

An Organizations and Incentives Critique of the Literature on Teacher Pay and School Governance

John Garen*
Department of Economics
Gatton College of Business and Economics
University of Kentucky
Lexington, KY 40506-0034
jgaren@uky.edu

October 2014

Abstract

This paper applies fundamentals of the economics of organizations and principal-agent theory to the ownership and governance of schools, the use of teacher incentive pay, and school reform efforts. We analyze schools as we do firms. Important elements are the multitask principal-agent model and models of public/private differences in institutional incentives. Applying these models to schools, we find that many public school teachers will have attenuated incentives, but distorted towards test scores and that mandates to increase test score rewards may be counterproductive. Institutional reform seems more promising, where the goal is to alter school's/schools administrators' payoff to make them more responsive to educational value produced and less to political influences, thereby inducing more effective teacher incentive systems. We discuss and critique school reform efforts in this regard, including Tiebout competition, charter schools, voucher programs, and use of "best practice" and also appraise the empirical literature on evaluating these programs. We find that many reform efforts are lacking in addressing critical aspects of institutional incentives and that empirical studies often fail to distinguish between trivial and large changes in school incentive environments.

JEL codes: J33, I28, L21

*For comments and consultation on previous versions, I thank William Hoyt, Lori Taylor, session participants at the Association of Private Enterprise Education conference and the Southern Economic Association meetings, and workshop participants at the University of Kentucky. I also thank the University of Kentucky's Gatton College BB&T Program for support.

I. Introduction

This article considers several fundamental facets of the literature on the economics of organizations and principal-agent theory and brings them to bear on critiquing and analyzing the literature on the governance of schools, the use and nature of teacher incentive pay, the performance of schools, and school reform efforts. Essentially, we analyze schools as we do firms. This approach, with a few exceptions, is absent from the literature on teacher incentive systems and school reform. We argue that our approach is essential in understanding and evaluating such issues.

The chronic underperformance of many public schools, despite the long-term growth in resources devoted to public education, has generated a number of reforms. A popular one is some form of teacher incentive pay that ties pay to student test scores. Another is experimentation with allowing more parental choice, such as charter schools and vouchers. Thus, our discussion focuses on teacher incentive pay and the governance of schools, where the latter includes school ownership, decision rights, and competition. We analyze and critique schooling policy using the same framework as when we analyze policy for other firms and industries.

Though the relevant literature on organizations and incentives is geared toward private, competitive organizations, it considers conditions that are quite relevant to schools and provides important insights into teacher pay and school governance. Thus, we develop a model of teacher incentive pay and school behavior in public versus private schools, in competitive and non-competitive settings, and use it to consider the effects of reform and to critique aspects of the empirical literature on teachers and schools.

Our critique and discussion focuses on the incentives imbedded in institutional/organizational frameworks and how this affects pay setting for employees/teachers. It is this perspective that is lacking in the education literature. We identify four parameters that are key in determining the behavior of the organization/school and show how they affect pay setting and organization performance. They are: (i) the degree of residual income claimancy of the organization and/or concentration of interests of stakeholders; (ii) how closely the organization's revenue/budget is tied to value produced; (iii) the importance of public/political symbols of success, and; (iv) the political strength of employees/unions.

Each of these affects an organization in predictable ways, and perhaps in ways that frustrate the goals of education policy. We argue that the appropriate way to address education policy – following the economics of organization approach – is to understand the role of these parameters and how they might be changed.

Our approach is based on a number of fundamentals in the literature. One is the multitask principal-agent model of Holmstrom and Milgrom (1991) where incentives are established for agents who do many tasks. Too great an incentive for one task leads to a distortion of effort and a possible reduction in value. This issue is well recognized regarding education and underlies the problem with mandates for rewarding test scores. It is examined carefully in what follows.

A second fundamental idea is based on the work of Jensen and Meckling (1992), who extend Hayek (1945). Jensen and Meckling (1992) stress the importance of combining decision-making power with incentives to make good decisions and argue that

decentralizing both decision making and incentives is especially critical where “specific” knowledge – akin to Hayek’s knowledge of particular circumstances – is important.

In the context at hand, “specific knowledge” is knowledge of unique and subtle characteristics of teachers, students, and schools. Much of this knowledge is held by school administrators, teachers, and parents and is hard to quantify and transfer to others. This is in contrast to general knowledge, such as standardized test scores, which is straightforward to quantify and transmit. Governance and incentives for use of these types of knowledge in the context of schools is detailed below.

Another fundamental from the literature is related to the work of Dixit (1997, 2002) and Acemoglu, Kremer, and Tian (2007), who contrast public and private organizations in their provision of incentives to employees. Essentially, the payoff function for public sector managers serves to attenuate managerial incentives and this attenuation is passed along to employees. Naturally, since most schools are public organizations, this analysis is quite germane.

We arrive at a number of broad conclusions from our approach:

(i) The applicability of our standard models is clear. These models consider implementing a reward system in scenarios that schools face, i.e., where information on employee performance is subtle, subjectively measured, and hard to assess.

(ii) School administrators have situation-specific knowledge about teacher productivity that looms large. Using this knowledge is important but requires subjective and discretionary evaluations and pay setting by school administrators.

(iii) For use of subjective performance evaluations, the incentives for school administrators to establish effective compensation policies for teachers matters. This incentive depends on institutional/organizational features.

(iv) Public schools with little competition are likely to have weak incentives, with any remaining incentives skewed toward test scores due to political factors. These institutional incentives are “passed along” to teachers, diluting and distorting their incentives.

(v) As is well-recognized, mandated test scores rewards for teachers distort their effort away from other useful educational efforts. The institutional setting of the school determines whether this harms or helps. It is harmful for schools in settings that approximate a competitive market, though it may be helpful otherwise, but only if tests are well designed. Also, this distortion appears even more unfavorable with the increased realization by researchers of the importance non-cognitive skills.

(vi) Rather than the use of mandates, our approach suggests a better framework for reform is to alter the underlying institutional incentives, e.g., how budgets are tied to value created, the extent of stakeholder incentives, and the degree of political influence.

(vii) There is a large body of empirical evaluations of this type of reform, e.g., of charter schools and other choice programs. Most are not informative tests of the effect of institutional reform because they compare widely divergent reform programs, or very weak reforms, to regular public schools. For example, charter programs vary widely regarding their availability, in their curricula and hiring autonomy, and none have the ability to set their price. Some are almost indistinguishable from regular schools and

others are markedly different. Thus, comparing a wide sample of charter schools to regular schools may reveal little about the effect of institutional reform.

(viii) Other reforms efforts focus on the adoption of better practices and better test score evaluation methods. Our approach indicates that this is problematic absent changes in institutional incentives. Moreover, good institutional incentive are expected to generate better practices without their mandate from above.

The outline of the remainder of the paper is as follows. Section II presents important background literature, supporting the validity of our approach. Section III begins the formal modeling by applying the Holmstrom-Milgrom model to teachers. Section IV considers the standard model of pay setting by the competitive, private-sector organization and applies this model to schools. Section V modifies the model to consider the case of a school administrator/manager operating in a public organization facing little competition. Here, the administrator's payoff function is altered, causing teachers incentives to be dulled and skewed.

Section VI considers the effect of mandating teacher incentives for test scores and illuminates pitfalls of doing so. Section VII turns to institutional reform efforts and empirical evaluations of such reforms in the literature. Section VIII considers adoption of best practices from successful schools. Lastly, section IX concludes.

