Risk Aversion and Support for Merit Pay:
Theory and Evidence from Minnesota's Q Comp Program

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Editorial Board

Abstract

Recent research attributes the lack of merit pay in teaching to the resistance of teachers. This paper examines whether the structure of merit pay affects the types of teachers who support it. We develop a model of the relative utility teachers receive from merit pay versus the current fixed schedule of raises. We show that if teachers are risk averse, teachers with higher base salaries would be more likely to support a merit pay program that allows them to keep their current base salary and risk only future salary increases. We test the predictions of the model using data from a new merit pay program, the Minnesota "Q Comp" program, which requires the approval of the teachers in each school district. Consistent with the model's predictions, we find that districts with higher base salaries and a higher proportion of teachers with masters degrees are more likely to approve merit pay.

1 Introduction

One of the more prominent findings in the recent education literature is the wide distribution of teacher quality. Using administrative datasets that include classroom teachers and their students' test scores, a number of studies have documented large differences in the measured effectiveness of teachers, even when accounting for the non-random sorting of teachers across schools and other confounding education inputs.[2] This variation in teacher quality has prompted calls to reform how teachers are licensed, hired, and compensated. One such reform, often referred to as "merit pay" or "performance pay," links teacher compensation to measures of performance. In most public schools, teacher compensation is based almost entirely on years of experience and accumulated graduate education credits and degrees earned (Lankford and Wycoff 1997; Allegretto, Corcoran, and Mishel 2004). The goal of merit pay is to create incentives for teachers to increase their level of teaching effort and encourage better teachers to enter and stay in teaching (Podgursky and Springer 2007). Despite the expectation that basing teacher compensation at least in part on merit considerations may improve education outcomes, merit pay programs have been estimated to exist in only about 10 percent of public schools, and the existing programs are often limited in the proportion

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[2]See Hanushek and Rivkin (2006), Wayne and Youngs (2003), and Hanushek (1997) for summaries of the recent literature. Examples of the most recent research include: Clotfelter, Ladd, and Vigdor (2006) using data for North Carolina; Hanushek, Kain, and Rivkin (2005) using data for Texas; Rockoff (2004) using data for New Jersey; and Aaronson, Barrow, and Sander (2003) using data for Chicago; Nye, Konstantopoulos, and Hedges (2004) using data for Tennessee; and Boyd *et al* (2006) using data for New York City.

of compensation that is tied to performance (Ballou and Podgursky 1993; Ballou 2001).[3]

Earlier research on the reasons for the lack of merit pay in the teaching profession has reached mixed conclusions. Murnane and Cohen (1986) presented some of the earliest findings using case studies of 6 school districts that had merit pay programs and concluded that the teaching profession is not suitable for merit pay. Referencing the literature on personnel economics, they argued that there are multiple goals of teaching, some of which cannot be measured, and basing teacher pay on the measurable goals creates incentives to neglect the others. In addition, to the extent that there is a team component to teaching, merit pay creates disincentives for cooperation among teachers. Murnane and Cohen (1986) concluded that merit based compensation works only under very special circumstances: small school districts, with homogeneous populations and high base salaries, and where the performance bonuses are small. Later research by Ballou and Podgursky (1993) disputed this conclusion. Ballou and Podgursky argued that the lack of merit pay in public schools is due to the opposition of teachers and their unions, rather than a fundamental unsuitability of teaching for merit pay. Ballou and Podgursky (1993) cited a number of attempts to create merit pay plans in the 1980s that were ultimately derailed by opposition from teacher's unions. As further evidence of this, Ballou (2001) examined the 1993-94

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[3]Some compensation in teaching may be indirectly tied to performance as in the case where administrators provide additional pay for selected teachers to supervise extra-curricular activities or serve as department chairs or mentors for other teachers.

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School and Staffing Surveys (SASS) and found that 20 percent of school districts where unions are not present have merit pay programs, compared to 8 percent of school districts where unions have the right of collective bargaining. Goldhaber et al (2008) using SASS 2000 data also find that unionization reduces the incidence of merit pay.[4]

In recent years, teachers' unions have begun working with policymakers to develop merit pay programs. Reflecting this change, Randi Weingarten, the current president of the American Federation of Teachers, has stated that her union is open to education reforms including merit pay.[5] The products of this collaboration, including Denver's ProComp, Minnesota's Q Comp, and Florida's Merit Awards Program, differ from earlier merit pay programs in that teachers can, either individually or collectively through their school district, choose whether to change their compensation.

In this paper, we use the recent experience of the Q Comp ("Quality Compensation for Teachers") program in Minnesota to examine the conditions under which teachers would voluntarily accept a merit pay basis for compensation. A distinguishing feature of this program is that before a Q Comp plan can be implemented in a district, the program needs the ap-

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[4]To test whether more information on teaching performance might independently lead to the adoption of merit pay, Goldhaber et al (2008) also examine the relationship between district use of accountability standards and the incidence of merit pay. While accountability standards might plausibly change the nature of teaching by providing districts with more information about teacher performance, they find no relationship between accountability standards and merit pay adoption.

[5]Dillon, Sam; "Head of Teachers' Union Offers to Talk on Tenure and Merit Pay," *New York Times*, November 17, 2008.

proval of a district's teachers, usually by a majority vote of the teachers. Understanding the nature of teacher opposition to merit pay may help us design merit pay programs that both improve educational outcomes and are acceptable to enough teachers to win approval.

The analysis in this paper contributes to the literature in two ways. First, incorporating the uncertainty that teachers face in a switch to merit pay, we develop a theoretical model of the utility risk averse teachers receive from merit pay relative to the current fixed schedule. Second, rather than use surveys of teacher attitudes toward hypothetical merit pay programs, we use actual district level approvals of the Q Comp program to explicitly provide information on the conditions under which teachers would voluntarily accept a merit pay reform.[6]

A distinguishing feature of our analysis is that we focus on heterogeneity in the types of teachers who would gain from a switch to merit pay. Our analysis complements the recent theoretical and empirical analysis of Goldhaber et al (2008), which examines the district's decision to offer merit pay. In their model, the district offers merit pay if the gains in student achievement outweigh the political costs and the higher wages that the district may have to offer teachers to compensate them for the uncertainty in compensation merit pay introduces. Their model is more general in the sense that a teacher's effort decision and the gains to merit pay to districts are explicitly

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[6]We do not discuss the optimal merit pay program or the effects of merit pay on the teacher labor market. For an overview of these issues, see Podgursky and Springer (2007).

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considered. However, in Goldhaber et al (2008) teachers are homogeneous with respect to base pay and other characteristics as merit pay simply affects the level and certainty of wages uniformly for all teachers. In addition, they do not consider differences in the structure of merit pay and how these differences might appeal to different kinds of teachers, depending on the teacher's current base pay due to different levels of experience and education.

In our model, we find an important difference between a merit pay program that bases all future salary on performance, and a program, like Q Comp, that guarantees teachers that their future salary will not fall below their current salary. We find that if teachers are risk averse and future compensation is sufficiently risky, teachers with higher base salaries under the current schedule will have larger gains from a switch to a merit pay program that allows teachers to retain their current base salaries since a smaller proportion of future salary is at risk. This implies that more experienced teachers and teachers with higher levels of graduate education, who have higher salaries under the current system, would be more likely to favor a Q Comp type merit pay program than younger teachers and teachers with only bachelors degrees. Underscoring this feature of Q Comp, when we examine a general merit pay program that bases all future salary on performance, we find the opposite pattern, as teachers with higher salaries before merit pay implementation have more to lose from the switch. This theoretical prediction is consistent with research by Ballou and Podgursky (1993) who examined a survey of teachers' attitudes toward a hypothetical general merit

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pay program (the 1987-88 School and Staffing Surveys). They found that teachers with masters degrees and more experience were more likely to oppose merit pay.

