Investing in Performance: Information and Merit-Based Incentives in K-12 Education

Optimally designing a performance-based contract requires understanding how workers respond to both incentives and information about performance, and the effect of the interaction between these two factors. We study such contracts in a K-12 educational setting, where a school district (the principal) contracts with teachers (the agents) to maximize the probability that students score “proficient” on the end-of-the-year state standardized test. We assume that the school district has a fixed budget to allocate between a merit-based incentive for teachers and an interim assessment, a type of student performance assessment that has become increasingly common in the past decade. Teachers will receive the merit-based incentive if a sufficient portion of students score “proficient” on the state standardized assessment. However, prior to the state test, both the district and its teachers are uncertain about how the state of student proficiency evolves during the school year. The district may choose to remove this uncertainty by administering an interim assessment at a cost. Teachers respond to both this information and the merit-based incentive by choosing a dynamic policy defining their effort levels. We model this setting using a dynamic principal-agent framework with partially hidden states.

Our analysis draws on the principal-agent model literature in economics and operations management, as well as the literature on performance pay in K-12 education. Dynamic principal-agent models have been studied in the operations literature. For example, Zhang and Zenios (2008) studies such models with hidden information, where the state is known to the agent but not to the principal. In our model, the state is obscured from both the agent and principal, but the principal can choose to invest in acquiring more information.

In the K-12 education literature, there is a rich stream of papers focused on contracting and performance-based pay, also known as “merit pay.” While merit pay has been implemented in a variety of settings (Cohen and Murnane, 1985; Podgursky and Springer, 2007), there has been resistance to adopting this practice, particularly teacher-level merit pay, due to negative effects brought on by increased competition among teachers and diminished morale (Johnson, 1984). Much of the recent work in this field is empirical, and the findings on the effects of merit pay are mixed. For example, Springer et al. (2011) and Marsh et al. (2011) find the effect of merit pay
is weak, but this may be due to the short-term nature of the experiment or relatively low bonus amounts. Dee and Wyckoff (2015) find that merit pay has a positive effect on teacher effectiveness when it is part of a multi-pronged, long-term program. Similarly, Chiang et al. (2017) find that merit pay led to a slight increase in student achievement by the second year of a four-year program.

In our work, we study the impact of the introduction of a merit pay contract on teacher effort levels, and we explicitly consider the effect of interim assessments.

This work is timely given the use of standardized testing for school accountability in the United States education system spurred by the passage of the No Child Left Behind Act of 2001. Consequently, schools increasingly rely on interim assessments, often purchased from third-party vendors, to gauge students’ progress towards state-mandated goals (Christman et al., 2009). At the same time, school districts are experimenting with performance-based teacher compensation approaches as part of their efforts to appropriately reward high-performing teachers. This was encouraged by the 2009 creation of the $4.35 billion Race to the Top Fund, which included funding for rewarding effective teachers and principals (U.S. Department of Education, 2009).

In our model, we consider a discrete-time, two-period setting. In each period, the school is either in the “proficient” state or the “not proficient” state, which indicates whether a sufficient fraction of the school’s students are on track to satisfy state-imposed learning standards. The state is known at the beginning of Period 1 (the “initial state”) and will be evaluated by the state standardized test at the end of Period 2 (the “final state”); the initial state is known to both the school district and the teachers, and the results of evaluation will be made known to both parties as well. Additionally, in each period, teachers must decide their effort level; this value is a proxy for work that can improve students’ performance on the test, such as extra time spent working with students. We assume that the teachers’ choice of effort level cannot be directly observed by the district. Teachers make their effort decisions in order to maximize their total expected utility, defined as their wages minus the cost of effort. Furthermore, if the district does not invest in an interim assessment, the district and teachers have imperfect knowledge of the state at the beginning of Period 2 (the “intermediate state”). Then, teachers’ effort decisions in Period 2 are based on incomplete information. If the district invests in an interim assessment at the end of Period 1, then
the intermediate state is perfectly known. The transition probabilities in each period depend both on the starting state and the teacher’s effort decision. The level of the merit-based incentive and decision of whether to invest in an interim assessment are determined by the school to maximize the probability that students are in the proficient state at the end of Period 2.

Our work makes the following contributions. First, we identify settings where the benefits of the additional information provided by interim assessments justify their costs. In particular, we find that interim assessments are most beneficial when the school is initially in the not-proficient state and has a moderate budget, or when the school is initially proficient and has a small budget. We also specify cases where this additional information may play a counterproductive role, suppressing teacher effort levels and resulting in poorer student performance. Our model is a useful tool for districts seeking to understand the trade-off between investing in information and investing in teachers, via performance pay.

REFERENCES


