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CAN BUREAUCRATS REALLY BE PAID LIKE CEOS?  
SCHOOL ADMINISTRATOR INCENTIVES  
FOR ANEMIA REDUCTION IN RURAL CHINA

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Can Bureaucrats Really Be Paid Like CEOs?

School Administrator Incentives for Anemia Reduction in Rural China

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## **ABSTRACT**

A large literature examines performance pay for managers in the private sector, but little is known about performance pay for managers in public sector bureaucracies. In this paper, we study performance incentives rewarding school administrators for reducing anemia among their students. Randomly assigning 170 schools to three performance incentive levels and two orthogonal sizes of unconditional grants, we analyze performance pay and its complementarity with discretionary resources. We find that both large incentives and larger unconditional grants reduced anemia substantially, but incentives were more cost-effective. Performance incentives led administrators to innovate by working with parents, mitigating potentially offsetting compensatory behavior among households. Strikingly, we also find that larger unconditional grants completely crowded-out the effect of incentives. Our findings suggest that performance incentives can be effective in bureaucratic environments – but also that discretionary resources can fully crowd-out their effect.

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## 1. Introduction

The provision of public services in many developing countries is poor (World Bank 2004; Banerjee, Deaton, and Duflo 2004; Das, Hammer, and Leonard 2008; Berendes et al. 2011). Although the underlying reasons are complex and incompletely understood, the culprit is not simply lack of resources, inadequate training, or deficiencies in provider knowledge. Supply-side incentives are also often poorly aligned with social objectives. Absenteeism in many parts of the world is pervasive (Chaudhury and Hammer 2004; Kremer et al. 2005; Chaudhury et al. 2006; Lewis 2006; Banerjee and Duflo 2006), and providers often fail to do in practice what is within their knowledge and means (Das and Hammer 2004; Alcázar et al. 2006; Chaudhury et al. 2006; Das and Hammer 2007; Leonard and Masatu 2010; Das et al. 2012; Sylvia et al. 2014).

To better align provider incentives with social objectives, performance pay has become increasingly common in public sector service delivery (Oxman and Fretheim 2008; Eichler and Levine 2009; Miller and Babiarz 2013). Drawing on the logic of performance pay in human resource management (Lazear 1995; Hall and Lieberman 1998; Lazear 2000), this approach provides direct financial rewards for achieving pre-specified performance targets. Despite their growing prominence, however, many important conceptual questions about the appropriate use of performance pay in public service delivery remain unexplored (Miller and Babiarz 2013).

A fundamental issue is that although performance pay in the private sector focuses on managers (corporate executives, for example), remarkably little is known about performance pay for managers in bureaucracies.<sup>2</sup> Previous studies of public sector

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<sup>2</sup> On performance pay for corporate executives and private sector managers in developed countries, see Jensen and Murphy (1990), Hall and Lieberman (1998), Murphy (1999), Hall and Murphy (2003), and Oyer

performance pay largely examine incentives to increase effort among front-line service providers, including teachers and health workers.<sup>3</sup> Performance incentives for managers have broader aims – including greater productive and allocative efficiency with the resources under their control (Holmstrom and Ricart i Costa 1986; Athey and Roberts 2001; Bandiera, Barankay, and Rasul 2007). In bureaucratic environments in which managers are strongly motivated by career concerns (and are rewarded little for good results – but may suffer substantial career harm for bad ones), performance incentives may be vital to encouraging innovation in service delivery (Holmstrom 1982; Holmstrom and Ricart i Costa 1986; Dasgupta and Sarafidis 2009).

Given the scope of their responsibility, a key feature of performance pay for managers is that it may be appropriate to base rewards on outputs of production (linking the compensation of corporate executives to their firm’s share value, for example) (Holmstrom 1982; Athey and Roberts 2001).<sup>4</sup> In contrast to performance pay rewarding inputs into production, rewarding outputs strengthens incentives for managers to draw on contextual knowledge about the optimal allocation of organizational resources (improving allocative efficiency), to use existing resources/inputs more efficiently (improving productive efficiency) – and more generally, to innovate. Moreover, for outputs jointly produced with service beneficiaries or recipients (health and educational

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and Shaefer (2005). Bandiera et al. (2007) and Bloom et al. (2011) study these virtues of performance pay for private sector managers in developing countries.

<sup>3</sup> Several recent studies have examined performance pay provided as personal income to front line workers in the health and education sectors, including Lavy (2002), Lavy (2009), Glewwe et al. (2010), Muralidharan & Sundararaman (2011), Duflo et al. (2012), and Behrman et al. (2015). Other recent studies have focused on incentives to institutions paid as budget revenue. These include Bloom et al. (2006), Basinga et al. (2011), Gertler and Vermeersch (2012), Olken, Onishi, and Wong (2014), and Yip et al. (2014). An exception is Rasul and Rogger (2013), who study incentives for bureaucrats in the Nigerian civil service. Behrman et al. (2015) also study incentives for school administrators bundled with incentives to students and teachers.

<sup>4</sup> Front line workers have less control over productive outputs – and may therefore be more strongly incentivized by performance pay rewarding the use of pre-specified productive inputs.

outcomes also depend on household inputs), output-based incentives may motivate agents to prevent offsetting compensatory behavior among beneficiaries (Leonard 2003). In the health sector, almost no previous research of which we are aware examines the effects of performance incentives for actual outputs of health production: good health.<sup>5</sup>

Although interest in public sector performance pay aims to improve the efficiency of public expenditures, there is also little evidence about how performance incentives interact with the size of operating budgets.<sup>6</sup> Bureaucracies in developing countries generally operate under stringent budget constraints – and increasing the size of their budgets is often considered an equivalent priority. Importantly, incentives and resources available to managers may function as either complements or substitutes in public service delivery. Complementarity is possible for intuitive reasons – for example, managers may wish to respond to performance incentives, but resources may facilitate their ability to do so.<sup>7</sup> There are also theoretical rationales for substitution – if the marginal return to effort devoted to improving efficiency (reducing waste) declines when managers have more resources at their disposal, managers may simply substitute resources for their own effort.<sup>8</sup>

More generally, performance incentives may be ill-suited for public sector managers altogether – because other institutional incentives may dominate them or

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<sup>5</sup> The two exceptions of which we are aware are (Miller et al. 2012) and Singh (2011). Leonard (2003) studies traditional healers' use of outcome-contingent contracts in Cameroun. In the education sector, performance pay rewarding good test scores is more common (Lavy 2009; Muralidharan and Sundararaman 2011; Behrman et al. 2015).

<sup>6</sup> Besley and Ghatak (2007) note that interest in applying performance pay to the public sector (and the philosophy underlying “New Public Management” more generally) was “born out of efforts to decrease the size of public funds going to public goods and services while preserving service levels” in the UK.

<sup>7</sup> Some research has emphasized the connection between incentives and control in organizations (for example, see Prendergast (2002)).

<sup>8</sup> Studying public procurement in Italy, Bandiera et al. (2009) estimate that 83% of total waste in public service provision is attributable to “passive waste,” which occurs (in part) because of weak incentives to minimize cost.

because well-known concerns with performance pay may apply with greater force, for example. First, career concerns can be particularly strong in bureaucracies – and may overpower incentives created by performance pay (Gibbons and Murphy 1992). Second, common concerns about multi-tasking may be exacerbated by the fact that bureaucracies often have a large number of ill-defined tasks and responsibilities (Dewatripont, Jewitt, and Tirole 1999; Dixit 2002; Besley and Ghatak 2007). Third, compared with their private sector counterparts, civil servants may be more intrinsically or pro-socially motivated (Francois 2000; Francois and Vlassopoulos 2008; Tonin and Vlassopoulos 2014) – and performance pay may dampen the effects of intrinsic motivation (Deci and Ryan 1985; Fehr and Falk 2002; Bénabou and Tirole 2006; Francois and Vlassopoulos 2008; Gneezy, Meier, and Rey-Biel 2011; Kamenica 2012).

In this paper we study these issues directly, analyzing a large-scale policy experiment in rural China rewarding primary school administrators (head principals, hereafter “administrators”) – managers and executive decision-makers in their schools – for improvements in the health of their students. Specifically, we offer several sizes of financial incentives to administrators for measurable reductions in student anemia – a leading child health problem in rural China – over the course of an academic year.<sup>9</sup> We also analyze how the response of managers to performance incentives varies with randomly assigned block grants.<sup>10</sup>

Our study yields four key findings. First, we find that larger incentives for anemia reduction were effective when administrators had fewer resources at their

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<sup>9</sup> Previous studies have shown anemia rates among primary school aged students in poor regions of western China to be around 30% on average (Luo et al. 2011; Miller et al. 2012).

<sup>10</sup> Because all administrators in our study are provided with information about anemia and a small block grant to implement an anemia reduction program, the effect of incentives that we estimate is net of effects due to “labeling” or increasing the salience of anemia (Benhassine et al. 2013).

disposal for implementing the program. Incentives that provided substantial additional income to administrators (mean realized payouts of about 2 months of annual salary) reduced anemia among students anemic at baseline by 13.8 percentage points (or 38%). Importantly, we also find that directly rewarding outputs (good health) in this way led school administrators to innovate in working with students' parents to improve diets at home (as well as at school). This finding suggests that outcome-based performance incentives may be an effective tool to mitigate potentially offsetting compensatory behavior among beneficiary households in response to supply-side investments in child education and health.<sup>11</sup>

Second, we find that small incentives (one tenth the size of the larger incentives) were ineffective in reducing anemia – and were significantly less effective than large incentives. A number of studies outside of organizational settings have shown that even small incentives (or the existence of incentives alone, independent of size) can lead to meaningful changes in behavior. Several studies report large increases in incentivized behavior in response to modest rewards (as well as highly elastic demand at prices close to zero) (Kremer and Miguel 2007; Thornton 2008; Banerjee et al. 2010; Cohen and Dupas 2010; Karlan, List, and Shafir 2011; Duflo, Kremer, and Robinson 2011). Alternatively, other research suggests that small incentives may *reduce* effort if the potential for financial rewards are dominated by negative effects due to the information conveyed by incentives – for example, if incentives cast doubt that a task is performed for prosocial reasons (Gneezy and Rustichini 2000; Bénabou and Tirole 2006; Gneezy,

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<sup>11</sup> That school-based inputs can potentially crowd-out household investments in nutrition and education has been noted in a number of contexts (Jacoby 2002; Kazianga et al. 2009; Islam and Hoddinott 2009; Buttenheim, Alderman, and Friedman 2011; Alderman and Bundy 2012; Das et al. 2013). The welfare consequences of mitigating household responses to supply-side investments are context dependent.

Meier, and Rey-Biel 2011). Our finding that small incentives do not lead to significant effects in either direction are more consistent with a linear monotonic relationship in the context that we study.<sup>12</sup>

Third, we find that even absent explicit experimental incentives, increasing school administrators' budgets led to sizeable reductions in anemia. This result suggests that administrators appear motivated to allocate resources to the nutrition program, even absent explicit incentives to do so. However, the resource cost of reducing anemia through larger school budgets was approximately twice as great (per case of anemia averted) as combining larger performance incentives with smaller budgets – implying that school administrators with incentives used smaller budgets with greater productive efficiency.