We test the predictions of the model by using district level information on the characteristics of teachers and students for Minnesota school districts. A significant finding from the empirical analysis is that Q Comp approval is more likely in school districts with higher salaries and a higher percentage of teachers who hold masters degrees. Although we cannot rule out the possibility of omitted variable bias from the unobservable characteristics, when we conduct a multivariate analysis including characteristics of each district's students, their surrounding communities, and other characteristics of the district's teachers, these findings prove to be robust.

The Q Comp program reverses the traditional opposition to merit pay programs from those teachers who gain under the fixed salary schedule. Under a program like Q Comp, most of the risk is borne by low base salary teachers as a greater proportion of their future compensation will be based on performance. By mandating that no teacher's salary will be lowered as a result of their district approving Q Comp, many of the disincentives from leaving the fixed salary schedule for teachers who benefit from this schedule are removed. The Q Comp merit pay program in effect re-calculates the political economy of merit pay by shifting the risk of merit pay onto inexperienced teachers and teachers with only bachelors degrees. This may explain the relative political viability of the Q Comp merit pay program and indicate

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a way to make future merit pay programs palatable to the teachers who have the most invested in the current system.

The next section provides background information on the Q Comp program and how the Q Comp program changes the compensation for teachers. Section 3 develops the behavioral model. The remaining sections describe the data used, present the empirical results, and discuss alternative hypotheses.

2   Background on Q Comp

2.1   Q Comp Administration

The Minnesota Q Comp legislation is adapted from the Milken Institute's Teacher Advancement Program (TAP), a pilot merit pay program currently being implemented in several test schools across the country.[7] The Minnesota Q Comp legislation does not establish one uniform merit pay program for all teachers but instead requires participating districts to formulate individual plans. Each interested district forms a committee of administrators and teachers to develop a plan based on five components: 1) multiple career paths, 2) job-embedded professional development, 3) performance pay for teachers, 4) teacher evaluation system, and 5) new salary schedule for teachers. The first two components involve establishing additional jobs, which typically include mentorship positions for experienced teachers. The remaining three components establish a new teacher compensation system.

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[7]For background on TAP, see Solmon *et al* (2007).

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The Q Comp law requires that the proposed salary schedule have at least 60 percent of all future salary increases aligned with evaluated teacher performance. Current salary levels for incumbent teachers are unaffected, and future salaries cannot fall below the current base salary. In the third component, districts are required to establish a teacher evaluation system, which the law states can be based on a combination of peer or supervisor evaluations and student gains on state examinations.

Once a district completes its proposed plan, the Q Comp law requires the district to obtain the approval of the head of the local teachers' union and the superintendent or school board chair before the plan is sent to the state for approval. The state has thirty days to evaluate the plan to make sure it contains the five components described above. If the submitted plan does not meet these requirements, the district is given thirty days to revise the plan. If the revised plan still does not meet the requirements of the Q Comp program, the district's plan is rejected. According to the Minnesota Department of Education, most districts are asked to revise their plans, however, only five have been rejected.[8] Upon acceptance by the state, the districts' teachers vote on the plan according to their district's collective bargaining agreement. Only four districts' teachers have voted down an approved Q Comp proposal.[9]

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[8]Several plans from charter schools have also been rejected. Because charter schools often operate very differently from non-charter schools, we exclude charter school districts in our empirical analysis.

[9]Because of Q Comp's novelty and controversy, the above process is heavily dissected in local and major newspapers in Minnesota. The public in general knows whether their district is proposing a plan, and we expect that districts that send plans for state approval already believe that their plan will be approved by their district's teachers in the final

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In the 2005-06 school year, the first year Q Comp was employed, nine school districts participated. By March 2007, 34 districts had joined for the 2006-07 school year. Appendix A provides a complete list of participating districts.

2.2 Salary Schedules

The traditional teacher salary schedule awards teachers a higher wage for more years of experience and education. Figure 1 plots the average wage schedule for the Q Comp school districts before they approved their Q Comp plan (2006-07). As the size and number of salary increments based on experience vary among districts, we compute the mean step increases separately for years 0 - 10, 10 - 20, and 20 and more.[10] In Figure 1 we plot the average salary schedules for teachers with bachelors and masters degrees. Teachers with only a bachelors degree earned an average starting salary of $31,595, and had salary step increases of $920 for the first 10 years, $451 during the next 10 years, and $225 thereafter. Teachers with masters degrees had a higher starting salary of $35,983, and had $1,329 step increases during the first 10 years, $743 during the next ten years, and $345 thereafter.[11]

We next examine the specific details of the Q Comp plans using data obtained from approval letters for participating districts. The letters describe

approval process.

[10]The number of steps in the Q Comp districts prior to Q Comp reform range from 12 to 43, with mean 24.54 and standard deviation 6.98.

[11]Teachers often can earn higher wages for completing graduate coursework leading up to, and beyond, a masters degree.

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how participating in Q Comp affects teachers' salaries.[12] The level of detail described in these approval letters vary, and we were not able to record data for all districts. As indicated in Table 1, participating districts on average offered teachers $1,912 in one-time performance bonuses that are not carried over the next year. Almost 70 percent of this amount is earned through receiving a positive performance review from the teacher's supervisors. The remaining portion is divided between the teacher's students' achievement and school-wide student achievement.

One concern for merit pay reform in public schools is the size of the performance incentives. Ballou (2001) finds using the 1990-91 SASS that public schools on average awarded their teachers a mere 2 percent of base salary, compared to about 10 percent in non-sectarian private schools. As summarized in Table 1, the $1,912 average Q Comp bonus is 6 percent of the average starting salary for a teacher with a bachelors degree.

Although the Q Comp law only requires school districts to offer one-time performance bonuses and allows districts to maintain their fixed salary schedule, as detailed in Table 1 more than half of participating districts require teachers to have a positive performance evaluation for earning future raises on a salary schedule. A few of these districts, such as Eden Praire and Grand Meadow, have dismantled the traditional salary schedule entirely, replacing it with a combination of potential performance-based permanent salary aug-

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[12]See the Data Appendix for details on how we used the letters to determine the data values summarized in this table.

mentations and one-time bonuses. Most of the districts maintain the salary schedule and require a positive performance evaluation before receiving a permanent salary augmentation, in addition to offering performance-based, one-time bonuses.[13]

Regardless of which method used, the teachers in Q Comp districts have voluntarily implemented a merit pay system that introduces an element of uncertainty into teacher salaries. Table 1 illustrates that in every district Q Comp reform introduces uncertainty into teachers' future incomes, although the amount of risk teachers incur varies among districts. With Q Comp, funding originally reserved for wages that were guaranteed is now divided between fixed and performance-based augmentations. Bonuses are in part a function of peer and administrator evaluations that are difficult to predict before Q Comp implementation. Additionally, bonuses depend on uncertain student performance. Finally, more than half of Q Comp districts require that future permanent salary increases are conditional on a positive performance review. Depending on the degree of teacher risk aversion, this uncertainty in future salaries could have important implications for how teachers value Q Comp relative to the certainty of the fixed wage schedule.

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[13] Mounds View's and LaCrescent-Hokah's Q Comp programs are examples of such reform.

