Assessing the Literature on School Reform From an Entrepreneurship Perspective

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

July 2016

Abstract

Enabling and incentivizing organizations to act based on their local knowledge is an important aspect of entrepreneurship. The significance of local knowledge in the context of schools is well recognized, but very little research investigates how to provide discretion and incentives to schools to use this knowledge. We build a model to guide this understanding for policy makers who may wish to foster entrepreneurship for schools and also use it to critique the literature and provide an alternative approach. The paper applies fundamentals of principal-agent theory to the ownership and governance of schools, the use of teacher incentive pay, and school reform efforts. Focus is on use of teacher incentives and on school choice initiatives. We find that many public school teachers will have attenuated incentives, but mandates to increase test score rewards may be counterproductive. Institutional reform via school choice seems more promising. We identify several institutional features that are expected to induce more entrepreneurial and productive activity by schools. We discuss and critique school reform efforts in this regard, including Tiebout competition, charter schools, voucher programs, and use of "best practice." Reform efforts often lack in addressing critical aspects of institutional incentives, and research in this regard also is mostly absent. We contend, however, that dealing addressing such issues is a key to effective reform.

JEL codes: J33, I28, L21

*For comments and consultation on previous versions, I thank John Merrifield, Dan Sutter, William Hoyt, Lori Taylor, session participants at the Association of Private Enterprise Education conference and the Southern Economic Association meetings, workshop participants at the University of Kentucky, and the anonymous referees. I also thank the John H. Schnatter Institute for the Study of Free Enterprise and the Gatton College BB&T Program for support.

I. Introduction

This article considers school reform from an entrepreneurship perspective and examines and critiques much of the research on schools from this viewpoint. An important aspect of entrepreneurship is the use of local knowledge on the specifics of time, place, and circumstance, and the importance of decision-makers/entrepreneurs being enabled and incentivized to act on this knowledge. While the significance of local knowledge in schools is often recognized, there is little focus on how to enable and incentivize its use. This paper builds a modeling framework to understand the key parameters that can guide policymakers who wish foster this aspect of entrepreneurship in schools. Further, it provides a springboard for critiquing much of the school reform literature and suggests an alternative approach to school reform research.

An older generation of education research examined the effects of a variety of school inputs – e.g., teacher certification, teacher experience, teacher-pupil ratio, overall expenditures – on student test scores. While most of these inputs show no consistently positive effect, this research exemplifies a centralized/non-entrepreneurial approach to schools and school research. Such studies seem to highlight the presumed importance of broad, easy-to-quantify inputs which can be controlled by a central authority. Also, there is perhaps an implicit disregard of the value of local, specific knowledge and practices that are difficult for outsiders to observe.

A more recent generation of school reform policy and research has taken two general tracks: one involves use of teacher incentives that ties pay to student test scores, and the other is experimentation with more parental choice, such as charter schools and vouchers. Thus, our discussion focuses on teacher incentive pay and school governance, where the latter includes school ownership, decision rights, and competition. As shown below, these tie closely with having the discretion and incentives to use local knowledge.

The approach of the paper differs greatly from most of the literature on school policy research. We suggest that, rather than focusing on what schools should do, researchers should consider the question of how schools might be empowered and incentivized to appropriately act on their knowledge. We develop a model indicating five parameters that influence this: (i) the school's stake in maintaining its net revenue; (ii) the link of school revenue to value produced; (iii) the importance of public/political symbols; (iv) discretion in decision making, and; (v) the political strength of employees/unions. We argue that the key to any school reform program is altering these parameters and critique much of the literature from this perspective.

The paper is based on several fundamentals in the literature. One fundamental is Hayek (1945) as extended by Jensen and Meckling (1992). 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.

A second fundamental 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. This is modeled and examined carefully 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 attenuates managerial incentives, and this attenuation is passed along to employees. Since most schools are public organizations, this analysis is quite germane.

The remainder of the paper is organized as follows: Section II reviews background literature regarding the validity of our approach; this literature shows the importance of local/specific knowledge, of non-cognitive outcomes that are difficult to measure, and of the effects of incentives on teachers and organizations. Section III.A begins the formal modeling of teacher pay in the context of difficult-to-observe local knowledge, as well as with the availability of "objective" information such as test scores. Section III.B continues in this vein by examining pay setting where schools must compete for students via robust parental choice options. The manner that schools are expected to use knowledge in this competitive/entrepreneurial setting is a building block for evaluating the literature on teacher incentives, as well as other policy efforts.

Section IV recognizes that the discretion of and incentive for an organization depends on whether it is a public or private enterprise. Public organizations alter the organizational administrator's payoff function in predictable ways and influence how knowledge is used. This is examined regarding pay setting. Section V uses this model to illustrate the effect of mandating teacher incentives for test scores. This is an aspect of removing entrepreneurial discretion from schools, and there are many pitfalls of doing so. Section VI utilizes our framework to assess institutional reform efforts, i.e., school choice programs, and the empirical evaluations of such reforms. Though such studies are of some value, most do not make key distinctions among

choice programs which allow varying amounts of school discretion and incentives. Section VII examines some recent literature regarding adoption of "best practice" from successful schools. As above, the key questions of discretion and incentives to adopt these practices is largely unaddressed. Lastly, Section VIII offers some conclusions. Unfortunately, much of the literature does not focus in examining institutional incentives as an important path of school reform. Our view is that doing so is fundamental.

II. Some Background Literature

Jensen and Meckling (1992), in their extension of Hayek (1945), define "general knowledge" as knowledge that is readily quantified and transmitted to others and "specific knowledge" as knowledge that is situation specific and difficult to quantify and transmit to outsiders. In the context of schooling, test scores are an example of the former and the latter is the myriad of information about student and teacher personalities, school culture, the nurturing of things such as creativity, teamwork, and perseverance, and a host of other items.