Finally, we find that performance incentives for managers and budget resources are substitutes in producing nutritional gains. The degree of substitution is substantial: although larger incentives led to significant reductions in anemia with smaller block grants, they had no significant effect with larger block grants. Put differently, unconditional resource transfers (of sizes chosen by government planners in practice<sup>13</sup>) completely crowd-out the effect of incentives. As our theoretical model shows, this is possible because administrators may substitute school resources for organizational effort when there are adequate resources to do so. We also find that with larger block grants,

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<sup>12</sup> We also note at least two key differences with this previous literature: one is that receiving incentive payments in our study required sustained behavior change (reducing iron deficiency anemia requires several months of dietary change), and another is that because all school administrators receive information about anemia, the presence of incentives may not alter its salience as much (Benhassine et al. 2013).

<sup>13</sup> China's recent school lunch program, for instance, provides a subsidy of 4 yuan (\$0.63) per student per day (Xinhua, 2015).

school administrators with performance incentives exert less effort to work with households to improve feeding practices at home.<sup>14</sup>

The rest of this paper is organized as follows. Section 2 presents a conceptual framework for understanding school administrators' behavioral responses to output-based performance incentives. Section 3 provides background on school-based nutrition programs as well as the causes and consequences of anemia. Section 4 describes our experimental design, data collection, and methods. Section 5 reports our results, and Section 6 concludes.

## 2. Conceptual Framework

In this section, we propose a simple model of the school administrator decision problem that we study. Specifically, we consider the influence of both output-based performance incentives and discretionary resources on organizational effort (collectively by the administrator and subordinates)<sup>15</sup> devoted to the rewarded output. Additionally, we model the interplay of both performance incentives and resources with existing incentives embedded in the “bureaucratic environment” (as we describe below). We assume school administrators to choose levels of organizational effort,  $e$ , and amount of inputs,  $i$ , devoted to the task of improving student health (in our context, reducing anemia) that solve:

$$\max_{e,i} w + \theta H - v(e) - \lambda p(e)Q \quad (1)$$

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<sup>14</sup> In this paper, we study health (specifically, anemia). In a companion paper, Miller et al. (2015), we study test scores and unintended behavioral responses (specifically, multitasking) to incentives for anemia reduction. In short, we find no significant changes in test scores associated with incentives for anemia reduction or with larger block grants.

<sup>15</sup> Although there are presumably important questions about how administrators motivate subordinates, we ignore these in the model for simplicity. An interesting related question is the relative effectiveness of incentives at the organizational level and incentives to administrators individually (see Miller and Babiarz 2013 for a discussion).

subject to:

$$w = tH + m \quad (2)$$

$$H = h(i) \quad (3)$$

$$i \leq (1 + \alpha e)G \quad (4)$$

Total take home pay,  $w$ , consists of base pay,  $m$ , and a reward for improving student health,  $tH$  – which is the product of  $t$ , the marginal bonus, and  $H$ , the net gain in student health (in our case, the net reduction in the number of students with anemia).  $H$  is produced with the chosen amount of inputs,  $i$ , according to the production function  $h(i)$ , which we assume to be strictly increasing and concave:  $h' > 0, h'' \leq 0$ . The disutility of effort,  $v(e)$ , is also strictly increasing but convex:  $v' > 0, v'' \geq 0$ . The parameter  $\theta$ , which is non-negative, allows the school administrator to be altruistic, deriving direct utility from student health (pro-sociality and public service motivation are often cited as important among public sector workers – for example, see Besley and Ghatak (2007)).

Equation (4) implies that the school administrator can exert effort to use discretionary resources,  $G$ , more efficiently. Specifically, the marginal increase in *effective* resources due to effort is given by  $\alpha > 0$ . This could reflect effort devoted to making inputs more effective (ensuring that students take multivitamins provided to them, for example), obtaining lower input prices, or identifying and choosing a strategy that will be most effective given local conditions. Additionally, because student health is jointly produced with households, effort could also focus on increasing the amount of resources by working with parents to increase health and nutrition investments at home.

We also incorporate “bureaucratic incentives” (embedded in local institutions) facing administrators into our model. In doing so, we capture a common – and important

– feature of bureaucratic environments: managers often face weak incentives to innovate and make potentially productive investments due to the existence of strong career concerns. Managers in bureaucracies are often rewarded relatively little for investment decisions and effort that is highly productive – and attributing productivity to managerial action is often difficult. Alternatively, managers in bureaucracies may suffer substantial career harm for adverse events or outcomes (though not generally for low productivity)– especially if adverse outcomes highlight deviation from rigid (implicit or explicit) organizational rules or norms (Wilson 1989; Dixit 2002).<sup>16</sup> Modeling bureaucratic incentives this way conforms to stereotypes of bureaucrats and civil servants as overly cautious and reluctant to undertake innovative (or even commonsensical) projects, even when there is little downside risk (Dixit 2002; Dasgupta and Sarafidis 2009).<sup>17</sup>

To introduce bureaucratic incentives explicitly into our model, we incorporate the expression  $\lambda p(e)Q$ , which reflects direct disutility to the school administrator. The administrator believes that an adverse event will occur with probability  $p(e)$ , and the damage to the administrator's career conditional on a bad outcome is  $Q$ . We assume that  $p(e)$  increases with effort to improve student health ( $p'(e) > 0$ , reflecting that greater effort devoted to anemia reduction might decrease effort on other tasks (such as monitoring, ensuring child safety, or teaching) and hence increasing the probability of an adverse event on those tasks – as well as the fact that more innovative interventions

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<sup>16</sup> Wilson (1989) argues that when production is complex and output is difficult to measure – as in public sector bureaucracies, evaluation of performance and career prospects of employees tends to be based on compliance with explicit or implicit rules or constraints because they are more easily observed and verified. Dixit (2002) argues that this is the case for public education systems and why school systems often have weak explicit incentives, many constraints and evaluation by evidence that rules are followed.

<sup>17</sup> These characteristics are highly relevant in the Chinese context (see Tan (2001)). The importance of concerns such as these was also evident in qualitative interviews conducted after the experiment.

require greater effort, but might also entail greater risk (and result in adverse events).<sup>18</sup>

For instance, preparing nutritious foods (such as meat and vegetables) requires more effort than distributing pre-made foods - but can also pose more career risk to administrators (given food safety concerns in China).<sup>19</sup> We also assume that  $p''(e) > 0$ , or that the probability of an adverse effect increases more rapidly with effort at higher effort levels.<sup>20</sup> The disutility weight of this probabilistic adverse outcome for the school administrator is given by  $\lambda > 0$ <sup>21</sup> (Alternatively,  $\lambda$  could represent the probability that the adverse event is detected by the administrator's superior (the school superintendent, for example)).

To solve the model, we use that constraint (4) is binding and hence we can use that  $e = \left(\frac{i}{\alpha G} - \frac{1}{\alpha}\right)$ .<sup>22</sup> The first order condition is:

$$(t + \theta)h'(i) = \frac{1}{\alpha G} \left( v' \left( \frac{i}{\alpha G} - \frac{1}{\alpha} \right) + \lambda p' \left( \frac{i}{\alpha G} - \frac{1}{\alpha} \right) Q \right), \quad (5)$$

implying that the school administrator chooses the amount of health improving input  $i$  by equating its marginal benefit (the increase in health,  $h'(i)$ , multiplied by  $t + \theta$ , reflecting both the increase in take home pay and the altruistic increase in direct utility) with its marginal cost. For what follows, it is useful to write the objective function (1) in terms of the health input,  $i$ , and to define its first and second derivatives as follows:

$$V'(i) = (t + \theta)h'(i) - \frac{1}{\alpha G} \left( v' \left( \frac{i}{\alpha G} - \frac{1}{\alpha} \right) + \lambda p' \left( \frac{i}{\alpha G} - \frac{1}{\alpha} \right) Q \right) \quad (6)$$

<sup>18</sup> We study multi-tasking in a companion paper (Miller et al. 2015).

<sup>19</sup> For a thorough discussion, see the FORHEAD Working Group on Food Safety (2014). School administrators have also been dismissed after school lunches were suspected in food poisoning incidents (Food Safety News, 2012).

<sup>20</sup> This guarantees the concavity of the objective function and the existence of a maximum. We could relax this assumption and also allow for a concave function as long as  $v(e)$  is sufficiently convex to ensure that the objective function is globally convex.

<sup>21</sup> Fundamentally,  $\lambda p(e)Q$  is another cost of effort as  $v(e)$  is, but it is useful to study the comparative statics with respect to  $\lambda$ .

<sup>22</sup> It is useful to derive predictions in terms of  $i$  rather than  $e$  because it is what we observe in the data.

and

$$V''(i) = (t + \theta)h''(i) - \left(\frac{1}{\alpha G}\right)^2 \left(v''\left(\frac{i}{\alpha G} - \frac{1}{\alpha}\right) + \lambda p''\left(\frac{i}{\alpha G} - \frac{1}{\alpha}\right)Q\right). \quad (7)$$

Note that  $V''(i) < 0$  for any  $i$ , which implies that the second order condition holds globally.

## 2.1 Comparative Statics

Our main interest is to analyze how the school administrator's use of health inputs changes with discretionary resources,  $G$ , and incentives,  $t$  – both separately and in combination (as we study in our experiment). The administrator's health input use changes with discretionary resources ( $G$ ) according to the expression.<sup>23</sup>

$$\frac{di}{dG} = -\frac{\frac{1}{\alpha G^2}(v' + \lambda p' Q) + \frac{i}{\alpha^2 G^3}(v'' + \lambda p'' Q)}{v''}, \quad (8)$$

which is always positive because the numerator is positive and the denominator (corresponding to the second order condition) is negative. The change in input use with incentives ( $t$ ) is given by:

$$\frac{di}{dt} = -\frac{h'}{v''}, \quad (9)$$

which is also positive. Given the bureaucratic environment of our study, we also consider how the effect of incentives varies with the strength of bureaucratic career concerns ( $\lambda$ ). Intuitively, an increase in  $\lambda$  increases the marginal disutility from effort ( $v' + \lambda p' Q$ ), so incentives should health input use less. Formally:

$$\frac{d^2i}{dt d\lambda} = -\frac{\left(\frac{p'' Q}{(\alpha G)^2}\right)h'}{(v'')^2}, \quad (10)$$

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<sup>23</sup> For simplicity, in what follows we omit the functions' arguments, which are the same as in equations (5), (6), and (7).

which is negative, implying that the effect of incentives on health input use decreases with bureaucratic career concerns.

Equation (9) is also useful for understanding how the administrator's response to incentives will vary with resources. Focusing on the numerator of Equation (9), if  $i$  is already large because  $G$  is large, then  $h'$  will be small – and hence the effect on the incentive on the inputs will also be smaller. More formally, the cross partial derivative between incentives and discretionary resources is given by:

$$\frac{d^2 i}{dt dG} = \frac{\left(\frac{1}{\alpha G^2}(v' + \lambda p' Q) + \frac{i}{\alpha^2 G^3}(v'' + \lambda p'' Q)\right)h''}{(v'')^2}, \quad (11)$$

which is negative – implying that discretionary resources and incentives are substitutes.

Note, however, that discretionary resources and incentives might be complements in other plausible models. For example, they can be complementary if there are non-convexities – for example, if greater resources increase the administrator's return to effort in student health production, for instance, if there is a technology with fixed cost  $F > 0$  that enhances the productivity of effort. An example of such technology is a refrigerator that allows one to store meat bought in the market, reducing time and money spent on trips to the market. The administrator could choose to buy this technology, which would imply that Equation (4) becomes  $i \leq (1 + \beta e)(G - F)$ , with  $\beta > \alpha$ . Incentives and block grants would be complements if  $G$  increased sufficiently, and  $\beta$  is sufficiently larger than  $\alpha$ .