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3   Model

This section develops a model of the utility teachers receive from a general merit pay program relative to the current fixed schedule of pay raises. We use this model to examine which types of teachers would favor merit pay over the current compensation schedule and how the structure of the merit pay program affects this support. The empirical sections below test these predictions using data on the school districts that have and have not approved a Q Comp merit pay program.

3.1   Wage Schedules

We first specify the wage schedules under the two systems for a given teacher. Teachers are assumed to be heterogeneous in their current base pay. To focus on the issue of how a merit pay program is valued by currently employed teachers, we assume individuals work as teachers for their entire career until an exogenous retirement date. We leave for future research the issue of how merit pay reforms affect the recruitment and career length of teachers.

When the merit pay plan is offered, the teacher is in year τ of her career with τ years of teaching experience. The teacher's base salary as they enter period τ is given by w_0. In each year, salaries under the fixed schedule, from the current period $t = \tau$ until the exogenous retirement date in period $t = T$, are given by

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$$w_{Ft} = w_0 + v_t. \tag{1}$$

$v_t \geq 0$ for all t is the cumulative step increase in the salary schedule for each period that is added onto each teacher's base salary at period t. The v_t step increase reflects any increase in salary from the initial level of base pay w_0.[14]

The alternative merit pay program replaces the fixed schedule of salary increases with stochastic performance bonuses. The total salary teachers receive in each year of the merit pay program consists of some fraction $\gamma \in [0,1]$ of their base salary plus a temporary performance bonus $b_t \geq 0$. The salary for teachers under merit pay for $t = \tau, \ldots, T$ is given by

$$w_{Mt} = \gamma w_0 + b_t. \tag{2}$$

γ indicates the proportion of their base salary that teachers are allowed to keep after the start of the merit pay program. If all salary is based on performance bonuses, $\gamma = 0$. With $\gamma = 0$, the merit pay program essentially re-sets all teacher salaries to the same level and eliminates any gains in salary teachers may have accumulated through obtaining graduate education or

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[14]For simplicity, we assume that the salary step increases v_t do not vary with base salary w_0, as with $w_{Ft} = w_0 + v_t(w_0)$. From the discussion of salary schedules above, we know that in Minnesota on average, teachers with bachelors and masters degrees (who have different base salaries) have different salary step increases. In general, the model could be expanded to allow for differences in salary step increases without changing the qualitative predictions. In this more general case, a teacher's relative utility over merit pay would depend not only on the level of their current base pay but also the year of their career τ since this determines the future salary increases the teacher expects on the fixed schedule.

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years of education. All salaries under this type of merit pay depend solely on performance bonuses. In the Minnesota Q Comp program, $\gamma = 1$, as future salaries are not allowed to fall below the teacher's base salary. Future salaries under this type of merit pay then depend on the current level of base pay and future performance bonuses.

3.2   Relative Utility from Merit Pay

We next define the utility teachers receive from merit pay relative to the current fixed schedule. The utility function is assumed to be a Constant Relative Risk Aversion function in current salaries: $u(w) = \frac{w^{1-\rho}}{1-\rho}$, where $\rho \in [0, \infty)$ measures the extent of risk aversion. As τ indicates the years of teaching experience a teacher currently has when the merit pay program is offered, a teacher has $T - \tau + 1$ remaining years in teaching. With a discount rate of $\delta \in (0, 1)$, the sum of discounted utility under the fixed schedule is

$$U_F(w_0) = \sum_{t=\tau}^{T} \delta^{t-\tau} u(w_{Ft}). \qquad (3)$$

For the merit pay program, the discounted sum of expected utility is

$$U_M(w_0) = \sum_{t=\tau}^{T} \delta^{t-\tau} E_b[u(w_{Mt})], \qquad (4)$$

where E_b indicates expectations with respect to the stochastic performance bonuses. We assume a simple distribution for the stochastic bonuses. Bonus are distributed independently over time, with distribution $b_t = b_H$

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(high bonus) with probability $\pi \in (0,1)$ and $b_t = b_L$ (low bonus) with probability $1 - \pi$. We assume the support of the bonus bounds the increase in the fixed salary schedule: $b_H > v_t > b_L$ for all t. This assumption implies that the merit pay bonus involves both a reward (b_H) that is higher than the current schedule of raises and a punishment (b_L) that is lower than the current schedule of raises.[15]

For a teacher with a base pay of w_0, we measure the relative utility from merit pay, or the "gains" from merit pay, using the difference in expected discounted lifetime utility between the two salary schedules for teachers: $\Delta(w_0) \equiv U_M(w_0) - U_F(w_0)$. A teacher with base pay w_0 would favor merit pay if $\Delta(w_0) > 0$.

3.3   Base Pay and Support for Merit Pay

We next consider how the relative utility from merit pay depends on the teacher's base pay under various merit pay structures (vary γ) and degrees of teacher risk aversion (vary ρ). We first consider the case in which the merit pay program does not allow teachers to keep their base pay ($\gamma = 0$). Under this type of merit pay plan, we have the following result:

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[15]The model could be generalized to allow for a floor on teacher salaries such that teacher salaries never fall below teacher salary floor of $\bar{w} < w_0$. With the imposition of a salary floor, salaries from merit pay are $w_{Mt} = \bar{w}$ if $\gamma w_0 + b_t < \bar{w}$ and $\gamma w_0 + b_t$ otherwise. At $\gamma = 0$, the merit pay system still guarantees teachers a salary floor of $\bar{w}$. With $\gamma = 1$, merit pay salaries are defined as above (2): $w_{Mt} = w_0 + b_t$. The simulation below sets such a salary floor since it seems reasonable that even in a merit pay system with $\gamma = 0$, teachers would be guaranteed a minimum salary. However, as the simulation shows, such a change to the model does not alter the qualitative results.

Proposition 1 *If teachers are not allowed to keep their base pay, teachers with higher base salaries would have lower relative utility from merit pay, for any degree of risk aversion.*

Proof Differentiating $\Delta(w_0)$ with respect to base pay w_0, we have

$$
\frac{\partial \Delta(w_0)}{\partial w_0} = \sum_{t=\tau}^{T} \delta^{t-\tau} \{\pi \gamma (\gamma w_0 + b_H)^{-\rho} + (1-\pi)\gamma (\gamma w_0 + b_L)^{-\rho} - (w_0 + v_t)^{-\rho}\}
$$

Specializing to $\gamma = 0$ yields

$$
\frac{\partial \Delta(w_0)}{\partial w_0} = -\sum_{t=\tau}^{T} \delta^{t-\tau} (w_0 + v_t)^{-\rho}.
$$

For any $\rho \in [0, \infty)$, $\frac{\partial \Delta(w_0)}{\partial w_0} < 0$. QED

The intuition for this result is that teachers who have reached a high base salary (e.g. because they are experienced or have a masters degree), have more to lose from a merit pay program that disregards current base salaries and sets future salaries based solely on stochastic bonuses. This result provides some insight into why experienced teachers and teachers with masters degree historically have greater opposition to merit pay programs that would not allow them to keep their base salaries.