While not denying the relevance of test scores, a good deal of literature makes it clear that the latter type of knowledge is important for schools. Jacob and Lefgren (2007), for example, find that parents' overall satisfaction with teachers is not simply related to the latter's effectiveness in improving student test scores. Their evidence is clear that parents value other aspects of teachers as well. Also, it is becoming increasingly recognized in the academic literature that various non-cognitive skills are quite important, yet are distinct from cognitive skills as measured by test scores. Heckman, Stixrud, and Urzua (2006) provide strong evidence in this regard.

The importance of using local, specific knowledge in fostering an important aspect of school culture – school discipline practices – also is recognized. See Garen (2014) for an

overview and also U.S. Department of Education (2014) and American Psychological Association Zero Tolerance Task Force (2008). Also regarding local knowledge, Hall (2000, 2006) notes that its use requires local decision-making authority and suggests that this is a reason for the weak effects of many state-level educational spending initiatives which typically do not allow local discretion.

Though most evidence shows that teacher characteristics such as certification and advanced degrees do not have much effect on student test scores, recent empirical research shows that specific teachers do indeed 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).

Moreover, 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 increases.[1] Jacob's findings also suggest that teachers may engage in "teaching to the test" rather than broader educational efforts. This raises the issue that incentives for test scores can distort teacher effort away from other educational activities.

Teachers presumably also can be rewarded for nurturing the various non-cognitive, 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.

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

This, too, is an example of local, specific knowledge. With the authority to do so, school administrators could use this knowledge to reward teachers. This more subjective measure of performance is likely to capture a broader picture of the teacher's contributions to educational value.

There are substantial difficulties in implementing a reward system based on complicated, subtle, subjectively measured, and hard to assess aspects of jobs. They have been noted and analyzed in detail in the private-sector, competitive setting. For a survey, see Prendergast (1999). It is also 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 below.

Relating to this issue, there is a significant literature that examines differences between public- and private-sector enterprises. 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 framework and use it to assess various aspects of the literature.

Note that school competition and school choice alters the organization's incentives by enabling parents to more easily move their children and funding to and 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.

Merrifield (2002) also emphasizes the importance of competition in prompting schools to improve. The effect of school competition is incorporated into our modeling framework below.

Various parts of the literature make the case for taking the approach of this paper. It is clear that teachers matter for producing educational value, and incentives affect teacher behavior. It is also clear that local and situation specific knowledge is important to parents and to the educational process, as well as in regards to teacher performance and rewards. Thus, determining how schools may be enabled and incentivized to be more entrepreneurial by acting on this knowledge is a highly relevant policy issue. Modeling schools, teachers, and incentives in public and private environments, with or without competition, is a step in this analysis.

III. The Competitive, Entrepreneurial Organization: Use of Knowledge in Setting Pay for Teachers

We begin building our framework by considering how schools in a competitive environment and who are "entrepreneurial" – in the sense of being enabled to use their specific knowledge – establish incentives for teachers. Its focus is on a simple, principal-agent model regarding teacher compensation. This simple model captures a good deal of the important issues at hand and is used as a benchmark for expected outcomes with a system of competitive, entrepreneurial schools.

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).
To do so, consider three aspects of teacher performance and effort that can affect educational value: 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. Denote 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 and so compensation can be based on these two.

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. 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 test 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 to the test. In 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, and 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, let teacher expected utility be given by: $U = E(Y) - C(T,A,N) - \frac{1}{2}\rho R$, where E(Y) is the teacher's expected income, C(·) is the utility cost of effort, ρ is the coefficient of absolute risk aversion, and R is the variance of teacher income.[2]

[2] This is the constant absolute risk aversion utility function widely used in the literature.

The school administrator observes T and A (with error) and sets compensation as a linear function[3] of T and A such that $E(Y) = b_0 + b_T T + b_A A$.

Teachers select the three types of effort, T, A, and N, to maximize utility given by $U = E(Y) - C(T,A,N) - \frac{1}{2}\rho R = b_0 + b_T T + b_A A - C(T,A,N) - \frac{1}{2}\rho R$. It is straightforward that effort on T rises with b_T and effort on A increases with b_A. 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 and the intuitive interpretation of this is quite sensible.[4]

The plausible (and worrisome) case is where more effort in improving test scores 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: both A and N fall, meaning that stronger incentives for test scores do not unambiguously increase educational value. Also, greater reward for the administratively measured effort, b_A, causes N to rise but T to fall. In summary: $\partial T/\partial b_T > 0$; $\partial A/\partial b_A > 0$; $\partial A/\partial b_T < 0$; $\partial N/\partial b_T < 0$; $\partial N/\partial b_A > 0$; $\partial T/\partial b_A < 0$.

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 that do not add much to educational value (i.e., the marginal product of T, V_T, is low) and where teacher effort on T causes substantial reductions on the intangibles, A and N.

[3] Actual rewards for teachers are likely to be nonlinear; indeed Ahn (2013) and Vigdor (2008) find this is the case for North Carolina's rewards to teachers for test scores. Linearity is a simple and tractable way to capture the idea that rewards are tied to T and A.
[4] More details are presented in the Appendix.

B. What Would Competitive, Entrepreneurial Schools Do?

Here, we consider pay setting by schools as we would for any competitive firm. As in the incentive pay literature, this is viewed as predicting how firms/schools would behave. This also establishes a benchmark for comparison.

As in standard models, 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.[5] Assume that the school competes in the labor market for teachers and also competes for students. The latter implies that it sells schooling services for their value, V.[6]

Thus, the payoff function per teacher for the school administrator is $F = E(V - Y) = V(T,A,N) - (b_0 + b_T T + b_A A)$.[7] The payoff maximizing compensation schedule is chosen subject to recognition that teachers respond to incentives and that teacher compensation must be competitive in the labor market. These are the incentive compatibility and individual rationality constraints from principal – agent theory. With these constraints, the payoff function becomes $F = V(T,A,N) - C(T,A,N) - \frac{1}{2}\rho R - U^M$, where U^M is teacher alternative utility.

The outcome of this model is 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 all

[5] 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. Nonprofit schools are discussed below.