II. Some Background Literature

Though teacher characteristics such as certification and advanced degrees do not have much effect on student test scores, recent empirical research shows that teachers do make a difference. Rockoff (2004) and Rivkin, Hanushek, and Kain (2005), for example, demonstrate that some teachers consistently have classrooms of students that outperform

others on test scores and that this difference is quite sizable. More recent support for this is in Chetty, et.al. (2014a,b).

There is ample evidence that teachers respond to incentives. As examples, Figlio and Kenny (2007), Eberts, Hollenbeck, and Stone (2002), Lavy (2009), and Jacob (2005) find that teachers respond largely as expected, i.e., the incentivized behavior increased.¹ Jacob's findings also suggest that teachers engage in "teaching to the test" rather than broader educational efforts. This raises the issue that incentives for test scores will distort teacher effort away from other educational activities.

Regarding the value of schooling, there is evidence that parents value better test scores, but they also value other aspects of their children's educational experience. See, for example, Jacob and Lefgren (2007). Also, Heckman, Stixrud, and Urzua (2006) show the importance of non-cognitive skills, which are not directly reflected in test scores.

Teachers presumably can be rewarded for nurturing such non-test score aspects of education. There is considerable anecdotal evidence that school principals are well informed regarding the quality and performance of their teachers in this regard. Jacob and Lefgren (2008) provide formal evidence. This is not surprising since school administrators work around their teachers every day, gaining information that is not reflected in test scores. With the authority to do so, school administrators could use this information to reward teachers. This more subjective measure of performance is likely to capture a broader picture of the teacher's contributions to educational value.

This brings up the issue of how situation-specific knowledge is utilized. Jensen and Meckling (1992), following the ideas of Hayek (1945), argue that those who have the

¹ Neal (2011) provides a more thorough review. Note that not all studies find an effect of teacher incentives. See, for example, Fryer (2013).

knowledge ought to have the incentives to use it appropriately. This speaks to the ownership and governance of schools and is modeled in what follows.

The difficulties of implementing a reward system based on complicated, subtle, subjectively measured, and hard to assess aspects of jobs have been pointed out and analyzed in detail in the private-sector, competitive setting. See Prendergast (1999) for a survey. It is well recognized (e.g., Lavy (2007)) that these issues apply in education. Neal (2009) points out that, despite these difficulties, the competitive process encourages the most efficient incentive systems and human resource practices. This competitive process is often lacking for public schools and is discussed extensively below.

A significant literature examines differences between public- and private-sector enterprises. Naturally, this is particularly important for schools since most are in the public sector. The papers of Dixit (1997, 2002) and Acemoglu, Kremer, and Tian (2007) are especially relevant since they discuss how the public sector organization alters incentives of employees. In their models, political constraints alter the payoff function for public sector managers. They find that their incentives are dulled, which is passed along to public organization employees. Below, we build these ideas into our model.

Note that school competition and school choice alters the organization's incentives by enabling parents to more easily move their children and funding from schools. Podgursky and Ballou (2001) argue that this can induce school administrators to adopt efficient reward systems for teachers. Hanushek and Rivkin (2004) and Neal (2009) make similar arguments. We model this below.

Various parts of the literature make the case for taking the approach of this paper. It is clear that teachers matter in producing educational value and that incentives affect

teacher behavior. Cognitive and non-cognitive skills are important. School administrators have knowledge about teachers that could be used to provide incentives. The effects of consumer choice and competition are mainstays in economics analysis and the analysis of public-private sector differences is well established. It seems quite sensible to apply these models to schools, i.e., to model schools as we do firms.

III. Teacher Assessment, Test Scores, and Incentives for Teachers

A. Applying the Principal-Agent Model to Teachers

Many issues regarding incentive pay for teachers can be illustrated with a standard multitask principal-agent model derived from Holmstrom and Milgrom (1991). This model has been used widely to understand compensation arrangements in the private sector in situations not unlike those of school teachers. i.e., where some aspects of jobs are easy to quantify and others quite difficult.

Consider three broad aspects of teacher performance and effort that can affect the educational value produced: T = the test scores of the teacher's students; A = the school administrator's assessment of the teacher's performance; and N = aspects of teacher performance that are not observed by third parties. Define educational value as V and let V be increasing in T , A , and N as $V=V(T,A,N)$. Only the first two types of effort are measured (with error) and so compensation can be based on these two. The first of the two can be objectively measured and while the second cannot.

Note that A reflects specific knowledge, i.e., knowledge acquired by the school administrator that is specific to the school and teacher that is difficult to summarize and transmit elsewhere. One must rely on the school administrator to use this knowledge and

is like subjective performance evaluation in standard principal-agent models. In contrast, T is information that is readily summarized, transmitted and understood by others.

The nature of the test underlying T determines the value of good scores to education as well as the nature of teacher effort in this regard. For a narrowly designed test, this may entail narrow effort, e.g., a focus on computational math problems. Also, if the test is easily “gamed,” it also may involve “strategic” effort such as teaching specific problems or taking steps so that low-achieving students do not take the exams. For these cases, tests, the marginal product of T in producing educational value, V_T , is very small.

The administrator’s evaluation, A, is expected to reflect broader, less objectively-defined aspects of teacher effort, e.g., effort directed at communication, problem solving, creativity as well as effort in teamwork and in dealing with parents. This also includes nurturing intangible, non-cognitive skills such as hard work, perseverance, and responsibility. The unobserved aspect of teacher performance, N, is likely to reflect similar efforts regarding intangibles and less objectively-measured outcomes.

Following the standard model, assume that teachers are risk averse with a constant absolute risk aversion utility function. The teacher’s certainty equivalent of utility is given by $U = E(Y) - C(T,A,N) - \frac{1}{2}\rho R$, where $E(Y)$ is the teacher’s expected income, $C(\cdot)$ is the utility cost of effort, ρ is the coefficient of absolute risk aversion, and R is the variance of teacher income due to error in measuring true efforts. The school administrator observes T and A (with error) and sets compensation as a linear function² of T and A such that $E(Y) = b_0 + b_T T + b_A A$.

² Actual rewards for teachers are likely to be nonlinear; indeed Ahn (2008) and Vigdor (2008) find this is the case for North Carolina’s rewards to teachers for better test scores. Linearity is a simple and tractable way to capture the idea that rewards are tied to T and A.

Teachers select the three types of effort, T, A, and N, to maximize utility given by $U = E(Y) - C(T,A,N) - \frac{1}{2}\rho R = b_0 + b_T T + b_A A - C(T,A,N) - \frac{1}{2}\rho R$. This entails choosing each type of effort to equate its marginal benefit its marginal effort cost. This is a standard model with straightforward results. Effort on T rises with b_T and effort regarding A increases with b_A , i.e., $\partial T/\partial b_T > 0$ and $\partial A/\partial b_A > 0$. The cross-effects of b_T on A and of b_A on T, as well as how N is affected by incentives are also important. In formal terms, these depend on the cross-partial derivatives in the cost of effort function. The intuitive interpretation of this is quite sensible.

Consider the “virtuous” case where each type of effort facilitates the other, that is, each lowers the marginal cost of the other; C_{AT} , C_{NT} , and C_{NA} are all negative. Here, an increase in either incentive raises all types of effort. The more plausible (and worrisome) case is where more effort in improving the test results impedes effort on A and N, i.e., T raises the marginal cost of A and N, implying that $C_{TA} > 0$ and $C_{TN} > 0$. Also, given the way A and N are defined, more effort on one aids that of the other, implying that $C_{AN} < 0$.