### **3. Background**

#### 3.1 School-Based Nutrition Programs

School-based interventions are believed to be among the most cost-effective approaches for delivering health and nutrition services to children in developing countries (Bundy and Guyatt 1996; Jukes, Drake, and Bundy 2008; Orazem, Glewwe, and Patrinos 2008). Because schools are natural points of contact with school-aged children, they provide a platform from which health and nutrition interventions can be delivered at relatively low cost (Bundy and Guyatt 1996; Bundy et al. 2006; Jukes, Drake, and Bundy 2008). Indeed, the 2008 Copenhagen Consensus ranked school nutrition programs among the top ten solutions to address global challenges according to cost-effectiveness criteria – and they may be particularly effective in countries such as China in which primary school attendance is nearly universal.<sup>24</sup>

### 3.2 The Causes and Consequences of Anemia

Our study examines school-based programs to reduce anemia. Anemia is estimated to affect nearly one quarter of all school-aged children worldwide (World Health Organization 2001). Although there are many causes of anemia (including a variety of genetic disorders and infections as well as nutritional deficiencies), iron deficiency accounts for about 50% of cases globally (Balarajan et al. 2011; Pasricha et al. 2013)<sup>25</sup> – and 85-95% of cases in China (Du et al. 2000).

The consequences of iron deficiency—with or without anemia—can be substantial, particularly for children at critical stages of development. A large literature links iron deficiency to fatigue and reduced work capacity among adolescents and adults,

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<sup>24</sup> Copenhagen Consensus 2008 results. <http://www.copenhagenconsensus.com/projects/copenhagen-consensus-2008/outcome> (Accessed Sep. 11, 2013). Nearly every country in the world seeks to feed at least some of its students through school-based programs (Alderman and Bundy 2012).

<sup>25</sup> There is some debate in the public health literature on the proportion of the anemia burden attributable to iron deficiency (Balarajan et al. 2011). Intestinal worms are unlikely to be a major cause of anemia in our study areas as the prevalence of hookworm (the parasite most commonly associated with anemia) is low (Xu et al. 1995).

impaired cognition and cognitive development among children, and reduced immune response for all age groups (Thomas et al. 2006; R. Yip 2001; World Health Organization 2001; Balarajan et al. 2011).<sup>26</sup> School-aged children with anemia (the focus of our study) have also been shown to have inferior educational outcomes (grades, attendance, and school attainment – Taras 2005; Nokes, van den Bosch, and Bundy 1998).

### 3.3 Biomedical Strategies for Reducing Anemia

Increasing iron consumption can effectively prevent iron deficiency anemia. Worldwide, fortifying staple foods with iron has historically been an effective approach to addressing micronutrient deficiencies (Allen et al. 2006). Fortification is an attractive strategy because it requires little behavior change and because it can be implemented on a large scale. However, fortification of staple foods may be ineffective in areas like Northwest China in which households grow and consume their own food (Allen et al. 2006).

An alternative approach is to increase the consumption of naturally iron-rich foods and those that promote iron absorption during digestion. Animal sources (including red meats, fish, and poultry) provide *heme* iron, which is more easily absorbed during digestion; plant sources (including green, leafy vegetables) provide *non-heme* iron, which is less readily absorbed – but can be promoted by consumption of vitamin C (and inhibited by consumption of milk and other calcium-rich products).<sup>27</sup>

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<sup>26</sup> One available estimate of the economic burden of iron deficiency—taking into account lost physical productivity among adults and cognitive effects among children—calculates the median present value of losses in a selected group of 10 developing countries to be \$25.60 per capita (Horton and Ross 2003).

<sup>27</sup> Initial stores of iron in the body can also affect absorption of dietary iron (Finch 1994). Because there is an optimal level of iron, the body increases absorption when iron stores are low and decreases absorption when initial stores are high. The returns to a given amount of iron are therefore decreasing in initial iron stores.

Finally, a third approach is the delivery of micronutrient supplements (for example, vitamins) containing iron. To be effective, however, regular consumption over several few months is necessary – and so inadequate compliance may render supplementation ineffective (Bobonis et al. 2006; Bhutta et al. 2013; Pasricha et al. 2013; Martorell et al. 2015).<sup>28</sup>

## 4. The Experiment

### 4.1 Sampling

To draw our study sample, we began with all 36 counties officially designated by the Chinese government as “poverty counties” in five regions (prefectures) in western China (Haidong in Qinghai Province, Dingxi, Tianshui, and Longnan in Gansu Province, and Ankang in Shaanxi Province – see Figure 1). In August 2011, we conducted a canvass survey in each county to construct a list of all rural primary schools and the number of students enrolled in each. Restricting our sampling frame to primary schools with 150-300 students total,<sup>29</sup> we randomly selected 170<sup>30</sup> of 1,410 eligible schools for

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<sup>28</sup> Previous trials addressing iron deficiency and anemia have suffered from low levels of compliance or attempted to preempt compliance problems. Bobonis et al. (2006), for example, instructed preschool teachers to provide children with iron therapy for 30 days following health camps but found that only around 18 days were actually administered. The WISE study in Indonesia (Thomas et al. 2006) hired facilitators to regularly visit participants and remind them to take their supplements.

<sup>29</sup> A lower bound of 150 students was chosen to ensure that the number of samples students per school was enough to meet power requirements. 300 was chosen as the upper bound to keep the project within budget. These bounds are on reported school sizes; actual numbers of students are often significantly less than reported. Note that 39.9% of rural primary schools in the sampling frame (all rural primary schools in project counties) were reported to be within this range.

<sup>30</sup> The full experiment involved an additional 130 schools, which were allocated to two other experimental groups where school administrators were offered incentives to based on test scores and “dual” incentives based on both anemia reduction and test score improvement. The results for these additional study arms are reported in a companion paper (Miller et al. 2015).

inclusion in our study (and limited our selection to one school per township<sup>31</sup>). Our sample size was based on power calculations conducted using data from primary schools in the same region of China (Miller et al. 2012).<sup>32</sup>

Within study schools, we randomly sampled 50 fourth and fifth grade students from each school. In China, fourth and fifth grade students are typically 10 to 11 years old, and we chose these grades to select students whom we considered sufficiently old to provide meaningful survey responses – but also sufficiently young to be generally pre-pubescent (given the independent effect of menarche on hemoglobin concentration).<sup>33</sup> We also conducted physical exams and collected data from students from other grades at baseline to obfuscate our focus on fourth and fifth graders.

#### 4.2 Data Collection

We conducted our baseline survey in September 2011 and our follow-up survey in May 2012 (at the beginning and end of the 2011-2012 academic year), collecting detailed information on students, households, school administrators, and schools.

*Student Surveys.* We interviewed all sampled students at their school, collecting information on student background, health behaviors related to anemia, school activities, and general health. To collect information on school and home feeding practices, students

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<sup>31</sup> Local administration of schools is generally done at the school district level, which is below the township. Contamination due to two school administrators meeting at events organized at higher levels, for example, was thus unlikely.

<sup>32</sup> Using data from Miller et al. (2012), we performed Montecarlo simulations to conduct power calculations for students who were anemic at the time of that study's baseline survey. The intra-class correlation was estimated adjusting for covariates (baseline hemoglobin concentration, the number of students in each school, whether schools had a kitchen, student-teacher ratio, distance to the furthest village served by the school, percent boarding students, and county dummies), which we also specified as covariates in the current study's pre-analysis plan.

<sup>33</sup> When there were less than 50 students in the two grades, all students were tested.

were also given standard food frequency questionnaires to record information about food consumption at school and at home over the past week.<sup>34</sup>

We also measured student blood hemoglobin (Hb) concentration at the time of the student survey. Nurses from the Medical School of Xi'an Jiaotong University accompanied study enumerators, collecting finger-prick blood samples to analyze on-site (at schools) using HemoCue Hb 201+ assessment systems.

*Household Surveys.* For each sampled student, we also collected information on students' households using forms completed by parents.<sup>35</sup> Specifically, these surveys collected information about interactions between parents and the school, household income and assets, health-related expenditures, expenditures on food and information on other household members, focusing on household characteristics that students would be unlikely to know themselves.

*School Administrator Surveys.* We interviewed school administrators (bureaucrats) at three different points in time: before and after school administrators were told about the incentive contract and block grant to which they were assigned and again at endline. At baseline, school administrators provided information about their background, job history, salary, and compensation as well as perceptions of professional responsibilities and anemia knowledge. Using scales adapted from Grant (2008), we also measured the intrinsic and pro-social motivation of administrators. Following their participation in the

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<sup>34</sup> Information on food consumption was collected using a seven-day recall "food frequency questionnaires" (FFQs) completed by students as part of the endline survey. These questionnaires asked children the number of times they had eaten each of 33 food items in the past seven days, separately for school and home. Food frequency questionnaires (FFQs) have long been used in nutrition research and have been recommended for use in large surveys of children given low cost and low respondent burden (McPherson et al. 2000; Magarey et al. 2011). FFQ responses by children about their own consumption has been shown to be more accurate than the responses of their parents (Burrows et al. 2013).

<sup>35</sup> For budgetary reasons, household surveys were given to students to take home and return. As a result, household forms are missing for approximately 20% of students. All possible information on students and households was collected with the student survey, which was administered by enumerators.

training session on anemia (conducted 3 weeks after the baseline survey) administrators were given a second short survey to measure their understanding of the training material.

*School Surveys.* Finally, we collected basic information from schools (about enrollment, staffing, facilities, finances, and meal provision) and teachers (about teacher characteristics, communication with parents, and teaching practices).

#### 4.3 Experimental Design

We designed our study as a cluster-randomized trial using a  $3 \times 2$  crosscutting design (Figure 2). After conducting our baseline survey, we provided all school administrators with information about anemia (see our written materials in the online appendix – and which also included a video presentation by a Chinese nutrition specialist), and schools were randomly assigned one of six experimental cells (see Figure 3 for the study timeline). The first three paths of Figure 2 show randomly-assigned incentive groups: a group without incentives (Group A), a “small” incentive group (Group B), and a “large” incentive group (Group C). Across these arm are two orthogonally-assigned block grant groups: a “small” block grant group (Group 1) and a “large” block grant group (Group 2). The reference group in our six-cell design is the default policy (education about anemia coupled with a modest resource transfer and no incentives, Group A1).<sup>36</sup>

To improve power, we used a stratified randomization procedure. Specifically, using joint quintiles of the baseline distribution of school-level hemoglobin concentration

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<sup>36</sup> In a previous study, we find that educating school administrators on anemia (including the same information as in the current study) alone, without incentives or grants, had no detectable impact on anemia rates (Miller et al. 2012). Our reference group also mimics how a recent Chinese school nutrition program (costing 16 billion yuan per year) was designed. Under the program, local education bureaus and schools receive 3 yuan per day per student (4 yuan for boarding students) to provide nutritious meals. How exactly the program is implemented and monitored varies widely across localities.

and combined standardized math and Chinese exam scores – yielding 25 strata, we randomized cell assignment within each stratum. Our analysis takes this randomization procedure into account, conditioning on stratum fixed effects (Bruhn and McKenzie 2009)

*Incentives for Anemia Reduction.* In the large incentive arm (65 schools, Group C in Figure 2), we offered school administrators financial incentives to be paid as private income according to the net reduction in number of students identified as anemic between the beginning and end of the school year. The specific structure of the large incentive contract was:

$$P = \begin{cases} 125 \text{ RMB} * (N_b - N_e) & \text{if } (N_b - N_e) > 0 \\ 0 & \text{otherwise} \end{cases}$$

where  $N_b$  is the number of students found to be anemic at baseline and  $N_e$  is the number of who were anemic at the time of the endline survey.<sup>37</sup> Based on an earlier study (Miller et al. 2012), the contract increment (125 *yuan* (RMB), or about \$19.40<sup>38</sup>) per student reduction was chosen to provide roughly two months of a school administrator's annual salary for a feasible reduction in anemia given previous studies (a reduction of about 50%).<sup>39</sup> Actual payouts for school administrators with the large incentive and small block were ultimately 3,303 *yuan* (or about \$516) – approximately two month's base pay for school administrators in this region. We did not reveal the identity of students who

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<sup>37</sup> We measured anemia using a sample of 50 4<sup>th</sup> and 5<sup>th</sup> graders and calculated the implied number of anemic children in the school using the prevalence rate in our sample.