Next, we consider the case in which teacher are allowed to keep their full base pay ($\gamma = 1$). Under this merit pay system, the gains to merit pay depend on the degree of risk aversion. If teachers are risk neutral, we have the following result:

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Proposition 2 *If teachers are allowed to keep their current base pay and are risk neutral, then the gains to merit pay are flat with respect to base pay.*

Proof With $\gamma = 1$,

$$\frac{\partial \Delta(w_0)}{\partial w_0} = \sum_{t=\tau}^{T} \delta^{t-\tau} \{\pi(w_0 + b_H)^{-\rho} + (1 - \pi)(w_0 + b_L)^{-\rho} - (w_0 + v_t)^{-\rho}\}.$$

With $\rho = 0$, we have

$$\frac{\partial \Delta(w_0)}{\partial w_0} = \sum_{t=\tau}^{T} \delta^{t-\tau} \{\pi + (1 - \pi) - 1\} = 0.$$

QED

From Proposition 2 we conclude that base salary has no relationship to support for merit for risk neutral teachers who can keep their base pay. However, if teachers can keep their base pay and are risk averse ($\rho > 0$), support for merit pay can be increasing or decreasing in base pay. How the support for merit pay relates to base pay depends on the particular structure of the merit pay program: the bonus size (b_L, b_H) and the probability of obtaining the bonus (π). Given some bonus sizes b_L, b_H, we have the following result:

Proposition 3 *If teachers are risk averse and can keep their base pay, support for merit pay is increasing in base pay if the probability of obtaining the*

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bonus π is $\pi < \pi^*$, and decreasing in base pay otherwise, where

$$\pi^* = \sum_{t=\tau}^{T} \delta^{t-\tau} \frac{(w_0 + b_L)^{-\rho} - (w_0 + v_t)^{-\rho}}{(w_0 + b_L)^{-\rho} - (w_0 + b_H)^{-\rho}} \in (0, 1).$$

Proof See Appendix.

Proposition 3 states that if the probability of receiving the bonus is sufficiently low relative to the size of the bonus, then, for risk averse teachers, the gains to merit pay are increasing in their level of base pay. A key insight is that this result is due to both a feature of the merit pay program (i.e. being allowed to keep their base pay) and teachers' preferences toward risk. Comparing this result to Proposition 1 and 2, we see that if teachers are either risk neutral or cannot keep their base pay, this result does not hold, and the gains to merit pay are weakly decreasing in base pay.

3.4 Simulation

Figure 2 shows the results of a simulation of the model. In this simulation, we examine teachers with 20 years of experience ($\tau = 20$) and assume the fixed schedule has salary increases of $v_t = \$100 * t$. The merit pay program has bonuses $b_L = 0$ and $b_H = \$2,000$ with probability of the high bonus set at $\pi = 0.1$.[16] We set the remaining parameters at $\delta = 0.95$ and $T = 35$.

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[16]In all of the simulations, we assume that a teacher's salary cannot fall below $25,000. Salaries under merit pay are then $w_{Mt} = 25,000$ if $\gamma w_0 + b_t < 25,000$ and $\gamma w_0 + b_t$ otherwise. As discussed above, this places a realistic floor on salaries even if teachers are not allowed to keep their full base salary ($\gamma = 0$).

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We simulate the gains from merit pay (Δ) using 5,000 draws from the bonus distribution and varying the level of the base pay from \$30,000 to \$50,000.

Figure 2 demonstrates the range of possible teacher gains from merit pay under four different combinations of parameters: i) $\rho = 0, \gamma = 0$, ii) $\rho = 3, \gamma = 0$, iii) $\rho = 0, \gamma = 1$, and iv) $\rho = 3, \gamma = 1$. The vertical axis of Figure 2 measures the gains in merit pay in terms of the proportional change in $\Delta(w_0)$ relative to the level at a base salary of \$30,000: $|\Delta(w_0) - \Delta(w_0 = 30,000)|/|\Delta(w_0 = 30,000)|$. Positive values of this metric indicate that the gains to merit pay are higher for teachers with higher levels of base pay. This relative gains metric allows us to abstract from the less controversial insight that, all else being equal, a higher bonus level and more favorable odds of obtaining the bonus attract greater teacher support.

Figure 2 indicates that if teachers cannot keep their base pay ($\gamma = 0$), the gains to merit pay are declining in the level of base pay (Proposition 1). However, an interesting element of the simulation is that the rate of decline is smaller for risk averse teachers ($\rho = 3$) than for risk neutral teachers ($\rho = 0$). This indicates that the more risk averse teachers are, the more the favor the fixed schedule over a merit pay system where they cannot keep their base salary. For teachers who are risk neutral and can keep their base pay, the gains are flat with respect to base pay (Proposition 2). In this simulation, the merit pay bonuses are sufficiently risky that the gains to merit pay are increasing for risk averse teachers under a merit pay program where teachers can keep their current base pay (Proposition 3). Only with

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risk averse teachers and a particular structure to the merit pay program are the gains increasing with respect to base pay.

4   Data

The theoretical model provides hypotheses about the relationship between the gains from merit pay and characteristics of teachers. As described in this section, we have access to district level data for the state of Minnesota that includes whether the district approved a Q Comp merit program and information about the characteristics of the specific merit pay program. We match these data to district level data on the characteristics of the teachers, students, and wage schedules at each district.

The data we use come from the Minnesota Department of Education (MDE) and National Center of Education Statistics Common Core of Data (CCD). The MDE provides information on which districts voted in favor of a Q Comp program for the 2005-06 and 2006-07 school years. Although teacher level voting data for Q Comp approval would be desirable, these data were not collected by the state of Minnesota.[17]

The MDE provides annual information on the characteristics of teachers

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[17]We also have no information on the exact approval criteria required by the teacher's unions in each districts. As discussed above, the Q Comp law specifies that each school district's teachers need to approve the Q Comp law according to their union rules. We do not know the specifics of this approval process, but conversations with administrators lead us to believe that approval requires at least a majority of teachers to vote in favor of the proposal. With a dataset of school districts, we estimate the probability a district approves Q Comp conditional on observed district characteristics. However, it is unlikely these voting criteria vary systematically by any of the other explanatory variables.

within each district including the proportion of teachers within each district that have a masters or PhD degree, and the age, gender, and racial composition of teachers within the district. The salary data provided by the MDE includes average salary for all teachers, starting salary for inexperienced teachers with a bachelors degree, and the maximum salary for experienced teachers with and without a masters degree. The MDE also provides data on school district results on yearly state examinations called the Minnesota Comprehensive Assessment (MCA). In 2003, the MDE reported scores on the MCA for third and fifth grade students on the reading and mathematics tests. As a measure of the proportion of high achieving students, we use the proportion of 5th grade students who earned the highest level on the reading MCA.[18] The MDE also provides the student attendance rate for each district.

The CCD provides a number of additional district level variables including student-to-teacher ratios, the proportion of students receiving free or reduced price lunch, the racial composition of the students, and per student expenditure. The CCD also includes data from the 2000 Population Census on the demographic and income composition of the district's surrounding community.

Our sample of school districts excludes 54 charter, special education, and other specialized school districts. In addition, we exclude 11 school districts with missing district level characteristics. The remaining sample includes 328 Minnesota school districts, 34 of which had approved a Q Comp program by

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[18]Similar results are found using the mathematics MCA.

March 2007. All school districts that we record as having approved a Q Comp program did so between the beginning of the program in 2005-06 and March 2007. Some school districts may approve Q Comp in the future either because of changes in the composition of students or teachers in the districts or because some school district teachers are undecided as to how Q Comp would affect them and are waiting for more information. We take the 34 districts that have already approved Q Comp as an indication that they are more in favor of Q Comp than the remaining districts. The matched district level data from the MDE and CCD is for the 2004-05 school year, 2004 budget year, 2003 test year, and 2000 Census. The district level characteristics are constructed using the most recent data available preceding the approval of Q Comp.[19]

5   Empirical Results

We use district-level data on Minnesota's Q Comp program to test our model's predictions. As discussed in Section 2.2, the fixed salary schedule rewards more educated and experienced teachers with higher base salaries. Our model predicts that districts with higher overall salaries and districts with more educated and experienced teachers who have higher base salaries will be more likely to approve Q Comp.