These entail that a greater reward for the test, b_T , reduces other aspects of teacher effort: $\partial A/\partial b_T < 0$ and $\partial N/\partial b_T < 0$. Thus, stronger incentives for test scores thus do not unambiguously increase educational value. Also, greater reward for the administratively measured effort, b_A , increases the unobserved aspects of output but reduces test scores: $\partial N/\partial b_A > 0$ and $\partial T/\partial b_A < 0$.

These simple results underlie much of the debate regarding the use of test scores as incentives for teachers: that it diverts teachers from other important educational tasks, perhaps to the detriment of educational value. This is especially likely for poorly

designed and/or easily gamed tests. For these types of tests, test scores do not correlate well with educational value, implying a low value for the marginal product of T, V_T . Also, for low-quality tests, teacher effort to raise test scores tends to be narrow and non-complementary to other educational efforts. Thus, encouraging better scores on poorly designed tests serves to add little to education directly and reduces value by distorting behavior away from other value-raising effort.

B. What Does the Literature Say . . . And Not Say?

The difficulties of measuring the contribution of teachers and the potential shortcomings noted above of rewarding student test scores are well recognized. Neal's (2011) review is an example. An extensive compilation this research – in economics, education, and psychology – is in the National Research Council study of Hout and Elliot (2011) while Neal's (2011) review focuses on the work in economics. Generally speaking, the literature finds that incentives do affect behavior as one might expect. However, one of Hout and Elliot's (2011) conclusions is that “incentives will often lead people to find ways to increase measured performance that do not also improve the desired outcomes.” As result, they recommend a cautious design and implementation of incentive plans, with further research and evaluation.

Similar concerns have been raised about a currently popular approach to evaluating teachers for possible use in incentive plans using so-called teacher value added. This approach examines the effect of individual teachers on the before and after test scores of students. Chetty, Friedman, and Rockoff (2014a,b) examine this method and the controversies associated with it at great length. Concerns have been raised regarding whether value added actually captures teacher performance and whether this

measure corresponds to true value or just “teaching to the test.” If the latter holds, greater rewards for value added are mostly misdirected incentives.

Though Chetty, et. al. (2014a,b) find that value added is a robust measure of educational value, there is a deeper difficulty to be addressed. Commentators recommend that good performance measures be developed and used appropriately in incentivizing teachers. But how, or by what process, might this be accomplished? More specifically, who implements the reward system and what are their incentives? Might we expect them to behave as commentators wish? Policy makers presumably ought to know these answers in devising recommendations since they will affect policy outcomes. This is where the economics of organizations plays an important role in understanding institutions and their incentives.

Regarding the standard incentive pay model for the private sector, a profit maximizing firm in a competitive environment chooses the parameters of the compensation plan for its agents. In these models, similar issues arise here as with incentives for teachers: workers may have jobs with tasks that are difficult to measure; available measures may be quite imperfect; rewards for one measure can distort effort in undesirable ways; there is subjective and specific knowledge on worker efforts that is often available. This literature recognizes that each of these presents difficulties and trade-offs, but ultimately it is the incentives implicit in competitive markets that determine pay setting.³

The environment in most schooling markets is usually quite different; schools operate with a mix of political and economic constraints. Thus, it is worthwhile to characterize the institutional setting/incentives in this environment for those who

³ See Prendergast (1999) for a survey.

determine compensation practices. We turn to this in the next two sections and use the findings for further critique of the literature.

IV. The Competitive Model of Incentive Pay

We initially consider pay setting by schools as we would for the competitive firm. As in the incentive pay literature, this model is viewed as predicting how firms/schools behave in this economic setting, as well as establishing a benchmark for comparison.

As in the standard, competitive model, consider the school administrator's payoff function as being closely approximated by the net income of the school. This can result from the administrator being the owner of the school or an employee-manager of a private organization with the appropriate incentives.⁴ Assume that the school operates in a competitive market and sells schooling services for their value, V , and also competes for teachers.⁵

Thus, the payoff function per teacher for the school administrator is $F = E(V - Y) = V(T, A, N) - (b_0 + b_T T + b_A A)$.⁶ The payoff maximizing compensation schedule is chosen subject to the incentive compatibility and individual rationality constraints from principal – agent theory. With these constraints, the payoff function becomes $F = V(T, A, N) - C(T, A, N) - \frac{1}{2}pR - U^M$, where U^M is teacher alternative utility.

The outcome of this model most instructive with further simplifying assumptions: assume that the V function is linear; $V = \alpha_T T + \alpha_A A + \alpha_N N$, and assume risk neutrality for

⁴ With administrators as the hired managers of school owners, the principal-agent problem emerges regarding how to provide incentives for school administrators. Thus, one might consider another layer of incentives with owners providing incentives to the administrators who then set incentives for teachers. Rather than trying to model more steps in this hierarchy, we focus on just two. Note that this issues arises in the standard model where firm owners wish to provide incentives to firm managers.

⁵ It is important that school-firms are free to set prices so revenue reflects value, V . Failure of this generates some issues to be discussed below.

⁶ We assume constant returns to scale in the number of teachers so the maximum payoff is attained by maximizing net value per teacher. Capital costs are assumed to be fixed and therefore suppressed.

all parties. These enable simple solutions without taking away from the basic, underlying economic implications. This model implies that firms/schools set incentives as:

$$(1) \quad b_T = \alpha_T - \alpha_N C_{NT} / \Omega$$

$$(2) \quad b_A = \alpha_A - \alpha_N C_{NA} / \Omega$$

where $\Omega > 0$ based on second-order conditions.

Since the marginal product of T is α_T and that of A is α_A , one can see how rewards for each type of effort diverge from the marginal products of the observed efforts. When $C_{NT} > 0$ (the plausible case), b_T is less than α_T . This is because b_T distorts effort away from N, so generates a lower incentive for T. Also, because increasing effort regarding A lowers the marginal cost of N ($C_{NA} < 0$), then $b_A > \alpha_A$. More effort for A also increases N, inducing a higher b_A .

Note that it is the environment of profit maximization in competitive markets that induces organizations to set their compensation systems in this manner. In this setting, the desirability of rewarding tests scores depends the quality of the test. Low-quality tests have a low α_T (a low marginal product) and impede efforts regarding N, implying a high value of C_{NT} . These induce the firm to set a low b_T . When the complementarity of A and N is large (a high C_{NA}), then firms set stronger rewards for the subjective, administrative evaluation. These foreshadow the potential pitfalls of mandating heavy reliance on rewarding T.⁷ Of course, most educational organizations do not operate in a competitive, private-sector environment. We turn to this issue next.

V. Pay Setting in Noncompetitive, Public Organizations

⁷ In the more general case with risk aversion of teachers, these basic results arise, though with some adjustment. Risk aversion tends to reduce b_T and b_A , assuming that T and A are measured with error, since they introduce risk into the teacher's compensation.

This section considers how pay for agents is established in the public and/or noncompetitive sector. The results are used to inform our critique of studies of teacher incentives and school organization.

A. Public Sector, Noncompetitive Organizations

There is a substantial literature regarding the behavior of organizations in the public and/or noncompetitive sector. We apply its findings and related ideas to pay setting by school administrators. Most schools are public sector enterprises. Differences from the private, competitive setting emerge because the different institutional setting alters the payoff function of managers/school administrators which, in turn, alters how they establish pay and incentives for teachers. Autonomy over pay setting for such organization translates into a different – and problematic – incentive system for teachers.

A number of distinctions are drawn between private and public institutions. Some key ones are the following. Public institutions rely on taxation for their funds rather than voluntary sources. Output is not directly sold to users. These put less pressure on public agencies to provide value and cover costs. This is related to the idea that voters are often rationally ignorant and so public sector outcomes are overly influenced by special interests. Also, public institutions are not structured so that managers (or anyone) are residual income claimants. These imply that the payoff functions of public sector officials need not be well aligned with net value.