<sup>38</sup> We use a conversion rate of \$1 = 6.4 RMB, the approximate exchange rate at the time of the baseline survey (September 2011).

<sup>39</sup> There are presumably superior contract structures, but optimal contract design requires substantial information not available to us, including information about the cost of provider effort, the productivity of provider effort, and the utility functions of both providers and the contracting ‘principal’ (Laffont and Tirole 1993; Salanié 2005). Simple, easily understandable contracts may also appear more transparent to school administrators and promote credibility.

were anemic at baseline to administrators (and when we asked teachers to identify students who were anemic at endline, they were unable to do so).<sup>40</sup>

The small incentive arm (40 schools, Group B in Figure 2) was identical to the large incentive arm except that the magnitude of the incremental incentive was ten times smaller (12.5 RMB, or about \$1.95 per student reduction in anemia between baseline and follow-up in our sample). This magnitude of this incentive provides roughly 0.2 additional months of annual salary for the same feasible reduction in anemia given previous studies.

At the time that school administrators signed incentive contracts, they were told the (implied) number of anemic students in their schools (the identity of anemic children was not revealed).<sup>41</sup> Contracts were written using official letterhead of the Chinese Academy of Sciences (a government agency) and counter-signed by the deputy director of the implementing research center (school administrators signed two copies of the contract, one of which they kept). Note that all interventions were implemented in partnership with local education bureaus, signifying to school administrators that the project was sanctioned by local governments.

*Block Grants.* The small block grant (Group 1 in Figure 2) was 0.3 RMB (\$0.05) per student per day (85 schools), which we calculated to be adequate for school administrators to purchase vitamins for each student to take daily. The large block grant (Group 2 in Figure 2) was 0.7 RMB (\$0.11) per student per day (85 schools). In total, small block grant schools received 7,452 yuan (\$1,164) on average and large block grant

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<sup>40</sup> We did reveal the identity of students who were severely anemic (with hemoglobin concentration below 80 g/L) as these students required immediate medical attention. There were 3 such students found at baseline.

<sup>41</sup> Note that administrators in all study cells were provided the same information about the number of anemic children in their respective schools.

schools received 17,388 *yuan* (\$2,717). These grants were given to schools in two installments, once at the beginning of the program and another approximately half way through the school year.<sup>42</sup> Although funds were given in the context of the nutrition program roll out, administrators were explicitly told that they were free to allocate these to other school functions at their discretion.<sup>43</sup>

*Health Education.* Because knowledge about anemia in our study areas was poor, prior to revealing treatment assignment, we provided health education about nutrition and anemia to all school administrators in our study (see online appendix for materials). Our health education materials were based on published, peer-reviewed studies and specifically included information about: 1) the prevalence and causes of anemia, 2) the consequences of anemia (including its effect on cognitive development and academic performance), and 3) efficacious nutritional approaches to reduce anemia (increasing dietary intake of iron-rich foods, nutritional supplementation with iron fortified soy and flour or with supplements, etc.).

#### 4.4 Balance and Attrition

Summary statistics and tests for balance across study arms are shown in Table 1.<sup>44</sup> Panel A shows student level characteristics (N=2051), Panel B shows characteristics of schools (N=167), and Panel C shows characteristics of school administrators

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<sup>42</sup> After explaining block grant assignment to administrators, we asked them to complete a non-binding budget plan for how they intended to use the block grant. Our study team emphasized that this plan was non-binding, but this plan would be used to coordinate orders for iron supplements to be delivered to schools. This was necessary because the market for supplements in rural areas is limited. Administrators were free to change their supplement orders at any time.

<sup>43</sup> Note that while these transfers were not large compared to total school expenditures, they do represent a significant increase in budgetary autonomy for school administrators as the bulk of school expenditures are earmarked for specified uses at higher levels of administration.

<sup>44</sup> This table shows summary statistics and tests balance for our main analysis sample of students initially anemic at baseline. Summary statistics and balance tests for the full sample are given in Appendix Table 1.

(N=167).<sup>45</sup> The first two columns of the table give the mean and standard deviation of each variable in the comparison (small block grant, no incentive) group. Columns (3) – (7) show coefficients on treatment variables and interactions estimated using Equation (12), controlling only for randomization strata fixed effects. The final column shows the p-value from a test that the coefficients are jointly zero for each characteristic. Only 4 of the 75 tests are significant at the 10% level, and a test for joint equality is rejected at the 10% level for only one characteristic (the number of times meat was consumed in the past week).<sup>46</sup> Joint tests for all 15 characteristics reveal no significant differences.<sup>47</sup>

The overall attrition rate between baseline and endline surveys was 6.2% in our sample of children anemic at baseline (5% for the full sample). Defining attrition as a missing hemoglobin measurement at endline for students with a baseline measurement, Appendix Table 2 shows that there were no meaningful differences in attrition across treatment groups (Columns 1 & 2). Analyzing the correlates of a missing household survey at endline conditional on a child not dropping out, Appendix Table 2 also shows that neither the treatment indicators nor other covariates are significantly correlated with a missing household survey form.

#### 4.5 Empirical Strategy

Given random assignment of schools to treatment cells shown in Figure 2, comparisons of outcome variable means across treatment groups provides unbiased

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<sup>45</sup> Although 170 schools were included in the study, no students were found to be anemic in 3 schools at baseline. No schools refused participation in the study. The baseline anemia rate (defined as Hb<120 g/L) in the full sample was 24%.

<sup>46</sup> Because baseline differences in meat consumption could possibly affect results, we repeated all analyses controlling for baseline meat consumption. There were no significant differences in results and very minor differences in point estimates (for example, the effects we estimate for the large anemia incentive and large grant on anemia change less than 0.1 percentage points). These results are available upon request.

<sup>47</sup> These tests were conducted by regressing treatment status on all 15 baseline covariates and testing that the coefficients were jointly zero. The smallest p-value from these F-tests was 0.29.

estimates of the effect of each experimental treatment. However, to increase power (and to account for our stratified randomization procedure), we condition our estimates on a set of covariates used in power calculations. With few exceptions, all of the analyses presented (including outcome variables, regression specifications, and hypotheses tested) were pre-specified in a pre-analysis plan written and filed before endline data were available for analysis.<sup>48</sup> In reporting results below, we explicitly note analyses that deviate from the pre-analysis plan.

As specified in advance, we use ordinary least-squares (OLS) regression to estimate the effect of cell assignment on child-level outcomes with the following specification:

$$Y_{i,j} = \alpha + \beta_1 SI_j + \beta_2 LI_j + \beta_3 LG_j + \beta_4 (SI_j) \times (LG_j) + \beta_5 (LI_j) \times (LG_j) + X'_{i,j} \gamma + \varepsilon_{i,j} \quad (12)$$

where  $Y_{i,j}$  is the outcome for child  $i$  in school  $j$ ;  $SI_j$  is a dummy that equals 1 if the administrator in school  $j$  was assigned to receive a small incentive contract and 0 otherwise;  $LI_j$  is equal to 1 if the administrator in school  $j$  was assigned to receive a large anemia reduction incentive contract;  $LG_j$  is equal to 1 if the school received a large block grant;  $X_{i,j}$  is a vector of child controls (age, class-year, and gender, and baseline value of the outcome variable), school controls (number of students, student-teacher ratio, whether the school has a kitchen, proportion of boarding students, and distance to the farthest village in the school's catchment area); and dummy variables for counties and randomization strata. We adjusted our standard errors for clustering at the school level using the cluster-corrected Huber-White estimator.

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<sup>48</sup> This analysis plan was filed with the Abdul Latif Jameel Poverty Action Lab at <http://www.povertyactionlab.org/Hypothesis-Registry>.

In addition to estimating effects on our two primary outcomes (hemoglobin concentration and a dichotomous indicator for anemia status), we use the same specification to estimate effects on secondary outcomes to examine the behavioral mechanisms underlying changes in primary outcomes. For these secondary outcomes, we focus our analysis on summary indices constructed using groups of closely-related outcome variables (as we specified in advance). To construct these indices, we used the GLS weighting procedure described by Anderson (2008). For each individual, we constructed a variable  $\bar{s}_{ij}$  as the weighted average of  $k$  normalized outcome variables in group ( $y_{ijk}$ ). The weight placed on each outcome variable is the sum of its row entries in the inverted covariance matrix for group  $j$  such that:

$$\bar{s}_{ij} = \left( \mathbf{1}' \widehat{\Sigma}_j^{-1} \mathbf{1} \right)^{-1} \left( \mathbf{1}' \widehat{\Sigma}_j^{-1} \mathbf{y}_{ij} \right)$$

where  $\mathbf{1}$  is a column vector of 1s,  $\widehat{\Sigma}_j^{-1}$  is the inverted covariance matrix, and  $\mathbf{y}_{ij}$  is a column vector of all outcomes for individual  $i$  in group  $j$ . Because each outcome is normalized (by subtracting the mean and dividing by the standard deviation in the sample), the summary index,  $\bar{s}_{ij}$ , is in standard deviation units. In addition to reducing the number of tests required, this weighting procedure can improve efficiency by placing less weight on outcomes that are highly correlated and more weight on those less correlated. The summary index variable can also be created for individuals with a subset of missing outcomes (these outcomes simply receive less weight in the construction of the index). Although we emphasize these indices in our discussion, we also report estimates for each individual index component in Appendix Tables 5 to 8.

A note on correcting for multiple comparisons is also warranted. For our primary outcomes, we test eight null hypotheses: five for treatment main effects and their

interactions (shown in Equation 12)) and three additional ones – that the small and large incentives have the same average effect ( $\beta_1 = \beta_2$ ), that the large incentive and the large block grant have the same average effect ( $\beta_2 = \beta_3$ ), and that the average effect of the large incentive in presence of a large grant is zero ( $\beta_2 + \beta_5 = 0$ ).<sup>49</sup> We therefore adjust our p-values to control the Family Wise Error Rate (FWER). Specifically, we use the free step-down resampling method of Westfall and Young (1993), which accounts for the dependency of the data. For secondary outcomes, we adjust our p-values according to the total number of tests within a family of outcomes (the number of outcomes in the family times five – the number of treatment coefficients in each regression).