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[19]74 school districts are missing data on salary information for their teachers. In the specifications below we include a dummy variable for school districts with this missing data.

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While our predictions are based on the fact that teachers keep their base salaries under Q Comp, high quality teachers who believe they are likely to obtain performance bonuses will also be more likely to approve merit pay, regardless of its structure. Since there are reasons why higher quality teachers may be located in districts with higher paid, better educated, and more experienced teachers, estimates of the effect of these factors on Q Comp approval may be upwardly biased.[20] We discuss this bias in more detail below.

5.1 Descriptive Statistics

Table 2 displays descriptive statistics for the main variables by whether the school district approved a Q Comp program. The teachers at these districts are similar in age, teaching experience, and racial composition, although Q Comp approving districts have less male teachers on average. The former salary schedules at the districts that approved Q Comp have similar starting salaries, but different experience profiles. The maximum salary for both bachelor degree holders and for masters degree holders is about 14 percent higher at the Q Comp districts than at the remaining districts.

One of the major distinguishing features of the teachers at districts that

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[20]Recent research has examined the relationship between teacher credentials and teacher quality and has concluded that i) higher quality teachers are matched with higher ability students, and ii) more educated and experienced teachers do not have significant effects on measured student learning, with the exception of perhaps the first few years of teacher experience. See, for example, Clotfelter, Ladd, and Vigdor (2006), Hanushek, Kain, and Rivkin (2005), Rockoff (2004), and Aaronson, Barrow, and Sander (2003).

approved a Q Comp plan is that on average about 50 percent of teachers at Q Comp districts held a masters degree, compared with 32 percent of the remaining districts. Figure 3 compares the district level distribution of the fraction of teachers with a masters degree for the districts that approved and did not approve Q Comp. The distribution of masters degrees for the two groups of school districts is quite distinct, with teachers at Q Comp districts far more likely to have earned a masters degree than at the remaining districts.

The students at the school districts that approved Q plans had on average significantly lower poverty rates and higher test scores. On average, in the districts that approved Q Comp plans, 26 percent of students received free or reduced price lunch, the available measure of poverty, compared to an average of 34 percent for the remaining districts. The mean percentage of students earning level 5 scores, the highest level on the MCA, is significantly higher in Q Comp districts. The differences are similar for both reading and mathematics and larger in the fifth grade compared to the third.

5.2   Q Comp Approval Analysis

We next estimate several probit models in which the dependent variable is whether the district approved a Q Comp plan and the independent variable is a district level characteristic. Table 3 reports the estimated marginal effects evaluated at the mean for each of the probit models.

In Columns 1-3 of Table 3 we examine the effect of each of the main

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variables of interest individually on the probability of a district's Q Comp passage. Because under Q Comp teachers keep their base salaries, we expect districts with more educated, experienced, and higher paid teachers to have a higher probability of approving a merit pay program. Both the percentage of teachers with a masters degree and the maximum salary of teachers with bachelors degrees are found to have positive, significant marginal effects on Q Comp approval. The marginal effect of average experience of teachers is statistically insignificant.

The marginal effect of the fraction of teachers with a masters degree Q Comp passage is statistically significant from zero at the 1 percent level. This marginal effect of 0.0041 implies that an increase of 10 percentage points from the mean in the percentage of teachers with a masters degrees would increase the probability of Q Comp passage by 4.1 percentage points. The probit estimate indicates that the marginal effect of increasing the maximum salary for bachelor degree holders by $1,000 from the mean would increase the probability of Q Comp passage by 1.2 percent.

5.3 Multivariate Analysis

One issue with bivariate relationships is that districts with higher quality teachers may also be more likely to adopt a merit pay program regardless of its structure. In Model 4 we estimate all the main variables together with a number of teacher, student, and district characteristics. If teacher quality is correlated with teacher credentials at the district-level, the estimated

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effects may be biased upwards. Therefore, we include a number of student and district characteristics to control for unobserved student and district factors, including a measure of student performance, free lunch eligibility, student race and gender composition, median family income, per student expenditure, the proportion of people in the surrounding of area with college degrees.[21]

Adding these variables reduces the marginal effect of the percentage of teachers with masters degrees by more than half, but it remains significant from zero (p-value = 0.082) and still sizable in magnitude. Increasing the percentage of teachers with masters degrees by one standard deviation (18.4 percentage points) from its state-wide mean increases a district's probability of Q Comp approval by 4.3 percent. In Model 4, the marginal effect of the maximum salary for teachers with bachelors degrees is cut in half but remains significant at the 5 percent level. Increasing the maximum salary of teachers with bachelors degrees by one standard deviation ($20,000) from its mean increases the probability of Q Comp approval by 24.4 percentage points. In-

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[21]A noteworthy result is that the percentage of 5th grade students earning the highest level on the reading MCA is found to be significant. The magnitude of the marginal effect implies that a 10 percent point increase from the mean in the percentage of high achieving 5th grade students increases the probability of Q Comp approval by 3.5 percentage points. There are a several ways to interpret this result. This may suggest that having higher performing students increases a teacher's probability of approving merit pay, which could occur if eligibility for receiving performance bonuses is based on student achievement levels. However, performances bonus eligibility is usually conditional on student achievement gains, not levels. Since bonuses are conditional on achievement gains, based on goals are set by the districts themselves, it is unlikely there is a direct effect of student performance on Q Comp approval. Given the positive correlation between student performance and teacher quality, we expect that this estimated effect is biased upwards by unobserved teacher quality.

terestingly, controlling for additional district-level characteristics reverses the sign of the marginal effect of average teacher experience. The marginal effect implies that an additional 5 years of average teacher experience from the mean increases the probability of Q Comp approval by 5 percentage points. However, the estimated effect is relatively imprecise (p-value = 0.153).[22]

5.4   Examining Salary Risk

We next examine the specifics of the approved Q Comp plans to see if there are systematic patterns in the approval of riskier merit pay programs by the composition of the teacher characteristics. Among the 34 Q Comp participating districts, 20 programs require performance evaluations before any future salary increase, 10 do not require a performance evaluation, and 4 had yet to determine this feature by the time of the plan submission. We take this element of the Q Comp merit pay plans as an indication of the degree of risk entailed in each district's merit pay program. Table 4 shows means for the three main district-level variables of interest by whether a performance evaluation is required: percentage of teachers with masters degrees, maximum salary for teachers with bachelors degrees, and average teacher

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[22]The simulation shown in Figure 2 suggests a nonlinear relationship between the relative gains from merit pay and base pay. In results not shown we test for nonlinear effects by estimating the specifications in Models 1 through 4 with additional squared terms for percent teachers with masters degrees, average teacher experience, and maximum salary for teachers with bachelors degrees. In each model, both the linear and squared terms are insignificant, suggesting collinearity between the linear and squared terms. This result indicates that the significance of the models estimated in Figure 2 should not be discounted because of the linear form we assume.

experience. To examine whether student ability plays a role, we also calculated the percentage of high achieving 5th grade students by each type of merit pay program. The pattern in Table 4 resembles the one found in the comparison of means between Q Comp and non Q Comp districts in Table 2. Districts with riskier merit pay plans had higher maximum teacher salaries for bachelors degree holders and more teachers with masters degrees, but similar teacher experience and student performance as those districts with less risky plans. It should be noted that the differences are not significant at typical significance levels given the small number of approved Q Comp plan we have available to analyze. However, the plan details provide at least some suggestive evidence that teachers with higher base salaries are more likely to support merit pay programs with greater degrees of salary risk.