Several theoretical papers in the literature provide formal models based on related ideas. Dixit (1997, 2002), building on the multitask principal-agent model of Holmstrom and Milgrom (1991) and the common agency work of Bernheim and Whinston (1986), develops a model where the government agent has multiple principals. The principals are

akin to a politician's constituents, each with different objectives that pull the government agent in many directions. This ends up diluting the government agent's payoff for pursuing any single objective.

Acemoglu, Kremer, and Mian (2007) develop a model in the context of rewards for student test scores with similar implications. In their model, politicians are responsible for many public agencies, including schools. They are rewarded by voters based on school performance as well as a host of other policies unrelated to schools. Thus, the politician may lose office for reasons unrelated to school performance. This implies that the politician's payoff function with respect to the school system is $(1 - \pi)$ times the value added of the schools, where π is the probability of losing one's office for reasons extraneous to schools. This payoff function dilutes the politician's incentives to pursue value maximizing schools.

The above models imply that the payoff to public sector managers depends on net value creation, but in a weak or diluted way, e.g., $F_P = \theta(V - Y)$, where F_P is the manager's payoff function and $\theta < 1$. The dispersion of incentives and knowledge of stakeholders in the organization (voters versus shareholders) for the public sector generate this results. We start with this payoff function but consider refinements based on related features of public institutions and public schools.

First, note that the revenue of a public school is its budget and is determined by a political process. This process is such that changes in value produced by the school are not necessarily well reflected in school revenue. Letting B represent the school's budget, this is expressed as $B = B(V)$, with $0 < B' < 1$. It is unlikely that $B' = 0$, i.e., that there is no link between V and B , since bad enough outcomes will cause repercussions for the

school's budget. Still, we expect $B' < 1$, implying that the political process mutes the relation of V to B .

For schools in a non-competitive environment, a related outcome is likely. In a competitive setting, total revenue received for delivering value V equals V . If value falls (rises) by \$1, total revenue falls (rises) by \$1. Where there is less competition, the revenue received may not fall dollar-for-dollar with changes in value. For schools that deliver a lower V , parents have few options and many will continue to send their children to the school and the school's total revenue does not fall commensurately. This reinforces the outcome of the previous paragraph that the relationship between the school's revenue and changes in V is attenuated.

Another important aspect of the public sector is that there is no lawful residual income claimancy, i.e., school administrators cannot keep net school revenue, $B(V) - Y$. Thus, the utility gained by the administrator from an operating surplus is not the value of the surplus itself. It is unlikely to be zero, however, since the administrator's job probably is safer when the budgeted revenue covers cost. Also, the residual of revenue over cost might be spent on workplace amenities. Still, the benefits are less than if provided in cash. This reinforces the idea that the public administrator's payoff depends on net revenue school in a muted way so that $F_P = \theta(B - Y)$, where $\theta < 1$.

A third aspect of the public sector is the importance of visible actions in influencing voters since it is the political support of voters that weigh heavily in determining the school's budget and not simply the satisfaction of the parents of children at the school. Visible, positively perceived actions enhance political support. Administrators who engage in such actions will improve their payoff. Test scores are

easy to report and are widely visible to the populace and so good scores are especially helpful in generating political support. This is less true of aspects teacher performance measured by the administrator, A. This involves subtle judgments that are difficult to convey to the public. Thus, higher test scores will be weighted more heavily in the administrator's payoff function. Assume that test scores carry the weight $\delta > 1$.

Putting all of the above together yields a public sector administrator payoff function of $F_P = \theta(B(V) - Y)$, where T in the V function carries a greater weight δ . Combining this with the individual rationality constraint and risk neutrality, this becomes $F_P = \theta(B(V) - C)$. Assuming V being linear as $V = \alpha_T T + \alpha_A A + \alpha_N N$, this gives F_P as $F_P = \theta(B(\delta\alpha_T T + \alpha_A A + \alpha_N N) - C)$.

A related possibility is that administrators benefit by making teachers happier, especially if a teachers' union has a strong political voice. This suggests that teacher utility, given by $Y - C$, enters into the school administrator's payoff function. However, raising teacher utility by handing cash over to teachers is a highly visible action that will create negative publicity and reduce political support. So suppose that teacher pay, Y, is politically fixed at Λ . With administrator payoffs depending on teacher utility, this gives $F_P = \theta(B(V) - \Lambda) + \varphi(\Lambda - C) = \theta B(V) - \varphi C + (\varphi - \theta)\Lambda$, where $\varphi > 1$ is the weight put on teacher utility. With Λ fixed, the administrator acts to maximize $\theta B(V) - \varphi C$. This is identical to the above payoff function with $\varphi > 1$ replacing $\theta < 1$ as the weight on C.

B. Pay Setting

The school administrator chooses compensation policy to maximize F_P . For ease of solution and exposition, let the budget function $B(V) = B \cdot V = B \cdot (\delta\alpha_T T + \alpha_A A + \alpha_N N)$, where $0 < B < 1$. Then the solution is a simple transformation of those (1) and (2) and is:

$$(3) \quad b_T = (\theta B/\varphi)[\delta\alpha_T - \alpha_N C_{NT}/\Omega]$$

$$(4) \quad b_A = (\theta B/\varphi)[\alpha_A - \alpha_N C_{NA}/\Omega]$$

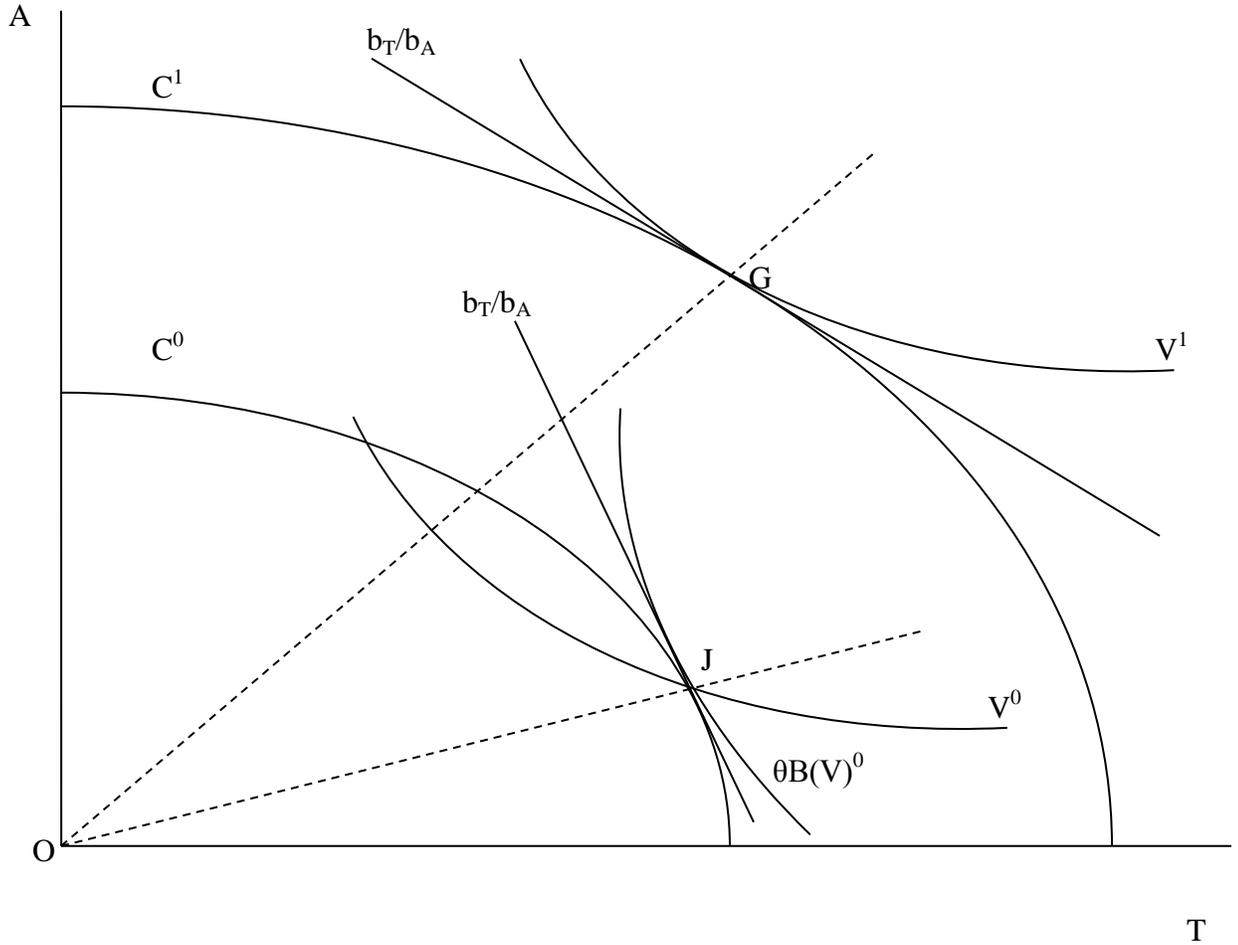
where $\varphi > 1$ or $\varphi = \theta$ depending on the form of the administrator's payoff function.