## 5. Results: Childhood Anemia and Underlying Behavioral Responses

In this section, we first present results obtained by estimating Equation (12) for anemia status and hemoglobin concentration, and in Section 5.2, we then investigate the underlying behavioral responses that may have produced them. Following our pre-analysis plan, we emphasize estimates from our sub-sample of children who were anemic at baseline. In the Appendix we report results for the full sample of children receiving hemoglobin tests (Appendix Tables 3, 4, 6, and 8).

### 5.1. Childhood Anemia

The first five rows of Table 2 report estimates for each treatment and their interactions (and the seventh row reports comparison group means for the no incentive, small grant group at endline). For each estimate, we report the regression coefficient, the

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<sup>49</sup> We did not pre-specify the last of the eight.

standard error and corresponding p-value, and the p-value adjusted for multiple hypotheses testing.

*Result 1: Large Incentives.* First, we find that the large incentive significantly reduced the probability of anemia at endline. Specifically, the large incentive was associated with a 14 percentage point reduction in anemia (Table 2, Row 2, Column 1; unadjusted p-value=0.001, adjusted p-value=0.064), implying a 37.9% reduction relative to the comparison group (small grant, no incentive schools) at endline. The corresponding increase in hemoglobin was about 2.6 g/L (Table 2, Row 2, Column 2; unadjusted p-value=0.015, adjusted P-value=0.285). These empirical findings agree with our model's prediction derived in Equation (9).

Because our incentives rewarded anemia reduction (and not hemoglobin levels per se) and anemia status reflects shifts in the distribution of altitude adjusted hemoglobin concentrations across the 120g/L threshold, Figure 4A plots the distribution of endline hemoglobin concentrations (adjusted for covariates included in Equation 1) by study arm among children who were anemic at baseline. The distribution for the large incentive group is shifted to the right of the control group distribution (Kolmogorov-Smirnov test p-value=0.02). This relative shift in mass is greater in the left tail of the distribution, implying that the large incentive reduced the share of children falling below the anemia threshold.

*Result 2: Small Incentives.* Second, in contrast, the small incentive had no detectable effect on the probability of anemia at endline (Table 2, Row 1, Column 1).<sup>50</sup> Comparing the estimates for small and large incentives ( $\beta_1 = \beta_2$  in Equation (1)), we

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<sup>50</sup> Note that although the number of schools in the small incentive group is smaller, the standard errors in the small and large incentive arms are similar, but the small incentive coefficient is close to zero (-0.012).

also reject the null hypothesis that the two estimates are equal (Table 2, Row 8, Column 1; adjusted p-value=0.089). Taken together, the estimates for the small and large incentives suggest that the price effect of incentives is meaningful independent of information conveyed by the presence of an incentive contract (Gneezy and Rustichini 2000). Figure 4A shows that the shift in the hemoglobin distribution for the small incentive arm relative to the control group arm is smaller – particularly in the left tail of the distribution.

An important question in the literature on financial incentives is whether or not they crowd-out intrinsic or pro-social motivation (Deci and Ryan 1985; Gneezy and Rustichini 2000; Fehr and Falk 2002; Francois and Vlassopoulos 2008; Gneezy, Meier, and Rey-Biel 2011; Kamenica 2012). We find that the small incentive increased the anemia rate by 31 percentage points (adjusted p-value= 0.038) amongst school administrators who score higher at baseline on a pro-sociality scale (adapted from Grant (2008)). We also find a similar effect for intrinsic motivation (also adapted from Grant (2008)), but it is not statistically significant (coefficient = 0.15, adjusted p-value = 0.60). However, the effect of the large incentive is not heterogeneous by pro-social or intrinsic motivation (the coefficients are close to zero and not statistically significant), implying that if monetary incentives are large, crowding-out of pro-social motivation may be overcome by extrinsic motivation provided by incentives.

*Result 3: Large Block Grants.* Third, in the absence of any explicit incentive, the large block grant alone reduced the probability of student anemia at endline (an unambiguous prediction of our model, as Equation 8 shows). Specifically, Table 2 (Column 1, Row 3) shows that the large block grant was associated with a 14.5 percentage point reduction in anemia (adjusted p-value=0.047), implying a 39.8%

reduction relative to the comparison group at endline. This reduction is very similar to the effect of the large incentive (-0.145 vs. -0.138), but the average increase in hemoglobin concentration is larger (4.205 vs. 2.567), although not statistically so (Table 2, Row 9, Column 2; adjusted p-value=0.597).

*Result 4: Substitution between Large Incentives and Large Block Grants.* Our model in Section 2 predicts that incentives and block grants will be substitutes unless there are investments requiring substantial resources – but that substantially enhance the productivity of effort. Empirically, we find that large incentives and block grants are indeed substitutes. Table 2 (Column 1, Row 5) shows that the estimate for the interaction between the large incentive and the large block grant ( $\beta_5$  in Equation 12) is positive and statistically significant (adjusted p-value=0.072). Strikingly, the magnitude of substitution implies that the large incentive and the large block grant fully crowd-out each other. Specifically, the marginal effect of the large incentive given the large block grant in Column 1 ( $\beta_2 + \beta_5 = 0.058$ ) is not statistically different from zero (adjusted p-value = 0.65) for the probability of anemia.

Our model in Section 2 illustrates the likely source of this substitution. The effect of incentives on the use of anemia-reducing inputs is proportional to the marginal productivity of the hemoglobin inputs (see Equation (9) in Section 2). If the quantity of inputs is relatively large given the large block grant, the marginal productivity of additional inputs (and hence their use) will be close to zero.

## 5.2. Behavioral Responses Underlying Changes in Anemia

We next examine the underlying behavioral responses to our interventions that may have produced the changes in anemia described in Section 5.1. To do so, we focus

on actions taken by administrators and subsequent responses among students and their parents – specifically, student consumption of iron-rich foods, direct iron supplementation, communication between parents and schools about anemia and its nutritional basis. For each family of outcome variables, we examine indices as described in Section 4.5.

*Behavioral Responses Underlying Result 1: Large Incentives.* We first consider the behavioral responses underlying Result 1 – that in the presence of the small block grant, the large incentive significantly reduced the probability of student anemia. Table 3 shows that the large incentive led administrators to increase vitamin supplementation and the provision of iron-rich foods by 0.14 standard deviations (sd) (Column 1, Row 2; adjusted p-value 0.104). This increase in iron-rich foods seems driven largely by home consumption (Row 2, Column 5, 0.187 sd, adjusted p-value 0.090).<sup>51</sup>

An interesting issue is if the increase in vitamin supplementation and provision of iron-rich foods occurred because school administrators with large incentives spent the block grant differently – or instead because they exerted more effort. As Figure 5 shows, reported use of block grants for different types of nutrition interventions (vitamins, food, fortification), and other uses is similar for incentive and non-incentives schools receiving a small grant, suggesting that greater anemia reduction due to incentives is driven by effort rather than differential allocation of the block grant.

In exploring how administrators were able to increase child consumption of iron rich foods at home, we examine contact with parents. Row 2, Column 8 of Table 3 reports a positive (but insignificant) increase in school contact of 0.130 standard

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<sup>51</sup> Sub-indices for supplements and food (including separate indices for food at home and school) were not explicitly specified in the pre-analysis plan.

deviations. However, Appendix Table 7 shows that estimates for several components of this index appear meaningful and important, albeit insignificant at conventional levels using adjusted p-values (largely because of the large number of hypotheses being tested ( $11 \times 5 = 55$ ).<sup>52</sup> These results are suggestive that the large incentive led administrators to engage more regularly with households – specifically about nutrition and anemia – which in turn appears to have improved children’s diets at home.

The finding that administrators responded to large incentives by engaging with households is important for at least two related reasons. First, it demonstrates innovation and the use of local knowledge in response to performance incentives that reward outputs (health outcomes) as opposed to those that rigidly reward the use of pre-specified inputs (such as vitamin consumption at school), as most performance incentives in the health sector do (Miller and Singer Babiarz, 2014). Second, for outcomes jointly produced with beneficiary households (like good child nutrition), it demonstrates the potential of performance incentives that reward outputs to minimize offsetting compensatory behavior among beneficiaries (a common finding among studies of school lunch programs, for example) (Jacoby 2002; Leonard 2003; Das et al. 2013).<sup>53</sup>

*Behavioral Responses Underlying Result 2: Small Incentives.* Second, we study the behavioral responses underlying Result 2 – that the small incentive did not reduce

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<sup>52</sup> Specifically, the number of individual meetings between administrators and households over the past semester increased by 0.52 (Column 2, Row 2) – an increase of 59%; whether or not schools contacted parents about nutrition in the past semester rose by 12 percentage points (Column 3, Row 2) – an increase of 29%; and whether or not schools contacted parents about feeding children iron-rich foods rich in the past semester rose by 10 percentage points (Column 4, Row 2) – an increase of 47%. Note that the number of school-wide parent meetings and number of individual meetings with parents were not pre-specified to be part of this index.

<sup>53</sup> We speculate that the bureaucratic environment is one reason that administrators chose to work through households. Administrators may have viewed this strategy as a way to reduce anemia (and increase rewards) while avoiding the risk of career harm due to possible adverse events. This career harm may also be more severe under incentives if incentives altered perceptions of administrators’ motivation for reducing anemia (analogous to how incentives may crowd-out effort if they alter the motives for prosocial tasks perceived by others – Bénabou and Tirole (2006)).

anemia prevalence. Table 3 (Column 1) shows that administrators with small incentives did not significantly increase the provision of supplements or Food (Row 1, Columns 1 to 3), nor did they increase their contact with households (Column 8) (Appendix Table 7, Row 1 also shows that none of the individual components of this index are statistically significant (even using unadjusted p-values).

*Behavioral Responses Underlying Result 3: Large Block Grants.* Third, we examine behavioral responses to large block grants, which reduced the prevalence of student anemia. The large block grant increased the provision of supplements and food by 0.22 sd (Table 3, Row 3, Column 1; adjusted p-value 0.006). This increase appears due to increases in both iron supplements (Column 2, 0.24 sd, adjusted p-value 0.051) and iron-rich food (Column 3, 0.196 sd, adjusted p-value 0.062).

Interestingly, the large block grant may have also increased school contact with parents – suggesting that administrators worked through households to reduce anemia without any explicit incentives to do so. Although the estimate for the index in Table 3 is not statistically significant (Row 3, Column 8), some estimates for index components are larger than those for incentives. This may reflect intrinsic or prosocial motivation – or a sense of obligation or organizational mission (Ashraf, Bandiera, and Jack, 2014). Furthermore, although the large block grant increased communication with households, the impact of block grants on food consumption at home is insignificant. We speculate that this could reflect less effort (relative to administrators with incentives) devoted to mitigating compensatory behavior by households in response to greater food provision at school (which seems to have increased, although not significantly, with large grants).

*Behavioral Responses Underlying Result 4: Substitution between Large Incentives and Large Block Grants.* Finally, with the combination of large incentives and large block grants, we find direct evidence of crowding-out of inputs consistent with our anemia estimates in Table 2 and with our model (Equation (11)). Specifically, Table 3 shows that for vitamin supplementation and consumption of iron-rich foods (both at school and at home), estimates for the interaction between the large incentive and large block grant are negative (Row 5).