[6] The competitive process pushes schools to charge marginal value, V – no more and no less. Note that it is important that school-firms are free to set prices so revenue reflects value. Failure of this generates some issues to be discussed below.

[7] 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.

parties.[8] These enable simple solutions without taking away from the basic, underlying economic implications. This model implies that firms/schools set incentives as:

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

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

where $\Omega > 0$ based on second-order conditions.[9]

There is a straightforward intuition to these results. In the case where all types of effort are observed, the teacher-agent is paid according to the marginal product of each of T, A, and N. This implies that $b_T = \alpha_T$, $b_A = \alpha_A$, and the reward for N is α_N. However, N is not observed (and so cannot be directly rewarded) and b_T and b_A affect N. Thus, both b_T and b_A diverge from their marginal products as shown in (1) and (2). From (1), when $C_{NT}>0$ (the plausible case), b_T is less than α_T. This is because b_T distorts effort away from N and generates a lower incentive for T. Also, from (2), increasing effort regarding A lowers the marginal cost of N ($C_{NA}<0$), implying that $b_A > \alpha_A$. More effort for A also increases N, inducing a higher b_A.

Note that it is the environment where schools compete and use all the knowledge available to them that induces them 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 school to set a low b_T. When the complementarity of A and N is large (a high C_{NA}), then schools set stronger rewards for the subjective, administrative evaluation. Competitive, entrepreneurial schools discount or enhance rewards for these

[8] The linear relationship between value produced and T and A is a simplification that helps illustrate the issues of interest. The exact relationship is likely to be more complex. For empirical evidence on this, see Cebula, Mixon, and Montez (2015).
[9] The Appendix provides more detail regarding these solutions.

measures as appropriate.[10] Of course, most educational organizations do not operate in this environment. We turn to this issue next.

IV. Pay Setting in Noncompetitive, Public Organizations

This section adapts the above framework to understanding pay-setting for agents in the public and/or noncompetitive sector. The results are used to inform our critique of studies of teacher incentives and school reforms.

A. Public Sector, Noncompetitive Organizations

There is a substantial literature regarding the difference of public/noncompetitive organizations to private/competitive ones that we apply 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.

There are several key distinctions between private and public institutions. Public institutions rely on taxation for their funds rather than voluntary sources and 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 rational ignorance of voters and so public sector outcomes are overly influenced by special interests. Also, public institutions are such that managers are not residual income claimants, nor is anyone. These imply that the payoff functions of public sector officials need not be well aligned with net value.

The papers of Dixit (1997, 2002) and Acemoglu, Kremer, and Mian (2007) model the effect of these and related ideas on pay-setting by public administrators. They find that the payoff to public sector managers depends on net value creation, but in a weak or diluted way,

[10] These foreshadow the potential pitfalls of mandating heavy reliance on rewarding T. Also, note that in the more general case with risk aversion of teachers, these basic results arise, though with some adjustment.

e.g., $F_P = \theta(V-Y)$, where F_P is the manager's payoff function and $\theta<1$. Additionally, this is translated into weaker incentives for public sector workers.

Now consider some refinements of this. First, note that the revenue of a public school is a budget determined by a political process. This process makes it likely that changes in value produced by the school are not 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 expected. Where there is less competition, the revenue received may not fall dollar-for-dollar with changes in value. If a school delivers 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 with full claimancy. This reinforces the idea that the public administrator's payoff depends on net school revenue 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. Thus, visible, positively perceived actions enhance political support and administrators who engage in such actions 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. Thus, higher test scores will be weighted more heavily in the administrator's payoff function. Assume that test scores carry the weight $\delta>1$.

The converse holds for teacher performance measured by A. This involves subtle judgments that are difficult to convey to the public. Hence, A is weighted less in the administrator's payoff function. Denote this weight by $\beta<1$. Note that the weights δ and β implicitly remove discretion from the school administrator by penalizing a more judgment-based pay setting.

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

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. Raising teacher utility by handing cash to teachers is a highly visible action that will create bad publicity, reduce political support, and be infeasible. So suppose that teacher pay, Y, is politically fixed at Λ. With administrator payoffs depending on teacher utility, this gives $F_P = \theta(B(V) - \Lambda) + \varphi(\Lambda - C) = \theta B(V) – \varphi C + (\varphi$

– θ)Λ, where φ>1 is the weight put on teacher utility. With Λ fixed, the administrator acts to maximize θB(V) – φC. This is identical to the above payoff function with φ>1 replacing θ<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) $$b_T = (\theta B/\varphi)[\delta\alpha_T - \alpha_N C_{NT}/\Omega]$$