Because $B < 1$ there is a tendency for incentives to be reduced. This is reinforced when $\varphi > 1$ and $\theta < 1$. Recall that $\theta < 1$ and $B < 1$ reflects the muted benefits to the administrator of raising value. This attenuation of incentives for administrators is "passed along" to teachers. Having $\varphi > 1$ further supports this result. Essentially, because administrators have weak incentives, so do teachers.

The exception to this is test scores. Because of their visibility and potential for political support, the benefit of providing incentives for T is magnified by the factor $\delta > 1$. Thus, incentives for T may be stronger than for the competitive, private case, depending on the net effect of their increased visibility versus the above-discussed diluting effects. However, relative incentives are altered. The ratio of the test score incentive to the measured performance incentive is b_T/b_A . It is larger here than in the competitive, private case because the factor δ magnifies test score rewards for the public sector.

Figure 1 illustrates this outcome. Point G is the equilibrium in the competitive, private schools case. It is at the tangency of school isovalue curve V^1 , teacher indifference curve C^1 , and a line of slope b_T/b_A , reflecting the relative price of T and A. In the noncompetitive, public sector case the equilibrium is given at point J. Here, there is a tangency of b_T/b_A to teacher indifference curve C^0 and to the isovalue curve distorted by the public, noncompetitive payoff function, $\theta B(V^0)$. As illustrated, point J shows reduced and skewed incentives.

Figure 1



It is this characterization of public school teacher incentives and incentive-setting that we use below in our critique of the literature. The institutional setting of the school is determined by the parameters B , θ , δ , and φ and their effects should be accounted for when examining the efficacy of proposed policies.

C. The Nonprofit Organization

Before proceeding, note that the private, nonprofit organization is common for schools, e.g., those with religious affiliation. They have residual income claimancy, but their legal, nonprofit status limits the distribution of the residual. Many charter schools

also are nonprofits. Their budget is determined by student enrollment, not by a political process, so their net income is $B - Y$, though the revenue per student is usually mandated.

That nonprofit organizations cannot take their residual income in cash suggests similarities to the public sector. However, many factors weigh against this. Nonprofits are supported by stakeholders interested in promoting the value of educational services provided, V . School administrators who raise V are more likely to succeed in their jobs. Thus, the gains from a higher V is heightened in a nonprofit organization relative to the public one. The private, nonprofit firm in a competitive setting seems more much more like competitive, private, profit-seeking firm than a public organization.

VI. Mandating Rewards for Test Scores: Institutions Matter

If point J in Figure 1 is a good approximation of many public schools, one sees the issue with teacher pay. Given their institutional environment, public school administrators dull teacher incentives to the detriment of school performance. Perhaps a natural reaction is to mandate teacher incentives. Doing so from the outside must rely on generally available information, which implies reliance on test scores. Many states have implemented teacher rewards based on the test scores at each school and there is increasing interest in measuring and rewarding individual teacher performance in this way. With the increased emphasis on rewarding test scores comes an implicit reduction in the ability of school administrators to reward teachers based on their evaluations of teacher performance. In effect, discretion is removed from the school administrator in setting pay. Here we account for the institutional setting when considering how this is likely to affect schools and the value of educational services provided.

In this analysis, consider two sorts of distinctions. One is between good and bad tests. This depends on the two features discussed above: the marginal product of test scores and the non-complementarity of effort on test scores to A and N. The other distinction is between “good” and “bad” schools. Good schools are those that reasonably approximate the outcome of point G in Figure 1.⁸ Bad schools are those that approximate point J. The former occur in environments where the parameters B, θ , δ , and φ are all close to one and the latter are the converse.

Now consider the effects of mandating rewards for different types of tests and schools. A mandated value of b_T above what the school would otherwise set requires an increase in b_T/b_A . For good schools that approximate the equilibrium at point G, any mandate of b_T/b_A is distorting and reduces net welfare. This reduction is worse if the test is bad, but has negative consequences even if the test is good.

The more relevant case is that of bad schools at point J that have dulled and skewed teacher incentives. The question is whether a mandate to increase the reward for test scores improves outcomes or not. This depends on whether the test is bad or good.

When a mandate for higher test score rewards is put in place, teachers shift effort toward generating higher test scores and away from other types of effort, causing T to rise. For bad tests, this adds little (if any) to educational value while distorting effort away from A and N. Since the latter reduces value, the net effect is to lower educational value. For good tests, this is less likely to be the outcome. Increasing T raises value and good tests have smaller non-complementarities to A and N, so they are not distorted as much. An increase in value produced is much more probable.

⁸Perhaps induced by strong Tiebout competition. This is discussed below.

Thus, accounting for the institution setting of schools, i.e., the parameters B , θ , δ , and φ , provides a more nuanced critique of mandating higher rewards for tests scores. While it is true that such mandates distort teacher incentives, this policy for an entire state will have negative consequences for the good schools in the state but positive consequences for the set of bad schools. However, the latter holds only if the test is well designed. If not, the unwanted outcome from the bad institutional setting is made worse. Questions about the validity of tests mandated by state departments of education have often been raised. If these concerns are legitimate, mandates for increased test score rewards have negative consequences.

VII. Reform, Evaluating Reform, and Institutions

Recall that the objective function for the public school administrator is:

$$(5) \quad F_P = \theta B(\delta \alpha_T T + \alpha_A A + \alpha_N N) - \varphi C,$$

where φ may equal θ . Our analysis implies that the four parameters B , θ , δ , and φ characterize the institutional setting of the school and determines the school's pay setting and performance. These parameters represent the following:

θ = the degree of incentives and knowledge of stakeholders (shareholders or voters) of the organization and/or residual income claimancy, with $\theta \leq 1$;

B = how closely tied the organization's revenue is to value produced, $B \leq 1$;

δ = the importance of public/political symbols of organization success, $\delta \geq 1$;

φ = the political strength of employees of the organization; $\varphi \geq 1$.