We note that administrators' reported use of block grants is consistent with the behavioral responses described above. Although we lack adequate power to test for differences in block grant use at the school level, administrators with large block grants and large incentives report spending more on tasks unrelated to anemia reduction (Figure 5).

### 5.3. Cost-Effectiveness

Finally, we examine the cost-effectiveness of each of our intervention combinations. In doing so, we consider both the sub-sample of children anemic at baseline and our full sample of children, and we present both “programmatic” cost-effectiveness (direct monetary program costs to the implementing organization) and social cost-effectiveness calculations. We calculate total social costs as the sum of: (a) programmatic costs; (b) the cost of public funds; and (c) costs incurred by households in responding to the interventions. From social costs we exclude incentive payments (apart from their contribution the cost of public funds), considering these payments to be transfers (incentive payments may also not be considered a cost, but rather simply another way of allocating salary expenditures – Muralidharan and Sundararaman 2011).

Appendix Table 9 presents these results.<sup>54</sup> The key finding that we highlight is that although large block grants were as effective in reducing student anemia as large incentives, they were more expensive. First, considering full social costs and using the full sample, the cost per case of anemia averted was 1,453 yuan (about \$227) in the large incentive/small block grant group – but 44% larger in the large block grant group (2,099 yuan, or about \$328). Second, the cost-effectiveness of these two interventions relative to each other is similar when we restrict our calculations to children anemic at baseline (as we do in Sections 4 and 5, following our pre-analysis plan). Specifically, the large incentive/small block grant intervention is approximately 50% more cost effective than large block grant intervention without incentives (723 yuan, or \$113, per case of anemia averted vs. 1,447 yuan, or \$226). Finally, considering calculating only programmatic costs and using children anemic at baseline, the cost-effectiveness of the large incentive/small block grant intervention is roughly one third of that of the large block grant (114 yuan, or about \$18 vs 331 yuan, or about \$52).<sup>55</sup>

## 6. Conclusion

This paper provides new evidence on how the provision of public sector services responds to performance incentives. Relative to the existing literature, its contributions include the use of performance pay rewarding outputs of health production (good health outcomes) and its targeting of bureaucratic managers (school administrators) – both of which hold promise for inducing incentivized agents to use their knowledge of local

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<sup>54</sup> See table notes for further details about these calculations.

<sup>55</sup> Although the superior cost-effectiveness of large incentives over larger resources strictly applies only to the specific incentive/block grant contracts that we implemented, similar results are reported by others comparing incentive contracts with in-kind input transfers (Lavy 2002, Muralidharan and Sundararaman, 2011).

contexts to innovate in service delivery. Additionally, to the best of our knowledge, it is the first study to analyze how behavioral responses to performance pay interact with exogenously assigned levels of resources – a critical issue in service delivery under severe resource constraints, as is common in many developing countries.

We report four key findings. First, when school administrators have fewer budgetary resources available to them, large performance incentives (with realized payments equivalent to a couple of months of annual salary) lead to substantial improvement in service delivery. This seems driven by greater effort rather than changes in budgetary resource allocation. In particular, school administrators demonstrated the ability to innovate, working through their students' parents to alter nutritional practices at home. Second, smaller incentives (one tenth the size of the larger ones) were ineffective on average and had negative effects on pro-socially motivated administrators. Third, even absent explicit performance incentives, increasing school administrators' budgets led to important improvements in performance (but was considerably less cost-effective than using performance incentives), implying the presence of other motives – potentially including intrinsic ones – in our context.

Fourth, and importantly, we find that performance pay and budget resources are substitutes in health production. The degree of substitution is substantial: at the policy-relevant levels that we study, increasing the size of unconditional block grants completely crowds-out the effect of incentives (and vice-versa). This finding is consistent with our model's predictions that the effect of incentives will be small when budgetary resources are large because the marginal productivity of anemia-reducing inputs approaches zero – and our empirical results suggest that this happens quite quickly. This is an important

result for resource-poor environments in which both budgetary resources and performance incentives are used simultaneously as policy levers for improving the quality of public service delivery.

Overall, among public sector administrators in rural China, we find evidence that appropriately designed performance incentives (sufficiently large, and absent substantial discretionary resources) can improve public sector service delivery – and ultimately, child outcomes. Despite the bureaucratic environment, our study suggests that performance pay can be an effective approach to motivating public sector managers.