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

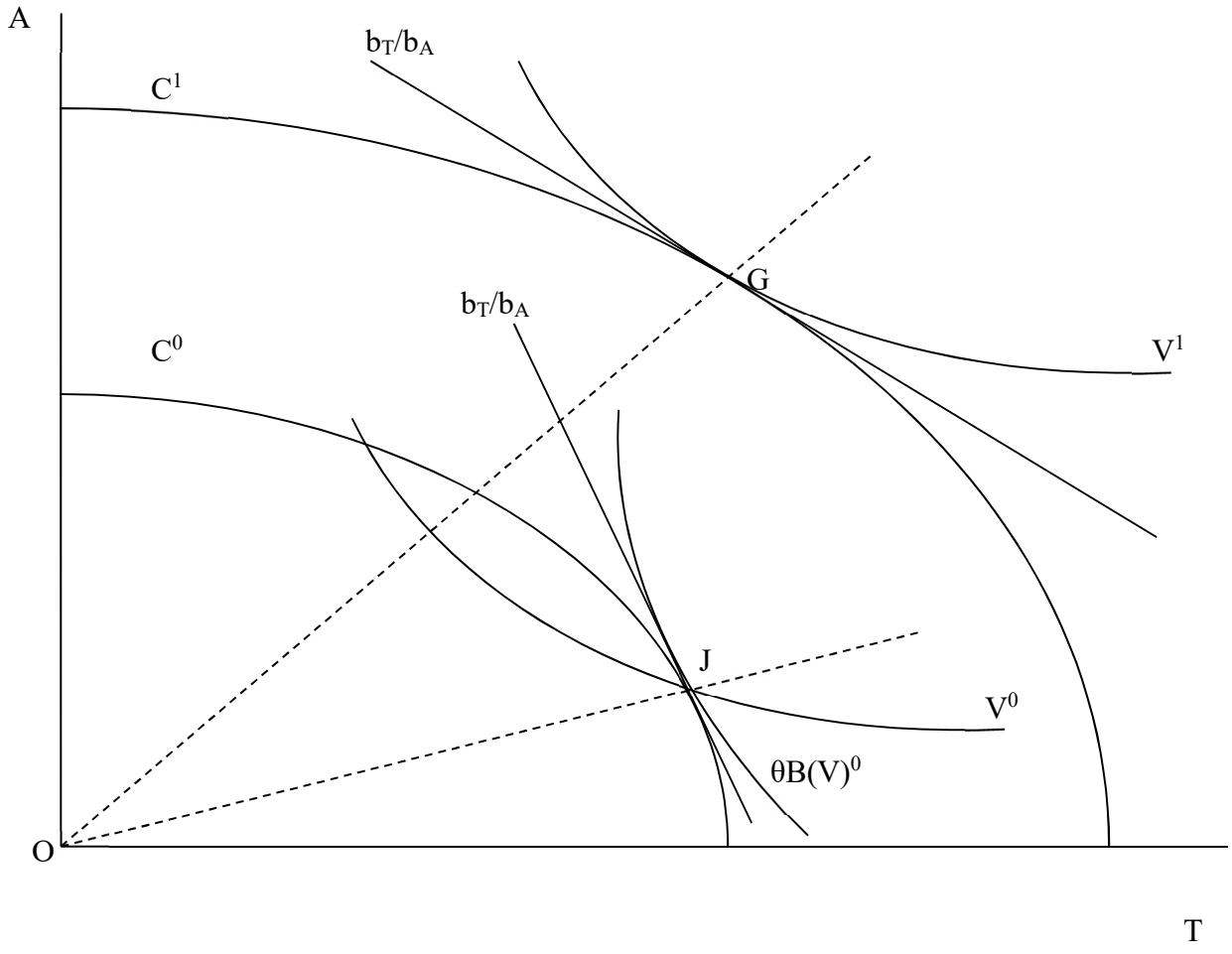
where φ>1 or φ= θ depending on the form of the administrator's payoff function.

Because B<1 there is a tendency for incentives to be reduced. This is reinforced by φ> 1 and θ < 1. Recall that θ<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 φ>1 further supports this result. Essentially, because administrators have weak incentives, so do teachers.

The above also is reinforced by the weight β<1 on A. 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 δ>1. Thus, rewards for T may be stronger than for the competitive, entrepreneurial 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 because the factor δ magnifies test score rewards in the public sector and the factor β diminishes it for A.

Figure 1 illustrates this outcome. Point G is the equilibrium in the competitive, entrepreneurial schools case and 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. Moreover, the institutional setting of the school as determined by the parameters B, θ, δ, β, and φ and their effects should be accounted for when examining the efficacy of school reform policies.

C. The Nonprofit Organization

Note that the private, nonprofit organization is common for schools. They have residual income claimancy, but their legal, nonprofit status limits its distribution. Many charter schools also are nonprofits. With nonprofits being unable to 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, and school administrators who do so successfully are likely to succeed in their jobs. Thus, the gains from a higher V is heightened relative to the public organization. The private, nonprofit in a competitive setting seems more much more like competitive, entrepreneurial firm than a public organization.

V. Mandating Rewards for Test Scores

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, and indeed this has been a popular policy proposal. 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.[11]

[11] More on this topic is below.

With increased emphasis on rewarding test scores comes a reduction in school administrator discretion in paying teachers. Here we account for the institutional setting when considering likely effects.

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 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.[12] Bad schools are those that approximate point J. The former occur in environments where the parameters B, θ, δ, β, and φ are all close to one and the latter are the converse.

A mandated value of b_T above what the school would set requires an increase in b_T/b_A. For good schools that are approximated by 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. 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 adopted, teachers shift effort toward T and away from other efforts. 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 cause little distortion to A and N. An increase in value produced is more probable.

[12]Perhaps induced by strong Tiebout competition. This is discussed below.

Thus, accounting for the institution setting of schools, i.e., the parameters B, θ, δ, β, and φ, provides a more nuanced critique of mandating rewards for test scores. 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 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. Where these concerns are legitimate, mandates for increased test score rewards have negative consequences.

Interestingly, Cohodes (2016) finds that charter schools in Boston, while improving student scores on high-stakes tests, also raise scores on tests that are not scrutinized for accountability reasons. This suggests that the tests are complementary enough to avoid serious effort distortions and/or the charters in Boston are competitive/ entrepreneurial enough that they continue to deliver value.

VI. Reform, Evaluating Reform, and Competitive/Entrepreneurial Organizations

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

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

where φ may equal θ. The five parameters B, θ, δ, β, 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 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 and/or the lack of discretion in rewards for T, $\delta \geq 1$;

β = the lack of discretion to use specific knowledge (A) in pay setting; $\beta \leq 1$;

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

Our analysis of school reform policy focuses on these parameters.[13] In order for schools to act as competitive, entrepreneurial organizations – being empowered and incentivized to act on specific knowledge – then reform needs to move these parameters in the appropriate direction. If it does not, then the fundamental incentives and discretion of the organization have not been altered and reform efforts are likely to be ineffectual. This is our perspective in critiquing studies and approaches to school reform policy.

A. School Choice via Mobility: Tiebout Competition

School governance and the administrator's payoff function are altered by school choice. It may do so by raising the responsiveness of the school's revenue (or budget) to V. i.e., it raises the parameter B. This is due to parents being able to move their child and funding if the parents believe value is not being delivered.