5.5   Alternative Hypotheses

We next consider two alternative hypotheses for why some districts are observed approving Q Comp merit pay programs. First, Minnesota media often credit a school district's need for additional funding as the reason for approving their merit pay plan.[23] Given the controversial change in pay for teachers, it is argued that only those districts desperate for funding would be willing to try the program. However, the characteristics of the school districts that approve Q Comp are not consistent with this hypothesis. Table 2 indicates

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[23]See, for example, a local newspaper article: Mathur, Shruti L. "Districts, unions explore merit pay plan." *Star Tribune.* September 21, 2005, 4W.

that the difference in per student expenditure between Q Comp and non-Q Comp districts is not statistically significant from zero. This finding is robust to the inclusion of additional district characteristics in the multivariate probit analysis in Table 3. In addition, the districts that approved Q Comp have on average about 20 percent fewer students receiving free or reduced price lunch than those districts that have not approved Q Comp.

For similar reasons we doubt the validity of a second alternative hypothesis that school districts approve Q Comp in order to attract and retain teachers.[24] From the available data, the school districts that approved Q Comp appear to be in wealthier areas, have a lower proportion of students in poverty, and have higher teacher salaries.

6   Conclusions

This paper examines the reasons teachers would prefer one merit pay program over another by developing an explicit model of the relative gains to merit pay over the current wage schedule and testing the predictions of this model using district level approval data for a new merit pay program in Minnesota. The theoretical model indicates the potential for considerable heterogeneity in the response to merit pay across the population of teachers. We find a systematic pattern in which districts that pay their teachers higher salaries under the fixed schedule and have a greater percentage of teachers with masters degrees

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[24]See, for example, a local newspaper article: Emily Johns, "District Applies for Merit Pay Program." *Star Tribune* June 14, 2006, 3S.

are more likely to approve a Minnesota Q Comp merit pay program. Our findings are at odds with the perspective that teachers universally oppose or favor merit pay solely based on notions of fairness or their assessment of how these programs would affect student outcomes. Both of our main empirical findings are consistent with a theoretical framework in which risk averse teachers compare the utility they individually receive from merit pay relative to the current fixed schedule of raises.

An important lesson from the experience with the Minnesota Q Comp program is that the structure of the merit pay program can greatly affect the types of teachers willing to support it. Our finding that districts with a higher proportion of teachers with masters degrees are more likely to approve Q Comp contradicts past research that had found that teachers with masters degrees were less likely to support a hypothetical merit pay system (Ballou and Podgursky 1993). We reconcile these two contradictory findings as underscoring the importance of the specifics of the particular merit pay programs in determining the sources of support. In our model, we find that a general merit pay program that bases all future salaries exclusively on uncertain performance is less appealing for experienced teachers and teachers with graduate degrees. However, this pattern is reversed if the merit pay program allows teachers to retain their current base salary, though only when teachers are assumed to be risk-averse.

There are several avenues for future research. Denver's ProComp merit pay program, like Minnesota's Q Comp, guarantees teachers who opt into

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the merit pay system their base salaries. Unlike in Minnesota where teachers vote for whether their district participates in Q Comp, each teacher in Denver has the choice to volunteer in ProComp. Thus, analysis of individual teacher-level data from ProComp would provide another test of our model's predictions. In addition, we do not examine the dynamics of support for merit pay. As the program continues and many of the teachers with higher base salaries retire from teaching, support for merit may erode as the teachers who are more exposed to the risks from merit pay become a larger proportion of the teacher labor force. Also, our paper does not address the optimal merit pay system nor how participating in merit pay could affect teacher turnover and the teacher labor market in general. With a merit pay system, the teaching profession may begin to attract individuals who have a higher tolerance for income uncertainty. Research on these topics would be of considerable importance as policy makers consider further merit pay reforms.

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Appendix A: DATA APPENDIX

While the Minnesota districts' Q Comp programs are still evolving and may be modified with future collective bargaining agreements, we assume in our analysis that teachers vote on their district's plans as if they were not able modify them after Q Comp approval.

The approval letters are available on the MDE website. As of June 24, 2008 available at

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http://education.state.mn.us/mde/Teacher_Support
/QComp/QComp_Application_Process/Approval_Letters/index.html
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The letters contain varying levels of detail on their merit pay programs; however, all letters describe how their plan meets the five components required under Q Comp, discussed in Section 2. We determined the size and source of districts' performance bonuses from the section detailing Component 3, where districts are asked to "describe how at least 60 percent of teacher compensation increases within a performance pay system aligns with teacher performance measure . . . ."

Counting the districts that require evaluations for future salary augmentations required more interpretation, as the wording in "Component 5: The Alternative Professional Schedule" varied considerably, and no formal mapping could be developed. In some districts, such as Brainerd, the Q Comp letter defines the amount in salary augmentations a teacher can receive through performance awards. Others are less specific though just as clear. For instance, the Mounds View letter states that, "all teacher salary increases are dependent upon successful completion of modules, student and school achievement gains, and teacher evaluations (3)." LaCrescent-Hokah's letter explicitly states that the traditional steps and lanes system was "eliminated and replaced with a performance appraisal system" (3). If the subject was not mentioned, it was assumed evaluations are not required.

A few districts explain in their letter that their alternative salary schedule is still unknown and will be relayed to the MDE at a later point. For instance, it is written in Alexandria's letter that "a new salary schedule has not been developed yet" (4). The MDE was contacted for any updates on these districts' plans, and clarifying information was received for two of the districts.

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Minnesota School Districts Participating in Q Comp

2005-2006 School Year: Alexandria, Fridley, Hopkings, La Crescent-Hokah, Marshall, Minneapolis Mounds View, St. Cloud, St. Francis

2006-2007 School Year: Albert Lea, Alden, Brainerd, Brandon, Burnsville, Centennial, Clearbrook-Gonvick, Delano, Eden Prairie, Farmington, Grand Meadow, International Falls, Lac Qui Parle Valley Le Center, Minnetonka, North St. Paul-Maplewood, Osseo, Pine River-Backus, Proctor, Red Rock Central, South St. Paul, South Washington County, St. Anthony-New Brighton, St. Louis Park, Wayzata

Appendix B: Proof of Proposition 3

If $\gamma = 1$ and $\rho > 0$, then

$$\frac{\partial \Delta(w_0)}{\partial w_0} = \tilde{\delta}\pi(w_0 + b_H)^{-\rho} + \tilde{\delta}(1 - \pi)(w_0 + b_L)^{-\rho} - \sum_{t=\tau}^{T} \delta^{t-\tau}(w_0 + v_t)^{-\rho},$$

where $\tilde{\delta} = \sum_{t=\tau}^{T} \delta^{T-\tau}$.

$\frac{\partial \Delta(w_0)}{\partial w_0} > 0$ if $\tilde{\delta}\pi[(w_0+b_H)^{-\rho}-(w_0+b_L)^{-\rho}]+\tilde{\delta}(w_0+b_L)^{-\rho} > \sum_{t=\tau}^{T} \delta^{t-\tau}(w_0+v_t)^{-\rho}$.