Any analysis of policy towards schools should take account of these parameters for the organizations involved.⁹ Do the values of the parameters indicate that school administrator incentives are to vigorously pursue policies given from above? Do the

⁹ Coulson (1999) discusses a similar set of items that affect school incentives.

policies themselves fundamentally change these parameters for the institution that would lead it to desired outcomes? If not, then it seems that the fundamental incentives of the organization has not been altered and reform efforts are likely to be ineffectual. We take this perspective in critiquing many of the studies and approaches to examining school reform policies.

A. School Choice via Mobility: Tiebout Competition

School choice is a way of altering school governance and the administrator's payoff function. One avenue it does so is by raising the responsiveness of the school's revenue (or budget) to V . i.e., it raises the parameter B . It does so by allowing parents to move their child and the funding if the parents believe value is not being delivered.

Tiebout competition may occur where there are multiple schools and/or school districts and people choose among schools by choosing their residence in the appropriate catchment area. Schools delivering a low V will have outmigration, presumably resulting in a lower budget. There is considerable discussion in the literature whether Tiebout competition can serve as a competitive force to discipline public schools. Probably the best known study in this regard is Hoxby (2000), who finds that this form of competition improves school test scores. Rothstein (2007) disputes this result, however. In related study, Hoxby (2002) finds that Tiebout competition changes teacher hiring practices toward more emphasis on teacher science and math skills, stronger college preparation, and teacher independence and effort.

However, one might ask how effective Tiebout competition can be in increasing the parameter B . This type of competition requires changing residence to change schools, which can be quite costly, and so can be a very cumbersome form of choice.

Choice of residence involves consideration of a host of factors in addition to schools, so catchment areas may lose or gain residents due to other factors. This lessens the competitive effect on schools. Moreover, school districts may respond to mobility by keeping the existing schools intact and redrawing catchment areas to maintain enrollment in all schools. Thus, regardless of how bad the school is, it may be guaranteed attaining full enrollment and retaining its funding. No school administrator will see declining enrollment and suffer its negative consequences.

This suggests that school reform efforts that rely largely on Tiebout competition may or may not change school administrator incentives much, depending on the mobility of families in the relevant locations and on the (in)ability of school systems to offset enrollment changes due to this mobility. Thus, its effects on school performance depends on these two factors. The empirical work in the literature has not addressed this.

Regardless of any shortcomings of this form of competition, its importance has likely declined considerably during the 20th century in the U.S. Hoxby's (2004) overview shows that, within this time period, the number of school districts in the U.S. fell from over 100,000 to less than 20,000 and the share of local funding for public schools fell from over 80% to less than 45%. Both suggest a diminished role of Tiebout competition.

B. "Zero-Sum" Choice Programs: Magnets and Open Enrollment

Other institutional reform efforts that entail a degree of school choice – and presumably increase the parameter B – are magnet schools and open enrollment programs. Magnet schools typically target an educational specialty and enroll a limited number of students; often the top students in that specialty. The remaining students are allocated to the other schools. Open enrollment programs allow students to enroll in

many schools in the district. Usually, the best schools fill up quickly and other schools are allotted the remaining students. These programs seem to have the potential for rewarding good schools (and raising B). But because remaining students are allocated elsewhere, even bad school are virtually guaranteed full enrollment and retention of funding. This indicates that B remains low. This is the “zero-sum” nature of these programs; individual schools, and the school system, has net zero change in enrollments. No school administrators have to suffer ill-consequences of declining enrollment and a declining budget. Any remaining incentive is the likely preference for having the better students at the school rather than the worst. Therefore, these are expected to do only a little to raise the value of B.

The above illustrates how the open entry and exit conditions in a competitive market, where new firms may enter and supplant inefficient ones, can sharpen incentives. It establishes a stronger link between value created and the firm’s revenue. This is missing from most open enrollment and magnet programs since the number of school-firms is fixed and established by a central authority. Nobody goes “out of business.”

C. Vouchers and Charter Schools

These the two types of institutional reform seem to offer more extensive choice and have the potential for substantial change in the parameter B, and well moving the other parameters – θ , δ , and φ – closer to one. A number of issues arise in this regard and are addressed below.

(i) Entry and Exit

Vouchers and charter schools have more potential in avoiding the entry and exit problem noted above. This is particularly true if vouchers may be used broadly and

charter laws are unrestrictive enough so that charter schools are generally available. Here, schools that lose students are not automatically allocated other students to make up for the loss. Newly opened or expanded private schools and charter schools can enroll students that do not get into the “best” schools. Funding for bad schools, and the school administrator’s payoff, will suffer for schools with continually declining enrollment.

While this creates potential for approximating open entry and exit conditions, much depends on state laws states in this regard. The Center for Education Reform (2013) rates states on the ease of opening, the availability, and autonomy of charter schools. Some are quite restrictive and others are not, so there is a great deal of variation across states as to the openness of entry via charter schools into schooling markets. Voucher programs are still relatively unusual and, where they exist, are targeted to a narrow group and so voucher-eligible schools cannot enter the broader schooling market.

(ii) Pricing

Related to this is the freedom of schools to set their own price (tuition). This is severely restricted in most cases. Open enrollment and magnet programs typically carry no price differential and charter and voucher program usually limit what schools can charge. These cause the problems of excess demand and supply of different schools noted above. Additionally, limits on pricing impede the ability of schools to gain by raising V , which keeps the parameter B at a low level.

Enrollment imbalances in open enrollment programs has led some school districts to implement school assignment protocols. These are critiqued by Pathak and Sonmez (2013) for being unstable and manipulable. They suggest Gale-Shapley-Roth type algorithms that lead to stable matching. However, the need for such sophisticated

algorithms results from limitations on pricing. Hatfield and Milgrom (2005) point out the parallels between matching and auction models and show that, as long a price (as well as non-price attributes) is part of the auction process, stable matching occurs. Similarly, Chiappori, McCann, and Nesheim (2009) show that, under broad conditions, the hedonic price equilibrium is equivalent to a stable matching equilibrium.

Thus, allowing pricing deals with these issues, as well as allowing high (low) value provision of education to be rewarded (penalized) with a high (low) price. The fact that most school choice reforms do not allow it serves to limit increases in B.

(iii) Politics and the Public Sector

Other parameters that distort the setting of teacher incentives – θ , δ , and φ – have to do with the political influence on school administrators and the lack of residual income claimancy in the public sector. With greater dependence on attracting students to attain revenue, one expects that vouchers and charters to be less influenced by political considerations. This implies lower values of δ and φ . Likewise, though charters and schools that receive voucher students are mostly nonprofits, their concern about residual income is likely to be higher than that for public schools. This serves to increase θ in administrators' payoff functions. Thus, charter and voucher programs that enable more residual income claimancy and autonomy from politics are likely to be more effective reforms.

(iv) Empirical Evaluations: Test Scores

A substantial number of empirical studies examine the effects of vouchers and charters on student test score achievement that can shed light on whether the presumed better governance in these settings improves schools. The literature on charter schools is

especially large and growing. Betts and Tang (2011) and Clark, et. al. (2011) provide recent evidence on the effects of charters on test scores and the volume compiled by Toma and Zimmer (2012) provides an overview of findings on charter schools. Most studies compare large samples of charter school students to compare to regular public school students, with various methods to control for pre-existing differences across the two groups of students.¹⁰ Though there are statistical disputes about these methods, most studies show positive effects on test scores for low-income students but not for others.