Tiebout competition occurs where there are multiple schools and/or school districts, and people choose among schools by choosing their residence. Schools delivering a low V suffer outmigration, presumably resulting in a lower budget. There is much discussion in the literature whether Tiebout competition can serve as a competitive force to discipline public schools. One of the best known studies in this regard is Hoxby (2000), who finds that this form of competition improves school test scores. Rothstein (2007) disputes this result, however. In a 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.

[13] Coulson (1999) discusses a similar set of items that affect school incentives.

The literature on migration also provides evidence regarding the Tiebout model. A good deal of this work focuses on migration to high-amenity areas, though a subset of this literature considers the effect of state and local variations in educational spending on migration patterns. The study of Pack (1973) finds that local education spending attracts migration into cities, while Cebula and Alexander (2006) show that statewide educational expenditure affects cross-state migration.

However, one might question how effective Tiebout competition can be in increasing the parameter B. It requires changing residence to change schools and so is a cumbersome form of choice. Also, residential choice involves a host of other factors besides schools, so catchment areas may lose or gain residents for other reasons. This lessens the competitive effect on schools. Moreover, school districts may respond to mobility by redrawing catchment areas to maintain enrollment in existing schools. Thus, regardless of how bad the school is, it still may attain full enrollment and retain its funding. No school administrator will face the consequences of declining enrollment.

This suggests that school reform efforts relying on Tiebout competition may not change school administrator incentives much, depending on the mobility of families and on the (in)ability of school systems of offset enrollment changes. Empirical work in the literature has not addressed these factors. Regardless of any shortcomings of Tiebout competition, its importance has likely declined in the U.S. Hoxby (2004) shows that, during the 20th century, 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 schools are 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, have net zero change in enrollments. No school administrators have to suffer ill-consequences of declining enrollment. Any remaining incentive is the likely preference for having the better students at the school. Therefore, these programs 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 two types of institutional reform seem to offer more extensive choice and have the potential for substantial change in the parameter B, as well as moving the other parameters – θ, δ, β, and φ – closer to one. A number of issues arise in this regard.

(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 so that charter schools are generally available. If so, schools that lose students are not automatically allocated other students. Newly opened or expanded private schools and charter schools can enroll students that do not get into the "best" schools. Funding for bad schools contracts.

While this creates potential for approximating open entry and exit conditions, much depends on state laws 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 as to the openness of entry via charter schools into schooling markets. Voucher programs, though growing, are still relatively unusual and, where they exist, are often 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 programs limit school tuition. These cause the problem of excess demand for certain schools noted above. Also, pricing restrictions limit the gain to schools from raising V, which keeps the parameter B at a low level.

Enrollment imbalances in open enrollment programs have led some school districts to implement school assignment protocols. These are critiqued by Pathak and Sonmez (2013) as being unstable and manipulable. They suggest Gale-Shapley-Roth algorithms that lead to stable

matching. However, the need for such algorithms results from limitations on pricing. Hatfield and Milgrom (2005) show that as long as price (as well as non-price attributes) is part of the matching process, stable matching occurs. Similarly, Chiappori, McCann, and Nesheim (2009) find 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 value provision of education to be rewarded with a higher price. The fact that most school choice reforms do not allow pricing serves to limit any increases in B.

(iii) Discretion, Politics and the Public Sector

Other parameters that distort the setting of teacher incentives – θ, δ, β, and φ – have to do with the political influence on school administrators, removal of discretion, and the lack of residual income claimancy in the public sector. With greater dependence on attracting students to attain revenue, one expects vouchers and charters to be less influenced by political considerations. This implies lower values of δ and φ. Likewise, their greater autonomy serves to lower δ and raise β. Also, though charters and schools receiving 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. Thus, charter and voucher programs that enable more residual income claimancy and autonomy are more likely to be effective in generating competitive/entrepreneurial schools.

(iv) Empirical Evaluations: Test Scores

A number of empirical studies examine the effects of vouchers and charters on student test scores, and 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. Most studies compare large samples of charter students to regular public school students, with various methods to control for pre-existing differences across the two groups.[14] 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 entering markets, their pricing, their discretion and autonomy in hiring and admissions, their accountability, and their (non)accommodation of unions. Each of these affects 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 likely differ little from regular public schools, and so have similar incentives and similar expected outcomes.

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 voucher programs on test scores, but a substantial minority do not. However, as with charters, many voucher programs are quite restrictive, and so likely have only limited effects on the parameters of importance: θ, B, δ, β, 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

[14] Hoxby, et. al. (2009), however, use a narrow sample from Harlem, with the charter students randomly selected. Also, see the work of Angrist, et. al. (2013, 2016) on similarly selected students in Boston.

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. If changes in school governance improve the nurturing of these non-cognitive skills, this may not show up in the evaluation of test scores, and the contribution of charters/vouchers to educational value is understated. 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 and/or 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 is from cognitive or non-cognitive skills. This entails values of θ and B close to one.

D. Other Institutional Changes

(i) Removing Politics and Restoring Discretion

Policies that isolate schools from politics reduce the parameters δ and φ and improve school administrator incentives. One such policy is stronger job security for school administrators so they feel less vulnerable to politically unpopular actions. This can reduce their sensitivity to test scores and may induce less worry about adverse teacher reaction to policies. Similarly, this can enable school administrators to use their discretion more effectively, increasing β. 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 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 idea is that parent representation makes the school more responsive to V, thereby increasing 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 Kenyan program giving parents a great deal of hiring authority for their schools. This removed decision authority from administrators and incumbent teachers, presumably raising B and reducing φ. They find higher test scores for these schools and also reduced teacher absenteeism.

VII. Adopting Best Practice

A. Correctly Measuring Teacher "Value Added"

The difficulties of measuring the contribution of teachers and the potential shortcomings noted previously of rewarding student test scores are well recognized. Neal (2011) provides a review and an extensive compilation of this research – in economics and other disciplines – is in Hout and Elliot (2011). They find that incentives affect behavior, though, as discussed above, incentives may lead to increasing measured performance without improving desired outcomes. Thus, Hout and Elliot (2011) recommend a cautious design and implementation of incentive plans.