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Figure 1: Study Regions



Figure 2: Experimental Design

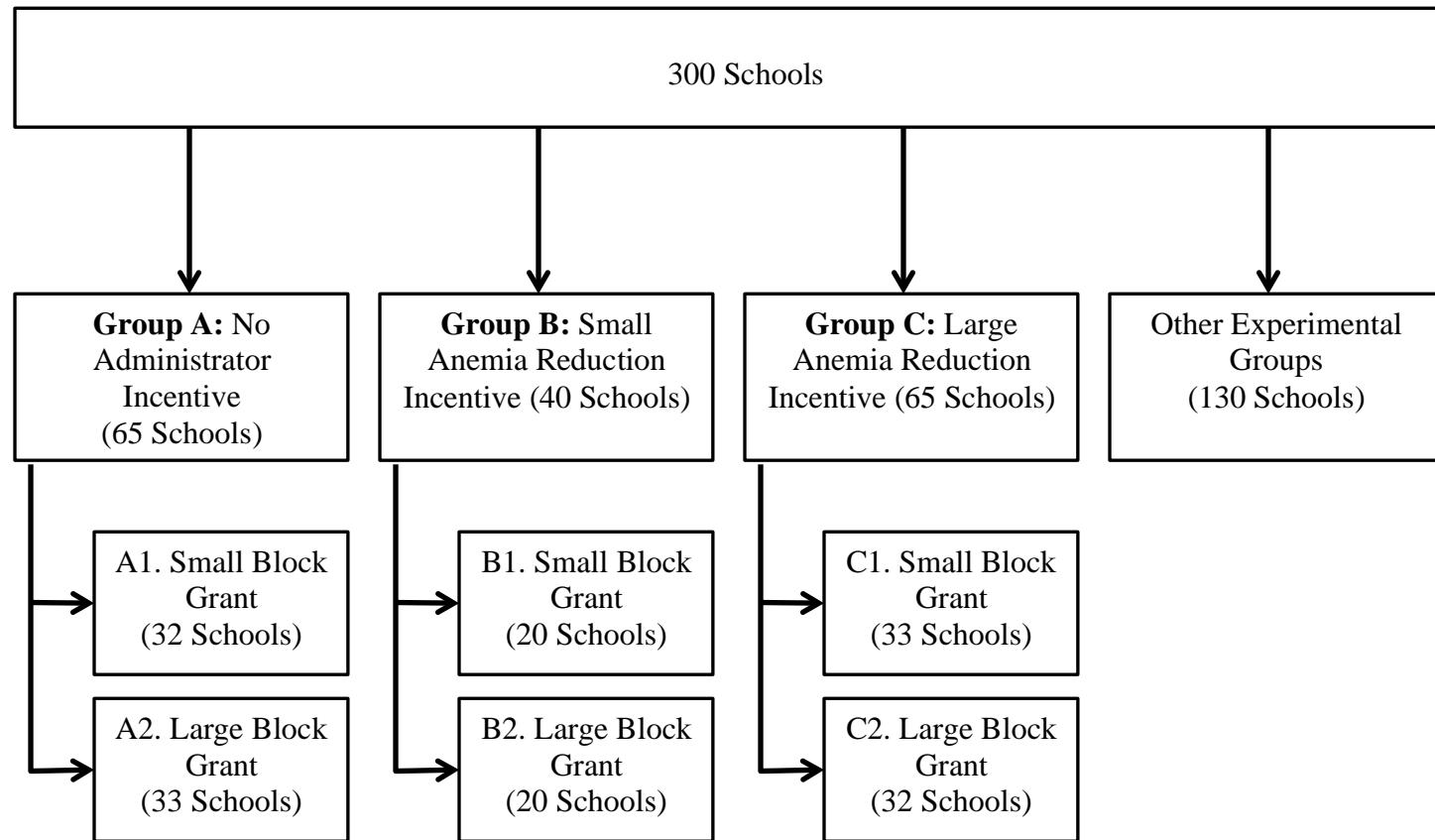


Figure 3: Data Collection and Intervention Timeline

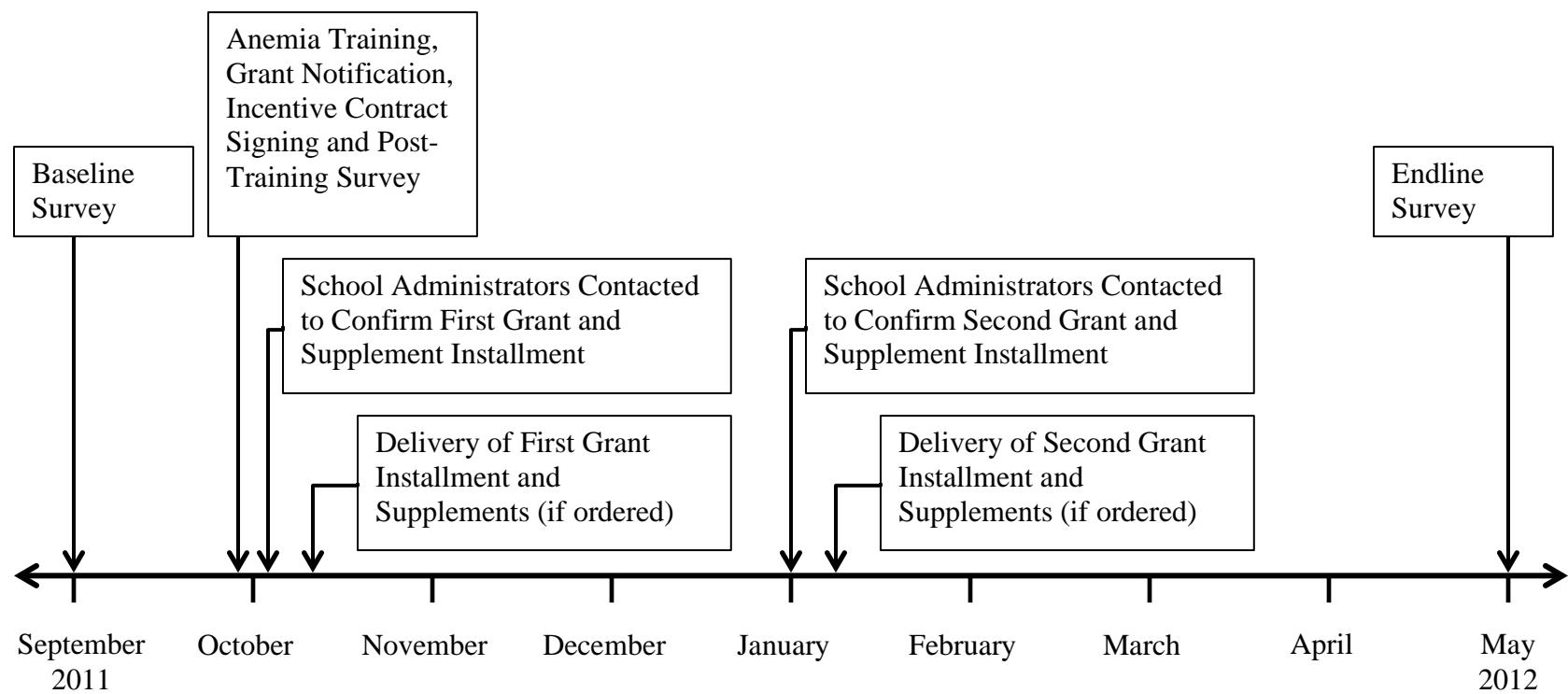


Figure 4: Distributions of Hemoglobin Concentration

Figure 4A: Small Block Grant

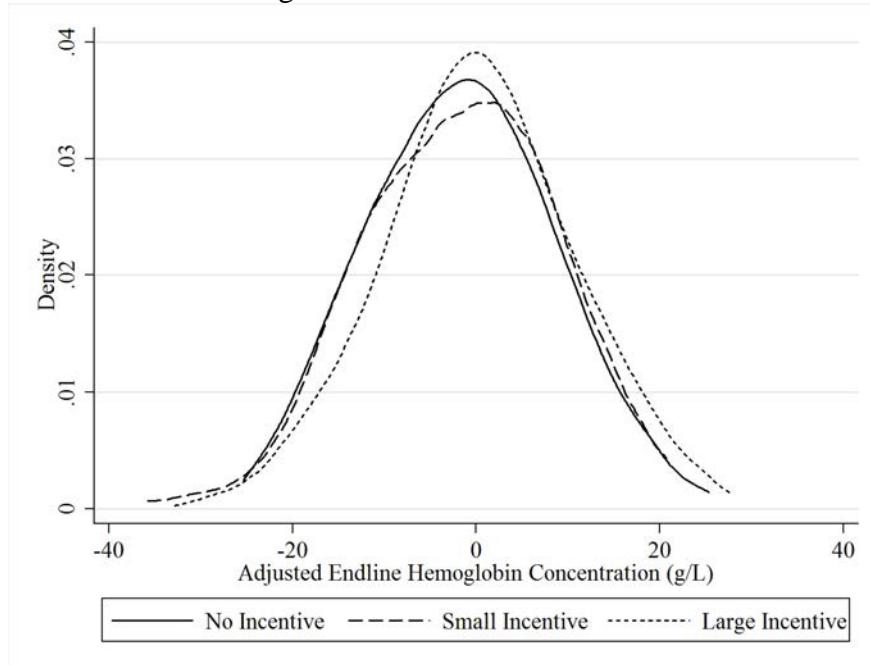
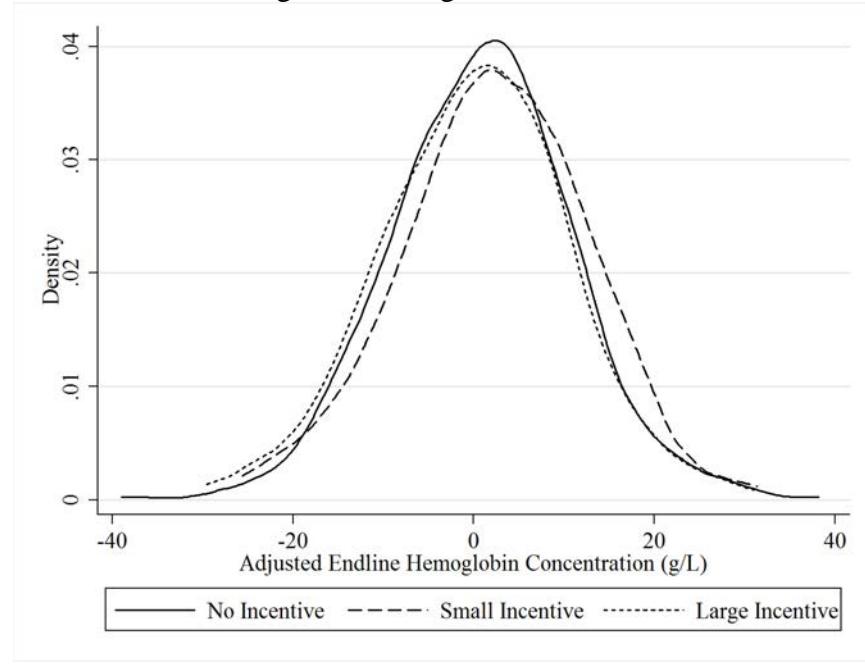
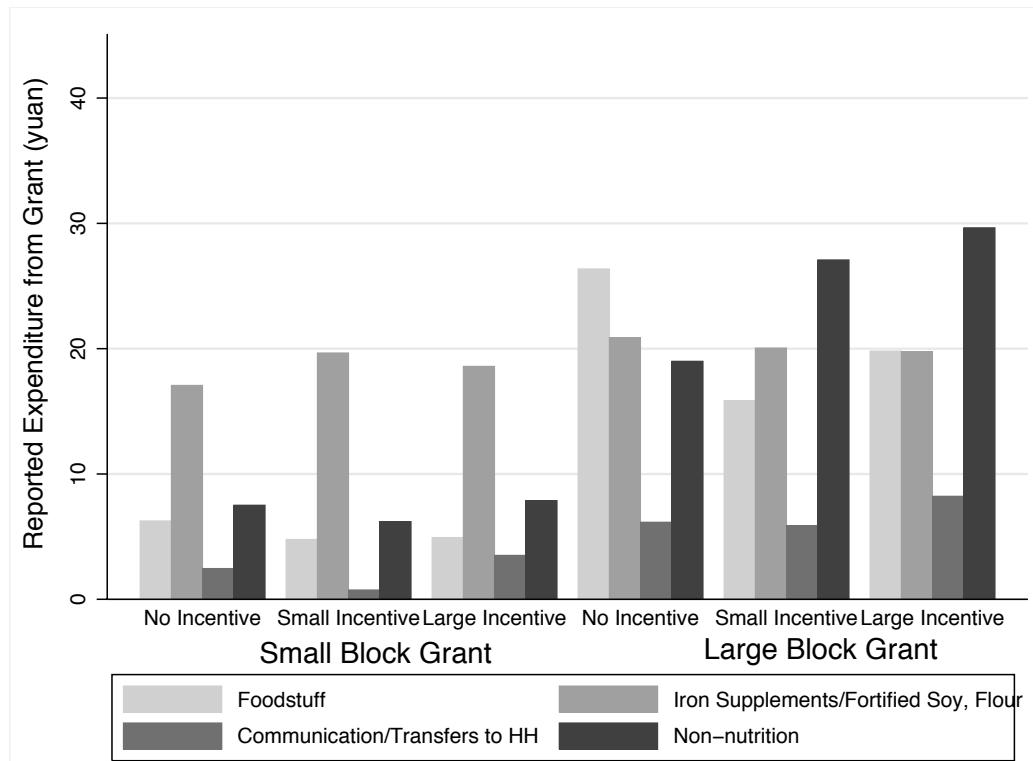


Figure 4B: Large Block Grant



NOTES: Figures plot the distributions of student level hemoglobin concentrations (in g/L) at endline across incentive treatment groups separately by small and large block grant groups. Endline Hb concentrations are adjusted for pre-specified baseline control variables. Kolmogorov-Smirnov P-values for Small Anemia Incentive vs. No Incentive are in 0.93 Panel A and 0.12 in Panel B. For Large Anemia vs. No Incentive these are in 0.02 Panel A and 0.24 in Panel B.

Figure 5: Reported Use of Block Grants by Category



NOTES: Figure shows mean values of reported use of block grants by experimental group from the endline survey. Expenditure amounts are per student.

**Table 1: Descriptive Statistics and Balance Check**

	No Incentive, Small Grant Group		Coefficient (standard error) on:						Joint Test P-value: All Coefficients=0	Observations
	Mean	SD	Small Incentive	Large Incentive	Large Grant	(Small-Incentive)X (Large Grant)	(Large Incentive)X (Large Grant)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
<b>Panel A: Child Characteristics</b>										
(1) Hemoglobin Concentration (g/L)	118.446	7.541	-0.965 (1.326)	-1.525 (1.163)	-0.653 (1.438)	2.868 (1.959)	1.479 (1.761)	0.420	2051	
(2) Age (years)	10.514	1.153	0.046 (0.166)	0.077 (0.125)	0.113 (0.134)	-0.002 (0.242)	-0.070 (0.189)	0.914	2051	
(3) 5th Grade (0/1)	0.468	--	0.055* (0.032)	-0.002 (0.029)	-0.003 (0.031)	-0.106** (0.050)	0.016 (0.042)	0.177	2051	
(4) Female (0/1)	0.530	--	0.003 (0.044)	-0.021 (0.035)	-0.009 (0.039)	0.001 (0.060)	0.044 (0.052)	0.945	2051	
(5) Times Consumed Meat in Past Week (incl. Chicken, Pork, Beef, Lamb)	3.922	4.145	-0.534 (0.618)	-1.293*** (0.453)	-0.352 (0.709)	-0.039 (0.888)	0.909 (0.790)	0.091*	2051	
<b>Panel B: School Characteristics</b>										
(6) Number of Students	203.733	55.788	2.424 (16.959)	7.060 (14.194)	-1.925 (15.304)	21.948 (25.245)	9.631 (20.780)	0.725	167	
(7) Has Kitchen (0/1)	0.067	--	0.135 (0.099)	0.068 (0.077)	0.054 (0.085)	-0.071 (0.161)	-0.052 (0.120)	0.732	167	
(8) Student-Teacher Ratio	16.192	4.356	2.859** (1.377)	1.190 (1.216)	0.019 (1.182)	-1.804 (1.928)	0.866 (1.678)	0.185	167	
(9) Time to Furthest Village Served (mins)	61.167	37.570	12.294 (13.474)	-2.256 (11.962)	4.020 (12.520)	-7.468 (21.139)	4.605 (17.681)	0.918	167	
(10) Percent Boarding Students (%)	4.277	9.493	2.228 (3.976)	0.756 (2.899)	1.310 (3.400)	-0.757 (6.204)	-1.804 (5.107)	0.985	167	
<b>Panel C: School Administrator Characteristics</b>										
(11) Male (0/1)	0.967	--	-0.015 (0.051)	0.028 (0.032)	0.038 (0.034)	0.014 (0.053)	-0.070 (0.046)	0.606	167	
(12) Age (years)	39.567	7.398	1.550 (2.112)	1.299 (1.837)	1.599 (1.882)	-4.730 (3.022)	0.090 (2.601)	0.383	167	
(13) Higher Education Degree (0/1)	0.900	--	0.018 (0.092)	-0.007 (0.081)	-0.107 (0.093)	0.032 (0.136)	-0.007 (0.126)	0.558	167	
(14) Experience (years)	8.333	6.227	-0.194 (1.531)	1.124 (1.786)	0.898 (1.630)	-2.761 (2.210)	-0.165 (2.577)	0.137	167	
(15) Monthly Base Salary (yuan)	1855.067	706.106	-57.049 (196.310)	-110.575 (178.286)	-36.880 (182.302)	-312.491 (305.716)	-35.944 (247.052)	0.602	167	

NOTES. Data source: baseline survey. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). The first and second columns show the mean and standard deviation in the comparison (small grant, no incentives) group. Columns 3 through 7 show coefficients and standard errors from a regression of each characteristic on indicators for incentive and large grant treatment group indicators and their interactions, controlling for randomization strata. Column 8 shows the p-value from a test that coefficients are jointly zero. All tests account for clustering at the school level. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1%.