However, as noted above, charter schools vary widely in what they are allowed to do regarding their ability to enter markets, their pricing, their autonomy in hiring and admissions, their accountability, and their (non)accommodation of unions. Each of these effects the key parameters of the school administrator's payoff function. Variation in these parameters generates different incentives and different expected outcomes. Studies that fail to distinguish between these differences across charter schools are not very meaningful. For example, tightly constrained charter schools probably will differ little from regular public schools, so have similar incentives and similar expected outcomes. This is not so for charters in states with unrestrictive rules.

Related comments apply to studies of voucher programs. Surveys of the empirical literature are in Coulson (2009) and Rouse and Barrow (2009). Many studies find positive effects of the voucher programs on student test scores, but a substantial minority do not. However, as with some charter schools, many voucher programs in the U.S. are quite restrictive, implying that they are likely to have only limited effects on the

¹⁰ Hoxby, et. al. (2009), however, use a narrow sample of Harlem students, with the charter students randomly selected by lottery.

parameters of importance: θ , B , δ , and φ . Thus, these studies probably say little about the effect of an extensive change in school governance.

(v) Non-Cognitive Skills

Most evaluation studies, with the exception of Dobbie and Fryer (2013b), do not consider outcomes aside from test scores. Test score outcomes matter but their extensive use is probably due to data availability. As noted above, Heckman, Stixrud, and Urzua (2006) show the importance of non-cognitive skills, which are not directly reflected in test scores. Thus, if changes in school governance improve the nurturing of these non-cognitive skills, this will not show up in the evaluation of test scores and the contribution of charters/vouchers to educational value are understated by such studies. Dobbie and Fryer's (2013b) work is suggestive in this regard. They find that students in the charter school they study in Harlem achieve higher test scores and also engage in somewhat fewer risky behaviors, e.g., crime, pregnancy, suggesting gains beyond test scores.

A key to attaining this outcome, though, would seem to be rewarding schools for a higher V , whether it's from cognitive or non-cognitive skills. This entails values of θ and B close to one.

D. Other Institutional Changes

(i) Removing Politics

Policies that isolate schools from politics move the parameters δ and φ toward one and improve school administrator incentives. One such policy is stronger job security for school administrators so they feel less vulnerable from politically unpopular actions. This can reduce their sensitivity to test scores and may induce less worry about adverse

teacher reaction to policies. However, greater job security for school administrators would induce less concern over value created, further reducing θ .

(ii) Parental Participation

Another possible way to tie administrator payoffs to value created is to encourage more parental participation by various means, such as use of site-based management councils. These councils review major school decisions and have representatives from the school administration, teachers, and parents. The intention is that parent representation makes the operation of the school more responsive to V , which would increase the parameter B . However, inclusion of teachers on the council increases the weight put on teacher utility, increasing rather than reducing ϕ . A further suggestion is for school administrators to be evaluated on a basis that more closely reflects parents' views, perhaps with use of parent satisfaction surveys.

Related to this, Duflo, Dupas, and Kremer (2012) examine a program in Kenya that gave parents a great deal of hiring authority for their local schools. This took decision authority out of the hands of administrators and incumbent teachers, presumably increasing B and reducing ϕ . They find higher test scores for these schools, along with reduced teacher absenteeism.

VIII. Adopting Best Practice

Recent work by Dobbie and Fryer (2013a) and Angrist, et. al. (2013) identify particular practices of charter schools that have led to success. Fryer (2014) suggests direct adoption of these practices into poorly performing schools. In particular, his work on New York City charter schools identifies five school practices that separate high-

performing charters from low-performing ones.¹¹ These practices were then implemented into some of the lowest performing schools in Houston, resulting in large, positive effects on test scores.

However, the critical question remains: what are the incentives to effectively institute these practices? In the Houston study, school principals were specially selected for this initiative and specific student performance goals were set for each school and the principal was held accountable for these goals. Thus, the role of governance – in establishing a payoff function for the school administrator to adopt effective policies and incentivize teachers to implement them – may have been a key to the improved performance. Study researchers apparently thought that such incentives were worthwhile since they included them.

Additionally, an issue that arises is whether the implementation of the five practices – in their emphasis, mix, and whether they are merged with local practices – involves a good deal of school-specific knowledge. If it does, then it is important to assign decision-making rights to school administrators and teachers, as well as providing them incentives to produce value, rather than requiring a fixed regimen of protocols.

This highlights a central issue and argument of this paper. The argument is that knowledge of “best practice” is not sufficient to yield success in school reform. Indeed, what constitutes best practice may vary from place to place depending on local and specific knowledge. To effectively implement these practices requires institutions with the incentives to do so. Thus, a consideration of the parameters of the payoff function is essential.

¹¹ These are frequent teacher feedback, use of data to guide instruction, high-dosage tutoring, increased instructional time, and high expectations.

IX. Conclusion

This paper illustrates how fundamentals from principal-agent theory and the economics of organizations are fruitfully applied to schools and teacher compensation. Some findings are well recognized in the literature, e.g., the potential pitfalls of mandating teacher rewards for student test scores. However, we emphasize the importance of four institutional incentives in affecting schools and school reform: (i) residual income claimancy and/or concentration of interests of stakeholders; (ii) the link of school revenue/budget to value produced; (iii) the importance of public/political symbols, and; (iv) the political strength of employees/unions. We argue that the key to any school reform program is altering these parameters.

We assess many reform efforts regarding how the above parameters are likely to be changed. Many seem to be lacking. Tiebout competition, though there is some evidence of its effectiveness, is often a cumbersome method of competition and of tying school budgets to value created. Most open enrollment programs always guarantee all schools full enrollment (and budget), so fails to link budget to school performance. Charter schools and voucher have the potential of emulating the entry and exit conditions of competitive markets and are likely to have fewer political concerns than public schools. However, many are tightly controlled, are limited in availability, and their prices (tuition) are controlled. Each of these takes away from the potential incentives of this reform. It is likely for this reason that studies of charter schools and vouchers find mixed evidence of their performance. Finally, our approach suggests that injecting “best practice” into low performing schools is likely to fail without a change in institutional incentives, but with a favorable change in the latter, best practices will result.

References

Acemoglu, Daron; Kremer, Michael; and Mian, Atif, "Incentives in Markets, Firms, and Governments," *Journal of Law, Economics, and Organization*, December 2007.

Ahn, Thomas, "The Missing Link: Estimating the Impact of Incentives on Effort and Effort on Production Using Teacher Accountability Legislation," working paper, Duke University, November 2008.

Angrist, Joshua; Pathak, Parag; and Walters, Christopher, "Explaining Charter School Effectiveness," *American Economic Journal: Applied Economics*, 5(4), October 2013, pp. 1-27.

Bernheim, B. Douglas and Whinston, Michael, "Common Agency," *Econometrica*, 54(4), July 1986, pp. 911-30.

Betts, Julian and Tang, Emily, "The Effect of Charter Schools on Student Achievement: A Meta-Analysis of the Literature," National Charter School Research Project, 2011.

Center for Education Reform, "Charter School Law Rankings and Scorecard, 2013," http://www.edreform.com/wp-content/uploads/2013/01/CER-CharterLaws2013_Chart_FINAL.pdf

Chetty, Raj; Friedman, John E.; and Rockoff, Jonah E., "Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates," *American Economic Review*, 104(9), September 2014a, pp. 2593-2632.

Chetty, Raj; Friedman, John E.; and Rockoff, Jonah E., "Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood," *American Economic Review*, 104(9), September 2014b, pp. 2633-2679.

Chiappori, Pierre-Andre; McCann, Robert; and Nesheim, Lars, "Hedonic Price Equilibria, Stable Matching, and Optimal Transport: Equivalence, Topology, and Uniqueness," *Economic Theory*, May 2009.