The concern about perverse incentives has led to research regarding appropriate measures of teacher "value added" on which to base compensation. This approach examines the effect of individual teachers on the before and after test scores of students. Chetty, et. al. (2014a,b) examine this method and the controversies surrounding it. Concerns have been raised 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. This is the issue of who is enabled and incentivized to develop and appropriately implement a reward system based on value added. Related to this is the question of nurturing non-cognitive skills. How is this to be measured and rewarded? As above, this speaks to the importance of schools being able to develop and use knowledge appropriately and to having the incentive to do so. Scant research pays attention to this point.

B. Replicate the Successful

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 adoption of these practices into poorly performing schools. His work on New York City charter schools identifies five school practices that separate high-performing charters from low-performing ones.[15] 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, specific student performance goals were set, and the principal was held accountable to these goals. Thus, 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

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

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: 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 enabled and incentivized to do so.

VIII. Conclusion

Examining school reform from an entrepreneurial perspective offers a different set of insights. Instead of asking "what works?" one asks "how can organizations be empowered and incentivized to find what works for them?" In a diverse world with dispersed knowledge, this approach seems much more viable. We emphasize five institutional features that speak to this question: (i) the school's stake in its residual income; (ii) the link of school revenue to value; (iii) the importance of public/political symbols; (iv) discretion in decision making, and; (v) the political strength of employees/ unions. We argue that the key to school reform is altering these parameters.

We assess many reform efforts in this light, i.e., how the above parameters are likely to be changed. Many are lacking. Tiebout competition, though there is some evidence of its effectiveness, is often a cumbersome method of competition of tying school budgets to value

created. Most open enrollment programs always guarantee all schools full enrollment, and so fail to link budgets to school performance. Charter schools and vouchers have the potential of emulating the entry and exit conditions of competitive markets, and are likely to have fewer political concerns and more autonomy 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. Finally, our approach suggests that injecting "best practice" into low performing schools is likely to fail without a change in institutional incentives. Moreover, with a favorable change in the latter, "local" best practices will likely result.

References

Acemoglu, Daron; Kremer, Michael; and Mian, Atif (2008), "Incentives in markets, firms, and governments", *Journal of Law, Economics, and Organization*, Vol. 24 No. 2, pp. 273-306.

Ahn, Thomas (2013), "The missing link: estimating the impact of incentives on teacher effort and instructional effectiveness using teacher accountability legislation data", *Journal of Human Capital*, Vol. 7 No. 3, pp. 230-273.

American Psychological Association Zero Tolerance Task Force (2008), "Are zero tolerance policies effective in the schools? an evidentiary review and recommendations", *American Psychologist*, Vol. 63 No. 9, pp. 852-862.

Angrist, Joshua; Pathak, Parag; and Walters, Christopher (2013), "Explaining charter school effectiveness", *American Economic Journal: Applied Economics*, Vol. 5 No. 4, pp. 1-27.

Angrist, Joshua; Cohodes, Sarah; Dynarski, Susan; Pathak, Parag; and Walters, Christopher (2016), "Stand and deliver: effects of Boston's charter high schools or college preparation, entry, and choice", *Journal of Labor Economics*, Vol. 34 No. 2, pp.275-318.

Betts, Julian and Tang, Emily (2011), "The effect of charter schools on student achievement: a meta-analysis of the literature", National Charter School Research Project, University of Washington, Bothell.

Cebula, Richard and Alexander, Gigi (2006), "Determinants of net interstate migration, 2000-2004", *Journal of Regional Analysis and Policy,* Vol. 36 No. 2, pp. 116-123.

Cebula, Richard; Mixon, Franklin; and Montez, Mark (2015), "Teachers' salaries and human capital, and their effects on academic performance: an institution-level analysis of Los Angeles County high schools", *Journal of Economics and Finance*, Vol. 39 No. 2, pp 347-356.

Center for Education Reform (2015), "Charter school laws across the states 2015: rankings and scorecard", available at: https://www.edreform.com/2015/03/charter-school-laws-across-the-states-2015-rankings-scorecard/ (accessed November 10, 2015).

Chetty, Raj; Friedman, John E.; and Rockoff, Jonah E. (2014), "Measuring the impacts of teachers I: evaluating bias in teacher value-added estimates", *American Economic Review*, Vol. 104 No. 9, pp. 2593-2632.

Chetty, Raj; Friedman, John E.; and Rockoff, Jonah E. (2014), "Measuring the impacts of teachers II: teacher value-added and student outcomes in adulthood", *American Economic Review*, Vol. 104 No. 9, pp. 2633-2679.

Chiappori, Pierre-Andre; McCann, Robert; and Nesheim, Lars (2010), "Hedonic price equilibria, stable matching, and optimal transport: equivalence, topology, and uniqueness", *Economic Theory*, Vol. 42 No. 2, pp. 317-354.

Clark, Melissa; Gleason, Philip; Tuttle, Christina; and Silverberg, Marsha (2011), "Do charter schools improve student achievement? evidence from a national randomized study", Working Paper 3, Mathematica Policy Research, Princeton, NJ.

Cohodes, Sarah (2016), "Teaching to the student: charter school effectiveness in spite of perverse incentives", *Education Finance and Policy*, Vol. 11 No. 1, pp. 1-42.

Coulson, Andrew (1999), *Market Education: The Unknown History*, Transactions Publishers, New Brunswick, NJ.

Coulson, Andrew (2009), "Comparing public, private, and market schools: the international evidence", *Journal of School Choice*, Vol. 3 No. 1, pp. 31–54.

Dixit, Avinash (1997), "Power of incentives in public versus private organizations", *American Economic Review*, Vol. 87 No. 2, pp. 378-82.

Dixit, Avinash (2002), "Incentives and organizations in the public sector: an interpretative review", *Journal of Human Resources*, Vol. 37 no.4, pp. 696-727.