Multiply by -1, $\frac{\partial \Delta(w_0)}{\partial w_0} > 0$ if

$$\pi\tilde{\delta}[(w_0 + b_L)^{-\rho} - (w_0 + b_H)^{-\rho}] < \tilde{\delta}(w_0 + b_L)^{-\rho} - \sum_{t=\tau}^{T} \delta^{t-\tau}(w_0 + v_t)^{-\rho}. \quad \text{(B-1)}$$

Given $b_H > b_L$ and $\rho > 0$, $\tilde{\delta}[(w_0 + b_L)^{-\rho} - (w_0 + b_H)^{-\rho}] > 0$. Dividing (B-1) by $\tilde{\delta}[(w_0+b_L)^{-\rho}-(w_0+b_H)^{-\rho}]$, then yields a condition on π: if $\pi < \pi^*$, then $\frac{\partial \Delta(w_0)}{\partial w_0} > 0$, where

$$\pi^* = \sum_{t=\tau}^{T} \delta^{t-\tau} \frac{(w_0 + b_L)^{-\rho} - (w_0 + v_t)^{-\rho}}{(w_0 + b_L)^{-\rho} - (w_0 + b_H)^{-\rho}}. \quad \text{(B-2)}$$

The numerator of (B-2) is positive since

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$$(w_0 + b_L)^{-\rho} > (w_0 + v_t)^{-\rho},$$

and we assume $b_L < v_t$ for all t. The denominator of (B-2) is also positive by a similar argument. Hence $\pi^* > 0$. In addition, the denominator of (B-2) is always larger than the numerator since $b_H > v_t$ for all t. Hence $\pi^* < 1$. QED

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Table 1: Summary of Q Comp Plans

	Mean	Standard Dev.	N
Performance Bonus Size			
Total	1912	653	24
Bonus/ (Minimum BA salary)	0.060	0.022	20
Bonus/ (BA step increase)	2.170	0.968	20
Bonus/ (MA step increase)	1.588	0.668	20
Performance Bonus Source	Fraction	Standard Error	N
Rubric and Peer Evaluation	0.689	0.058	24
Student Achievement (classroom)	0.140	0.033	
Student Achievement (school)	0.171	0.033	
Evaluation Required for Raise			
Yes	0.529	0.087	34
No	0.294	0.079	
TBD	0.177	0.066	

Notes: Step increase defined as the average salary increase over the first 10 years under the step and lanes salary schedule.

Source: 2005-2006 salary schedules from Education Minnesota. Performance bonus data from district Q Comp proposals.

Table 2: Descriptive Statistics

	Non Q Comp Mean (Std. Dev.)	Q Comp Approved Mean (Std. Dev.)	Difference in Means (Std. Error)
Teacher Characteristics			
Avg. Teacher Age	41.823	41.556	0.282
	(2.577)	(2.562)	(0.464)
Avg. Teacher Experience	16.413	15.811	0.602
	(2.577)	(2.925)	(0.524)
Percent of Teachers Black	0.154	0.495	-0.342
	(0.512)	(0.243)	(0.248)
Percent of Teachers Hispanic	0.198	0.437	-0.239
	(0.032)	(0.130)	(0.134)
Percentage of Teachers Male	32.49	29.733	3.042
	(7.065)	(6.098)	(1.115)
Percentage of Teachers w/ Masters Deg.	32.19	50.056	-17.879
	(17.637)	(17.009)	(3.095)
Teacher Salary Characteristics			
Starting Salary with Bachelors Deg.(1,000 $)	23.107	24.236	-1.129
	(12.547)	(12.589)	(2.281)
Max. Salary with Bachelors Deg. (1,000 $)	34.825	39.775	-4.949
	(19.386)	(21.608)	(3.877)
Max. Salary with Masters Deg. (1,000 $)	41.028	46.982	-5.953
	(22.715)	(25.274)	(4.535)
Difference Between Max. and Min. Bachelors Deg. Salaries (1,000 $)	11.718	15.539	-3.821
	(7.905)	(10.306)	(1.827)
Student Characteristics			
Attendance Rate	94.862	94.834	-0.007
	(2.819)	(1.548)	(0.313)
Percentage of Students Black	1.52	5.735	-4.205
	(0.213)	(1.413)	(1.429)
Percentage of Students Hispanic	3.803	3.915	-0.111
	(0.347)	(0.702)	(0.783)
Perc. Free or Reduced Price Lunch	33.634	26.06	7.506
	(14.234)	(14.490)	(2.623)
Total Students (1,000)	2.013	6.334	-4.32
	(0.246)	(1.345)	(1.367)

Table 2: Descriptive Statistic (con't)

	Non Q Comp Mean (Std. Dev.)	Q Comp Approved Mean (Std. Dev.)	Difference in Means (Std. Error)
Student Test Scores			
Percentage of Students Earning Level 5 Score in …			
3rd Grade Mathematics	13.23	15.601	-2.371
	(8.892)	(8.222)	(1.505)
3rd Grade Reading	16.319	19.903	-3.585
	(8.364)	(5.914)	(1.128)
5th Grade Mathematics	14.602	20.024	-5.423
	(8.477)	(9.629)	(1.725)
5th Grade Reading	23.129	29.336	-6.207
	(9.286)	(9.119)	(1.656)
Community/District Characteristics			
Percentage of Pop. with Bachelor Deg.	11.013	17.685	-6.63
	(5.018)	(9.265)	(1.616)
District Total Population (1,000)	11.478	40.827	-29.204
	(24.687)	(64.458)	(11.150)
Median Family Income (1,000 $)	48.017	58.9	-10.883
	(0.604)	(2.690)	(2.757)
Per Student Expenditure (1,000 $)	7.925	7.841	0.074
	(1.158)	(1.006)	(0.185)
Total Full Time Teachers	126.593	376.44	-249.847
	(259.642)	(491.643)	(85.684)
Student to Teacher Ratio	14.829	16.506	-1.63
	(2.475)	(1.874)	(0.352)

Notes: 328 school districts used in analysis, 34 of which approved a Q Comp program by March 2007. Standard errors for difference in means calculated assuming unequal variances.

Sources: 2004-2005 School District Data, 2004 Financial Data, and 2003 MCA test data from the Minnesota Department of Education and the NCES Common Core of Data.

Table 3: Relationship of Q Comp Approval to District Characteristics

Dependent Variable: Approval of Q Comp

	(1)	(2)	(3)	(4)
Percentage of Teachers w/ Masters Deg.	0.0041 (0.0008)***			0.0018 (0.0010)*
Avg. Teacher Experience		-0.0073 (0.0062)		0.0076 (0.0053)
Max. Salary with Bachelors Deg. (1000 $)			0.0117 (0.0029)***	0.0059 (0.0025)**
District Level Control Variables	No	No	No	Yes
N	328	328	328	328
Log Likelihood	94.9646	108.5503	100.6428	81.4161
Pseudo R-Squared	0.1307	0.0063	0.0787	0.2547

Notes: *significant at 10 percent level, **significant at 5 percent level, ***significant at 1 percent level. This Table reports marginal effects from a probit model where the marginal effects are reported at the mean of each variable. Standard errors in parentheses. Specifications with teacher salary data include a dummy variable for missing values. District Level Control Variables include percentage black teachers, percentage Hispanic teachers, percentage male teachers, student attendance rate, percentage of 5th grade student with level 5 in reading on assessment, percentage with reduced price lunch, percentage of black students, percentage of Hispanic students, student to teacher ratio, median family income in the district, percentage of population with bachelor degree, per student expenditures, and total students in district.

Sources: 2004-2005 School District Data, 2004 Financial Data, and 2003 MCA Test Data from the Minnesota Department of Education and the NCES Common Core of Data.