Clark, Melissa; Gleason, Philip; Tuttle, Christina; and Silverberg, Marsha, "Do Charter Schools Improve Student Achievement? Evidence from a National Randomized Study," Mathematica Policy Research working paper, December 2011.

Coulson, Andrew, *Market Education: The Unknown History*, New Brunswick, N.J.: Transaction Publishers, 1999.

Coulson, Andrew, "Comparing Public, Private, and Market Schools: The International Evidence," *Journal of School Choice*, 3:31-54, 2009.

Dixit, Avinash, "Power of Incentives in Public Versus Private Organizations," *American Economic Review*, 87(2), May 1997, pp. 378-82.

Dixit, Avinash, "Incentives and Organizations in the Public Sector: An Interpretative Review," *Journal of Human Resources*, 37(4), Autumn 2002, pp. 696-727.

Dobbie, Will and Fryer, Roland, "Getting Beneath the Veil of Effective Schools: Evidence from New York City," *American Economic Journal: Applied Economics*, 5(4), October 2013a, pp. 28-60.

Dobbie, Will and Fryer, Roland, "The Medium-Term Impacts of High-Achieving Charter Schools on Non-Test Score Outcomes," NBER Working Paper #19581, October 2013b.

Duflo, Esther; Dupas, Pascaline; and Kremer, Michael, "School Governance, Teacher Incentives, and Pupil-Teacher Ratios: Experimental Evidence from Kenyan Primary Schools," NBER Working Paper No. 17939, March 2012.

Eberts, Randall, Kevin Hollenbeck, and Joe Stone, "Teacher Performance Incentives and Student Outcomes," *Journal of Human Resources*, 37(4), Autumn 2002, pp. 913-927.

Figlio, David N. and Lawrence W. Kenny, "Individual Teacher Incentives and Student Performance," *Journal of Public Economics*, 91, 2007, pp. 901-914.

Fryer, Roland, "Teacher Incentives and Student Achievement: Evidence from New York City Public Schools," *Journal of Labor Economics*, 31(2), pt. 1, April 2013, pp. 373-407.

Fryer, Roland, "Injecting Charter School Best Practices Into Traditional Public Schools: Evidence From Field Experiments," *Quarterly Journal of Economics*, 129(3), August 2014, pp 1355-1407.

Hatfield, John and Milgrom, Paul, "Matching with Contracts," *American Economic Review*, 95(4), September 2005, pp. 913-935.

Hanushek, Eric A. and Steven G. Rivkin, "How to Improve the Supply of High Quality Teachers," in *Brookings Papers on Education Policy*, D. Ravitch (ed.), 2004, pp. 7-25.

Hayek, Friedrich A., "The Use of Knowledge in Society," *American Economic Review*, 35, September 1945, pp. 519-530.

Heckman, James; Stixrud, Jora ; and Urzua, Sergio, "The Effect of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior," *Journal of Labor Economics*, 24(3), July 2006, pp. 411-482.

Holmstrom, Bengt and Milgrom, Paul, "Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design," *Journal of Law, Economics, and Organization* 7(special issue), Spring 1991, pp. 24-52.

Hout, Michael and Elliot, Stuart W., editors, "Incentives and Test-Based Accountability in Education," Committee on Incentives and Test-Based Accountability in Public Education, National Research Council, National Academies Press, 2011.

Hoxby, Caroline M., "Does Competition Among Public Schools Benefit Students and Taxpayers?" *American Economic Review*, 90(5), December 2000.

Hoxby, Caroline M., "Would School Choice Change the Teaching Profession?" *Journal of Human Resources*, Vol. 38, No. 4, 2002.

Hoxby, Caroline M., "Productivity in Education: The Quintessential Upstream Industry," *Southern Economic Journal*, 71(2), 2004, pp. 209-231.

Hoxby, Caroline M.; Murarka, Sunali; and Kang, Jenny, "How New York City's Charter School Affect Achievement," The New York City Charter School Evaluation Project, September 2009, http://users.nber.org/~schools/charterschoolseval/how_NYC_charter_schools_affect_achievement_sept2009.pdf.

Jacob, Brian A., "Accountability, Incentives, and Behavior: The Impact of High-Stakes Testing in the Chicago Public Schools," *Journal of Public Economics*, 89, 2005, pp. 761-796.

Jacob, Brian and Lars Lefgren, "What Do Parents Value in Education? An Empirical Investigation of Parents' Revealed Preferences for Teachers," *Quarterly Journal of Economics*, Nov. 2007, pp. 1601-1637.

Jacob, Brian and Lars Lefgren, "Can Principals Identify Effective Teachers? Evidence on Subjective Performance Evaluation in Education," *Journal of Labor Economics*, 26(1), Jan. 2008, pp.101-136.

Jensen, Michael and Meckling, William, "Specific and General Knowledge, and Organizational Structure," in Lars Werin and Hans Wijkander (eds.), *Contract Economics*, Cambridge, Mass.: Blackwell, 1992, pp. 251-274.

Lavy, Victor, "Using Performance-Base Pay to Improve the Quality of Teachers," *The Future of Children*, 17(1), Spring 2007, pp. 87-109.

Lavy, Victor, "Performance Pay and Teachers' Effort, Productivity, and Grading Ethics," *American Economic Review*, 99(5), December 2009, pp 1979-2011.

Murnane, Richard and Cohen, David, "Merit Pay and the Evaluation Problem: Why Most Merit Pay Plans Fail and a Few Survive," *Harvard Educational Review*, 36(1), February 1986.

Neal, Derek, "Designing Incentive Systems for Schools," in Matthew Springer (ed.), *Performance Incentives: Their Growing Impact on American K-12 Education*, Brookings Institution, 2009.

Neal, Derek, "The Design of Performance Pay in Education," in Hanushek, Machin, and Woessmann (eds.), *Handbook of the Economics of Education*, vol. 4, Amsterdam: North Holland, 2011.

Pathak, Parag and Sonmez, Tayfun, "School Admissions Reform in Chicago and England: Comparing Mechanisms by their Vulnerability to Manipulation," *American Economic Review*, 103(1), February 2013, pp. 80-106.

Podgursky, Michael and Dale Ballou, "Let the Market Decide," *Education Next*, 1(1), Spring 2001.

Podgursky, Michael and Springer, Matthew, "Teacher Performance Pay: A Review," National Center on Performance Incentives, Vanderbilt Peabody College, November 2006.

Prendergast, Canice, "The Provision of Incentive in Firms," *Journal of Economic Literature*, 37(1), March 1999, pp.7-63.

Rivkin, Steven G., Eric A. Hanushek, and John F. Kain, "Teachers, Schools, and Academic Achievement," *Econometrica*, 73(2), March 2005, pp. 417-458.

Rockoff, Jonah E., "The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data," *American Economic Review*, 94(2), May 2004, pp. 247-252.

Rothstein, Jesse, "Does Competition Among Public Schools Benefit Students and Taxpayers? A Comment on Hoxby (2000)." *American Economic Review* 97(5), December 2007: 2026-2037.

Rouse, Cecilia and Barrow, Lisa, "School Vouchers and Student Achievement: Recent Evidence and Remaining Questions," *Annual Review of Economics*, 1, 2009, pp. 17-42.

Toma, Eugenia and Zimmer, Ron, "Two Decades of Charter Schools: Expectations, Reality, and the Future," *Economics of Education Review*, 31, 2012.

Vigdor, Jacob L., *Teacher Salary Bonuses in North Carolina*, National Center for Analysis of Longitudinal Data in Education Research working paper no. 15, Feb. 2008.