Dobbie, Will and Fryer, Roland (2013), "Getting beneath the veil of effective schools: evidence from New York City", *American Economic Journal: Applied Economics*, Vol. 5 No. 4, pp. 28-60.

Dobbie, Will and Fryer, Roland (2013), "The medium-term impacts of high-achieving charter schools on non-test score outcomes", Working Paper #19581, National Bureau of Economic Research.

Duflo, Esther; Dupas, Pascaline; and Kremer, Michael (2012), "School governance, teacher incentives, and pupil-teacher Ratios: experimental evidence from Kenyan primary schools", NBER Working Paper No. 17939, National Bureau of Economic Research, Cambridge, MA.

Eberts, Randall, Kevin Hollenbeck, and Joe Stone (2002), "Teacher performance incentives and student outcomes", *Journal of Human Resources*, Vol. 37 No. 4, pp. 913-927.

Figlio, David N. and Kenny, Lawrence W. (2007), "Individual teacher incentives and student performance", *Journal of Public Economics*, Vol.91 No. 5-6, pp. 901-914.

Fryer, Roland (2013), "Teacher incentives and student achievement: evidence from New York City public schools", *Journal of Labor Economics*, Vol. 31 No. 2, pp. 373-407.

Fryer, Roland (2014), "Injecting charter school best practices into traditional public schools: evidence from field experiments", *Quarterly Journal of Economics*, Vol. 129 No. 3, pp 1355-1407.

Garen, John (2014), "School choice and school discipline: why we should expect the former to improve the latter", *Journal of School Choice*, Vol. 8 No. 4, pp. 618-636.

Hall, Joshua (2000), “Investment in education: private and public returns”, report for Joint Economic Committee, United States Congress, Washington, DC.

Hall, Joshua (2006), “The dilemma of school finance reform”, *Journal of Social, Political and Economic Studies*, Vol. 31 No. 2, pp. 175-189.

Hatfield, John and Milgrom, Paul (2005), “Matching with contracts”, *American Economic Revew*, Vol. 95 No. 4, pp. 913-935.

Hanushek, Eric A. and Rivkin, Steven G. (2004), “How to improve the supply of high quality teachers”, in Ravitch, D. (Ed), *Brookings Papers on Education Policy*, Brookings Institution, Washington, DC, pp. 7-25.

Hayek, Friedrich A. (1945), “The use of knowledge in society”, *American Economic Review*, Vol. 35 No. 4, pp. 519-530.

Heckman, James; Stixrud, Jora ; and Urzua, Sergio (2006), “The effect of cognitive and noncognitive abilities on labor market outcomes and social behavior”, *Journal of Labor Economics*, Vol. 24 No. 3, pp. 411-482.

Holmstrom, Bengt and Milgrom, Paul (1991), "Multitask principal-agent analyses: incentive contracts, asset ownership, and job design", *Journal of Law, Economics, and Organization*, Vol. 7 Special Issue, pp. 24-52.

Hout, Michael and Elliott, Stuart W. (Eds) (2011), “Incentives and test-based accountability in education”, Committee on Incentives and Test-Based Accountability in Public Education, National Research Council, National Academies Press, Washington, DC.

Hoxby, Caroline M. (2000), "Does competition among public schools benefit students and taxpayers?" *American Economic Review*, Vol. 90 No. 5, pp. 1209-1238.

Hoxby, Caroline M. (2002), “Would school choice change the teaching profession?” *Journal of Human Resources*, Vol. 37, No. 4, pp. 846-891.

Hoxby, Caroline M. (2004), “Productivity in education: the quintessential upstream industry”, *Southern Economic Journal*, Vol. 71 No. 2, pp. 209-231.

Hoxby, Caroline M.; Murarka, Sunali; and Kang, Jenny (2009), “How New York City’s charter schools affect achievement”, The New York City Charter School Evaluation Project, Cambridge, MA.

Jacob, Brian A. (2005), “Accountability, incentives, and behavior: the impact of high-stakes testing in the Chicago public schools”, *Journal of Public Economics*, Vol. 89 No 5-6, pp. 761-796.

Jacob, Brian and Lefgren, Lars (2007), "What do parents value in education? an empirical investigation of parents' revealed preferences for teachers", *Quarterly Journal of Economics*, Vol. 122 No. 4, pp. 1601-1637.

Jacob, Brian and Lefgren, Lars (2008), "Can principals identify effective teachers? evidence on subjective performance evaluation in education", *Journal of Labor Economics*, Vol. 26 No. 1, pp.101-136.

Jensen, Michael and Meckling, William (1992), "Specific and general knowledge, and organizational structure", in Werin, Lars and Wijkander, Hans (Eds), *Contract Economics*, Blackwell, Cambridge, MA, pp. 251-274.

Lavy, Victor (2007), "Using performance-base pay to improve the quality of teachers", *The Future of Children*, Vol. 17 No. 1, pp. 87-109.

Lavy, Victor (2009), "Performance pay and teachers' effort, productivity, and grading ethics", *American Economic Review*, Vol. 99 No. 5, pp 1979-2011.

Merrifield, John (2002), *School Choices: True and False*, The Independent Institute, Oakland, CA.

Neal, Derek (2009), "Designing incentive systems for schools", in Springer, Matthew (Ed), *Performance Incentives: Their Growing Impact on American K-12 Education*, Brookings Institution, Washington, DC.

Neal, Derek (2011), "The design of performance pay in education", in Hanushek, Machin, and Woessmann (Eds), *Handbook of the Economics of Education*, Vol. 4, North Holland, Amsterdam, Netherlands.

Pack, Janet (1973), "Determinants of migration to central cities", *Journal of Regional Science*, Vol. 13 No. 2, pp. 249-260.

Pathak, Parag and Sonmez, Tayfun (2013), "School admissions reform in Chicago and England: comparing mechanisms by their vulnerability to manipulation", *American Economic Review*, Vol. 103 No. 1, pp. 80-106.

Podgursky, Michael and Ballou, Dale (2001), "Let the market decide", *Education Next*, Vol. 1 No. 1, available at: http://educationnext.org/let-the-market-decide/ (accessed November 10, 2015).

