, Schneider, & Shang, 2004; Ingersoll, 2003; Kirby, Berends, & Naftel, 1999). Finally, the level of support from administrators and fellow teachers seems to be important (Boyd, Grossman, et al., 2011; Ingersoll, 2001; Johnson & Birkeland, 2003; Loeb, Darling-Hammond, & Luczak, 2005).
- 6 Both before and after QTEA, applicants would know what their salary in SFUSD would be if they were hired by looking at the salary schedules, which are posted online, or through word-of-mouth.
- 7 Recent work by Perez, Muraki and Loeb (Under review) suggests that higher-quality teachers do want to be compensated accordingly, as indicated by their preference for merit pay.
- 8 There is some skepticism in the research literature about whether districts and principals hire the best teachers when given a choice. Some research has suggested that schools and districts are not always skilled in this regard, showing that candidates from selective universities are less likely to be hired as teachers after applying (Ballou, 1996) or that the teachers who obtain teaching positions have lower levels of academic ability than those who do not obtain positions (Murnane, Singer, Willett, Kemple, & Olsen, 1991). However, recent research has shown that when given the opportunity, schools often select higher quality teachers as measured by teachers' gains to student achievement (Boyd, Lankford, Loeb, Ronfeldt, & Wyckoff, 2011).
- 9 This method controls for all "secular trends," not just changes in the economy. For example, there were significant changes in recruitment policies at the district office corresponding with QTEA implementation. However, these changes affected all potential applicants (not those differentially affected by QTEA), so the methods detailed here control for such changes.
- 10 The example provided in Figure 4 provides salary increases as a result of QTEA for the teachers on the salary schedule BA + 60 units of continuing education units. Other salary schedules followed the same pattern.
- 11 Teachers are considered targeted at 6 percent increase because these increases follow a bimodal distribution. In the analyses that follow, we tested many variants on the construction of this variable, including using a continuous variable to indicate whether an applicant was targeted (the continuous variable representing the percentage increase in salary they gained as a result of QTEA). All of these variations have the same outcome when used in analysis, so we retained only the binary indication to identify "targeted" applicants for ease of interpretation.
- 12 When teachers enter into SFUSD they receive credit on the salary schedule for all of their years of experience; in other words, new-hires receive year-for-year credit for outside teaching experience, which means that new-hires with teaching experience would benefit from the additional salary at all levels of the salary schedule.
- 13 Results still hold in a specification that includes only teachers with 3-10 years of prior teaching experience; these teachers are arguably even more similar than those with 2-15 years of prior experience.
- 14 To create these cohorts, we combined survey responses from three surveys: 2008 applicant survey (response rate 31.94 percent), 2010 applicant survey (response rate 48.50 percent), 2010 teacher survey (response rate 52.95 percent).
- 15 Of teachers who applied to at least one school district, the average teacher applied to 4.92 other local school districts.
- 16 Scores measuring teachers' contribution to student achievement can only be calculated for new-hires in tested grades and subjects. Thus, approximately 20 percent of teachers have either a score in math or ELA in each year ( $N=400$ ).
- 17 Such scores, while imperfect, are widely used in education for both accountability and research purposes, and are one of the only measures of teacher quality that can be calculated using existing data sources (McCaffrey, Koretz, Lockwood, & Hamilton, 2004).
- 18 The proportion of new-hires is no different in the first (partial) year of implementation (2008-09) than it was prior to QTEA implementation.
- 19  $N=1627$  for ELA,  $N=1640$  for Math.
- 20 Scores measuring teachers' contribution to student achievement could only be calculated for teachers through 2009-10, as data was not yet available to calculate the scores for the 2010-11 school year.
- 21 The actual model employed is a multinomial logit model. We are interested in understanding changes in the proportions of teachers who stayed in their school, transferred to another school in SFUSD, or left the district before and after QTEA.
- 22  $N=4427$ . It is difficult to identify the teachers who would have received the bonus after their 8th year with SFUSD's administrative data. In the full report, teachers with 3-9 years of experience are included in a model specification; results are not significant.
- 23 It is important to recognize that the hardest-to-staff schools are excluded from this analysis because we were not able to establish schools that resembled them in observable characteristics.
- 24 We use scores measuring teachers' contribution to student achievement to define teachers as either "highly-effective" or "less-effective," placing half of the teachers in each year, grade, and subject in each category. This strategy removes some of the variability in scores associated with teacher-by-year estimates of teacher's contribution to student achievement (Atteberry, 2011; Koedel & Betts, 2007; McCaffrey, Sass, Lockwood, & Mihaly, 2009), hopefully better identifying teachers who are more effective. The analytic sample for this question includes all teachers with such scores; 4,878 teachers in ELA, and 4,745 teachers in Math, with 50 percent of teachers in each subject in each effectiveness category.

25 In the end, the overall salary increases and the hard-to-staff school bonus remained intact, but the retention bonus was reduced by half for the 2010-11 and 2011-12 school years.

26 Indeed, there are proposals currently under consideration to dramatically change the way that schools in California are funded (Rose & Weston, 2013).

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