Table 4: Teacher Evaluation Required for Salary Change

	Evaluation Required?			
	Yes	No	TBD	N
Percent Teachers				
MA/PHD	53.92	42.66	49.24	34
	(14.54)	(19.56)	(20.32)	
Max BA Salary	52.99	47.55	44.97	27
	(8.28)	(5.15)	(5.99)	
Avg. Years Experience	15.21	16.79	16.37	34
	(2.05)	(4.08)	(3.39)	
Percent Lv. 5				
(Reading)	29.89	30.30	24.15	34
	(9.92)	(8.14)	(7.19)	
Observations	20	10	4	

Notes: Sample means for Q Comp school districts reported with standard errors in parentheses. Determination of whether an evaluation is required for salary change is based on a school district's Q Comp Approval Letter and correspondence with the Minnesota Department of Education. See Appendix details.

Sources: 2004-2005 School District Data and 2003 MCA Test Data from the Minnesota Department of Education.

Figure 1: Average Salary Schedule for Minnesota Q Comp School Districts Prior to Q Comp
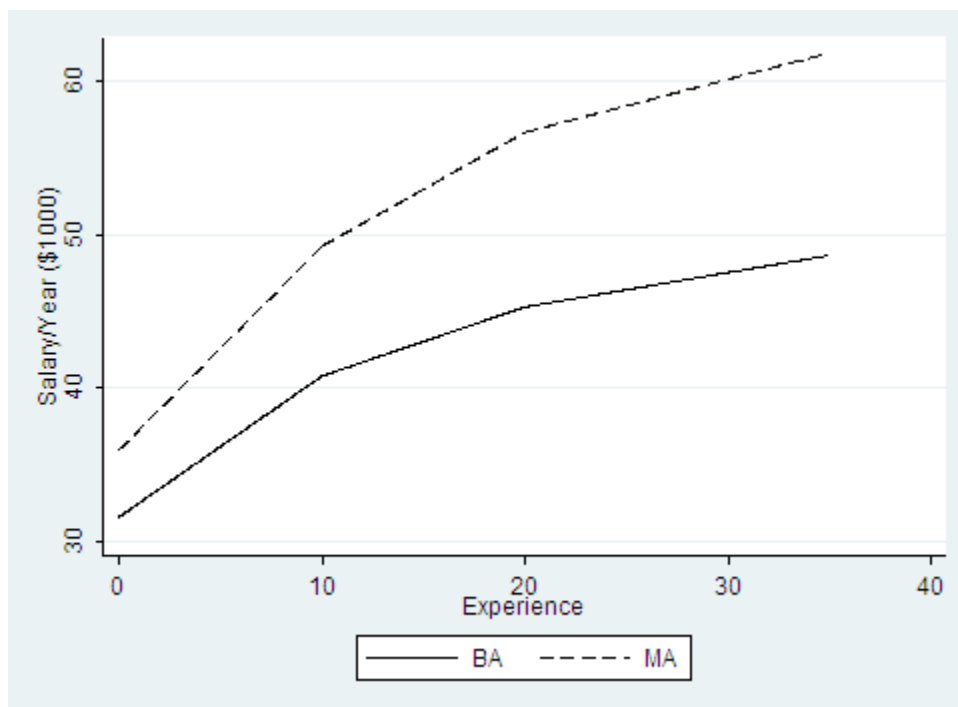
Source: 2006-2007 Salary Schedule Data (before Q Comp approval) from Education Minnesota. The figure uses 2006-2007 salary data obtained from the state teachers union, Education Minnesota. Schedules were available for 28 of the 34 Q Comp participating districts. These schedules reflect agreements made between school districts and the local teachers unions before Q Comp implementation.

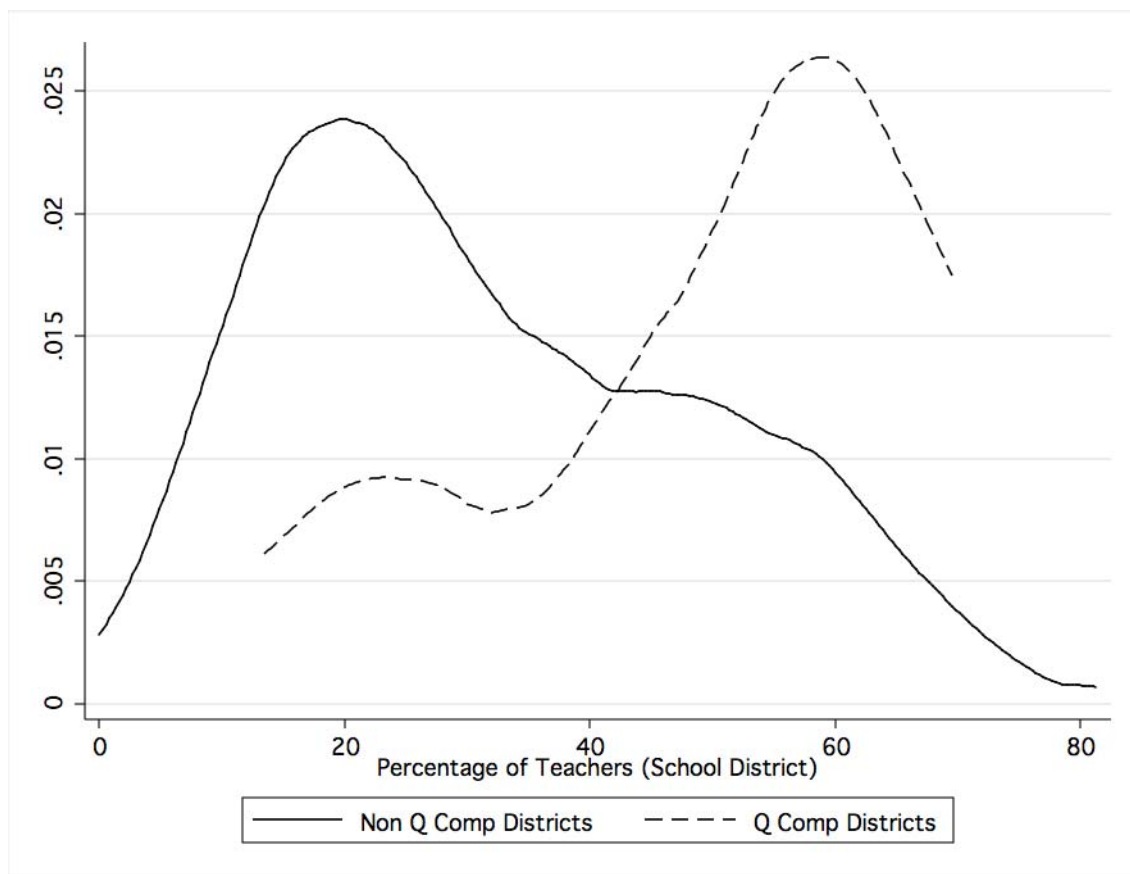Figure 2: Simulation: Relative Gains from Merit Pay by Base Pay

Notes: Relative Gains from Merit Pay is the relative proportional gains to merit:
| Gains – Gains at Base Salary at 30,000| / | Gains at Base Salary of $30,000|.

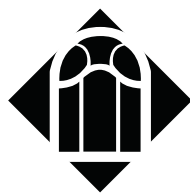Sources: Simulation from parameters defined in the text.

Figure 3: Distribution across School Districts of Fraction of Teachers with Masters Degrees

Source: 2004-2005 School District Data from the Minnesota Department of Education.

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