Prendergast, Canice (1999), "The provision of incentive in firms", *Journal of Economic Literature*, Vol. 37 No. 1, pp.7-63.

Rivkin, Steven G.; Hanushek, Eric A.; Kain, John F. (2005), "Teachers, schools, and academic achievement", *Econometrica*, Vol. 73 No. 2, pp. 417-458.

Rockoff, Jonah E. (2004), "The impact of individual teachers on student achievement: evidence from panel data", *American Economic Review*, Vol. 94 No. 2, pp. 247-252.

Rothstein, Jesse (2007), "Does competition among public schools benefit students and taxpayers? a comment on Hoxby (2000)." *American Economic Review,* Vol. 97 No. 5, pp. 2026-2037.

Rouse, Cecilia and Barrow, Lisa (2009), "School vouchers and student achievement: recent evidence and remaining questions", *Annual Review of Economics*, Vol. 1, 2009, pp. 17-42.

Toma, Eugenia and Zimmer, Ron (2012), "Two decades of charter schools: expectations, reality, and the future," *Economics of Education Review*, Vol. 31 No. 2, pp. 209-212.

U. S. Department of Education (2014), "Guiding principles: a resource guide for improving school climate and discipline", available at: http://www2.ed.gov/policy/gen/guid/school-discipline/guiding-principles.pdf (accessed November 10, 2015).

Vigdor, Jacob L. (2008), "Teacher salary bonuses in North Carolina", Working Paper 2008-03, National Center on Performance Incentives, Vanderbilt University, Nashville, TN.

Appendix: Solving the Model

We outline the solution the version of the standard, Holmstrom-Milgrom (1991) principal-agent model discussed in the text. Teacher expected utility is $U = E(Y) - C(T,A,N) - \frac{1}{2}\rho R$, where $E(Y)$ is teacher 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. The school administrator observes T and A and sets compensation as a linear function such that $E(Y) = b_0 + b_T T + b_A A$.

Teachers select effort levels 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 yields the first-order conditions:

(A1a) $U_T = b_T - C_T = 0$
(A1b) $U_A = b_A - C_A = 0$
(A1c) $U_N = - C_N = 0$

Each of these indicates the effort is selected such that its marginal benefit equals its marginal cost. Though there is no direct benefit of N, a positive N occurs if the marginal cost of N is zero at N>0, which can occur if N lowers the marginal cost of another type of effort.

The second-order conditions for a utility maximum are the following:

$$(A2) \qquad \begin{vmatrix} -C_{TT} & -C_{TA} & -C_{TN} \\ -C_{AT} & -C_{AA} & -C_{AN} \\ -C_{NT} & -C_{NA} & -C_{NN} \end{vmatrix} = -D < 0, \; D > 0$$

and that principal minors D_{11}, D_{22}, and D_{33} are positive, and C_{TT}, C_{AA}, and C_{NN} are all positive. Differentiation of first-order condition (A1) and application of Cramer's Rule gives:

$$(A3) \qquad \frac{\partial T}{\partial b_T} = \frac{D_{11}}{D} > 0, \; \frac{\partial A}{\partial b_A} = \frac{D_{22}}{D} > 0 \text{; and}$$

$$(A4) \qquad \frac{\partial A}{\partial b_T} = \frac{D_{12}}{D}, \; \frac{\partial T}{\partial b_A} = \frac{D_{21}}{D}, \; \frac{\partial N}{\partial b_T} = \frac{D_{13}}{D}, \; \frac{\partial N}{\partial b_A} = \frac{D_{23}}{D}$$

The conditions noted in the text are that A and N are complementary with each other, but not with T. These imply that $C_{AN}<0$, $C_{TA}>0$, and $C_{TN}>0$. Under these conditions, we find:

(A5) $\partial A/\partial b_T < 0;\ \partial T/\partial b_A < 0;\ \partial N/\partial b_T < 0;\ \partial N/\partial b_A > 0.$

Given these results, the school administrator chooses b_T and b_A to maximize his/her payoff function. Under competition, this is $F = E(V - Y) = V(T,A,N) - (b_0 + b_T T + b_A A)$. Assuming a linear V function as $V = \alpha_T T + \alpha_A A + \alpha_N N$ and substituting in the incentive compatibility and individual rationality constraints, the payoff function becomes: $F = \alpha_T T + \alpha_A A + \alpha_N N - C(T,A,N) - \frac{1}{2}\rho R - U^M$, where U^M is teacher alternative utility. With the further assumption of risk neutrality, the first-order conditions are:

$$(A6) \qquad \frac{\partial F}{\partial b_T} = (\alpha_T - C_T)\frac{\partial T}{\partial b_T} + (\alpha_A - C_A)\frac{\partial A}{\partial b_T} + (\alpha_N - C_N)\frac{\partial N}{\partial b_T} = 0$$

$$(A7) \qquad \frac{\partial F}{\partial b_A} = (\alpha_T - C_T)\frac{\partial T}{\partial b_A} + (\alpha_A - C_A)\frac{\partial A}{\partial b_A} + (\alpha_N - C_N)\frac{\partial N}{\partial b_A} = 0$$

The intuition of these conditions is the following. An increase in b_T raises (or lowers) marginal value as it raises (or lowers) T, A, and N, each of which have value α_j, j=T,A,N. This is balanced against the marginal cost of effort, C_j, j=T,A,N, from increasing b_T that induces more (or less) T, A, and N. A parallel argument applies to b_A. With substitution and algebra, one obtains the solutions in the text:

(A8) $b_T = \alpha_T - \alpha_N C_{NT}/\Omega$

(A9) $b_A = \alpha_A - \alpha_N C_{NA}/\Omega$

where $\Omega > 0$ based on second-order conditions. The solutions in the public, noncompetitive case are simple transformations of (A8) and (A9) since the payoff function is a straightforward transformation of the competitive one. If risk aversion is introduced, the same general findings occur, albeit with some qualifications.