**Table 2: Impacts of School Administrator Anemia Reduction Incentives and Block Grant Size on Student Hemoglobin Concentration and Anemia Prevalence**

Dependent Variable:	Anemic at Endline (Hb<120 g/L)	Hemoglobin Concentration (g/L)
	(1)	(2)
<b>Panel A: Impacts Relative to Comparison (No Incentive, Small Grant) Group</b>		
(1) Small Incentive	-0.012 (0.040) [0.771] {0.972}	-0.387 (1.101) [0.726] {0.792}
(2) Large Incentive	-0.138* (0.039) [0.001] {0.064}	2.567 (1.044) [0.015] {0.285}
(3) Large Grant	-0.145** (0.038) [<0.001] {0.047}	4.205** (1.123) [<0.001] {0.045}
(4) (Small Incentive)X(Large Grant)	-0.042 (0.056) [0.453] {0.888}	1.445 (1.541) [0.350] {0.664}
(5) (Large Incentive)X(Large Grant)	0.196* (0.058) [<0.001] {0.072}	-4.580 (1.586) [0.004] {0.173}
(6) Observations	1923	1923
(7) Mean in No Incentive, Small Grant Group	0.364	129.901
<b>Panel B: P-values of Additional Comparisons</b>		
(8) Large vs. Small Incentive	[0.002] {0.089}	[0.014] {0.285}
(9) Large Incentive vs. Large Grant	[0.854] {0.972}	[0.169] {0.597}
(10) Large Incentive vs. Large Incentive + Large Grant	[0.141] {0.650}	[0.080] {0.511}

NOTES. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). Rows 1-5 in Panel A show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for baseline hemoglobin concentration, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values. Panel B shows unadjusted and adjusted p-values from tests between coefficients.

**Table 3: Child and Household Reported Receipt of Supplements and Iron-Rich Food**

Dependent Variable:	Index: Supplements and Food	Sub-index: Supplements	Sub-index: Food	Sub-index: Food at School	Sub-index: Food at Home	Index: Information	Sub-index: Information to Students	Sub-index: Information to Households
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Small Incentive	0.069 (0.053) [0.201] {0.336}	0.138 (0.084) [0.104] {0.234}	-0.022 (0.049) [0.657] {0.750}	-0.083 (0.061) [0.179] {0.475}	0.072 (0.061) [0.243] {0.403}	0.027 (0.075) [0.724] {0.935}	0.062 (0.126) [0.623] {0.911}	0.045 (0.084) [0.594] {0.690}
(2) Large Incentive	0.144 (0.052) [0.006] {0.104}	0.158 (0.080) [0.052] {0.234}	0.131 (0.048) [0.008] {0.101}	0.106 (0.060) [0.079] {0.426}	0.187* (0.064) [0.004] {0.090}	0.070 (0.072) [0.332] {0.800}	0.111 (0.101) [0.272] {0.796}	0.130 (0.084) [0.124] {0.430}
(3) Large Grant	0.221*** (0.048) [0.000] {0.006}	0.241* (0.072) [0.001] {0.051}	0.196* (0.063) [0.002] {0.062}	0.220 (0.085) [0.010] {0.175}	0.189 (0.075) [0.013] {0.126}	0.162 (0.076) [0.034] {0.326}	0.136 (0.107) [0.207] {0.768}	0.233 (0.113) [0.041] {0.352}
(4) (Small Incentive)X(Large Grant)	-0.208 (0.078) [0.008] {0.104}	-0.269 (0.116) [0.021] {0.186}	-0.113 (0.088) [0.201] {0.508}	-0.108 (0.107) [0.314] {0.475}	-0.150 (0.105) [0.157] {0.403}	-0.037 (0.123) [0.766] {0.935}	0.190 (0.178) [0.288] {0.796}	-0.314 (0.148) [0.036] {0.352}
(5) (Large Incentive)X(Large Grant)	-0.301** (0.072) [0.000] {0.011}	-0.289 (0.106) [0.007] {0.124}	-0.314** (0.088) [0.000] {0.030}	-0.362* (0.107) [0.001] {0.050}	-0.292 (0.110) [0.009] {0.122}	-0.117 (0.108) [0.282] {0.800}	-0.039 (0.151) [0.797] {0.911}	-0.356 (0.146) [0.016] {0.271}
(6) Observations	1932	1932	1928	1925	1927	1932	1928	1548
(7) Mean in No Incentive, Small Grant Group	-0.044	-0.055	-0.048	-0.043	-0.053	-0.040	-0.017	-0.082

NOTES. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). The dependent variable in each regression is a summary index constructed using the GLS weighting procedure in Anderson (2008). Estimates for the individual components of each index are shown in Appendix Tables 5 and 6. Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

**Appendix Table 1: Descriptive Statistics and Balance Check (Full sample)**

	No Incentive, Small Grant Group		Coefficient (standard error) on:							Joint Test P- value: All Coefficients=0	Observations
	Mean	SD	Small Incentive	Large Incentive	Large Grant	(Small- Incentive)X (Large Grant)	(Large Incentive)X (Large Grant)				
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>Panel A: Child Characteristics</b>											
(1) Hemoglobin Concentration (g/L)	134.191	12.912	-0.912 (1.127)	-1.192 (1.009)	0.514 (1.028)	0.140 (1.501)	-0.021 (1.476)	0.541	8398		
(2) Anemic (0/1)	0.233	0.423	0.024 (0.017)	0.017 (0.019)	-0.015 (0.018)	-0.001 (0.024)	0.003 (0.025)	0.222	8398		
(3) Age (years)	10.713	1.173	-0.172 (0.128)	-0.041 (0.111)	-0.030 (0.106)	0.352* (0.185)	-0.013 (0.144)	0.379	8398		
(4) 5th Grade (0/1)	0.531	0.499	-0.002 (0.006)	0.001 (0.006)	-0.005 (0.008)	0.007 (0.011)	0.001 (0.010)	0.941	8398		
(5) Female (0/1)	0.485	0.500	0.003 (0.020)	-0.008 (0.017)	-0.009 (0.019)	0.024 (0.030)	0.010 (0.025)	0.808	8398		
(6) Times Consumed Meat in Past Week (incl. Chicken, Pork, Beef, Lamb)	3.826	3.966	-0.194 (0.435)	-1.174*** (0.316)	-0.402 (0.442)	-0.432 (0.604)	0.962* (0.550)	0.002***	8398		
<b>Panel B: School Characteristics</b>											
(7) Number of Students	207.094	64.823	-1.276 (17.567)	3.623 (14.959)	-5.396 (16.043)	25.344 (25.554)	12.357 (20.856)	0.797	170		
(8) Has Kitchen (0/1)	0.063	0.246	0.141 (0.101)	0.074 (0.075)	0.059 (0.083)	-0.075 (0.162)	-0.068 (0.120)	0.681	170		
(9) Student-Teacher Ratio	16.228	4.227	2.538* (1.354)	0.893 (1.210)	-0.286 (1.159)	-1.506 (1.911)	1.064 (1.657)	0.257	170		
(10) Time to Furthest Village Served (mins)	62.031	36.695	12.218 (13.109)	-2.281 (11.564)	3.878 (12.945)	-7.346 (21.467)	3.764 (17.794)	0.921	170		
(11) Percent Boarding Students (%)	5.327	11.404	1.511 (4.112)	0.106 (3.006)	0.610 (3.492)	-0.079 (6.293)	-1.611 (5.179)	0.991	170		
<b>Panel C: School Administrator Characteristics</b>											
(12) Male (0/1)	0.938	0.246	0.015 (0.058)	0.056 (0.041)	0.065 (0.042)	-0.012 (0.059)	-0.093* (0.051)	0.488	170		
(13) Age (years)	39.313	7.253	1.883 (2.047)	1.620 (1.777)	1.892 (1.831)	-5.022* (2.957)	-0.399 (2.560)	0.351	170		
(14) Higher Education Degree (0/1)	0.906	0.296	0.002 (0.089)	-0.022 (0.078)	-0.122 (0.090)	0.047 (0.133)	0.010 (0.122)	0.506	170		
(15) Experience (years)	8.031	6.141	-0.242 (1.472)	1.088 (1.729)	0.838 (1.569)	-2.706 (2.156)	-0.310 (2.520)	0.141	170		
(16) Monthly Base Salary (yuan)	1854.750	692.449	-48.275 (190.039)	-103.680 (175.240)	-26.684 (178.777)	-321.983 (304.280)	-17.503 (242.283)	0.641	170		

NOTES. Data source: baseline survey. Table uses full sample of children tested for hemoglobin concentration. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). The first and second columns show the mean and standard deviation in the comparison (small grant, no incentives) group. Columns 3 through 7 show coefficients and standard errors from a regression of each characteristic on indicators for incentive and large grant treatment group indicators and their interactions, controlling for randomization strata. Column 8 shows p-values from a test that coefficients are jointly zero. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1%.

**Appendix Table 2: Attrition**

Dependent Variable:	Hb Measurement Missing at Endline	Household Survey Missing at Endline		
	(1)	(2)	(3)	(4)
<b>Panel A: Treatments and Interactions</b>				
(1) Small Incentive	0.014 (0.019) [0.473] {0.892}	0.017 (0.020) [0.404] {0.851}	0.164 (0.100) [0.102] {0.546}	0.176 (0.099) [0.078] {0.529}
(2) Large Incentive	-0.027 (0.017) [0.127] {0.545}	-0.027 (0.017) [0.117] {0.546}	0.124 (0.081) [0.126] {0.546}	0.133 (0.081) [0.102] {0.529}
(3) Large Grant	0.010 (0.023) [0.647] {0.893}	0.009 (0.022) [0.703] {0.932}	0.019 (0.098) [0.846] {0.890}	0.042 (0.104) [0.689] {0.931}
(4) (Small Incentive)X(Large Grant)	-0.059 (0.031) [0.056] {0.400}	-0.063 (0.031) [0.042] {0.372}	-0.233 (0.139) [0.095] {0.546}	-0.265 (0.149) [0.077] {0.529}
(5) (Large Incentive)X(Large Grant)	-0.007 (0.031) [0.835] {0.893}	0.000 (0.031) [0.992] {0.994}	0.069 (0.140) [0.626] {0.890}	0.044 (0.139) [0.750] {0.931}
<b>Panel B: Child Characteristics</b>				
(6) Baseline Hemoglobin Concentration (g/L)	-0.000 (0.001)	-0.000 (0.001)	0.001 (0.001)	0.001 (0.001)
(7) Age (years)		0.013* (0.007)		-0.010 (0.009)
(8) 5th Grade (0/1)		-0.011 (0.011)		0.007 (0.023)
(9) Female (0/1)		-0.018 (0.013)		-0.019 (0.014)
<b>Panel C: School Characteristics</b>				
(10) Number of Students		-0.000 (0.000)		0.001 (0.001)
(11) Has Kitchen (0/1)		0.006 (0.025)		0.143 (0.112)
(12) Student-Teacher Ratio		-0.001 (0.002)		-0.006 (0.007)
(13) Time to Furthest Village Served (mins)		-0.000 (0.000)		0.000 (0.001)
(14) Percent Boarding Students (%)		-0.000 (0.001)		-0.003 (0.003)
(15) "Free Lunch" Policy School		0.019 (0.056)		-0.167 (0.258)
(16) Constant	0.118 (0.103)	0.027 (0.124)	-0.095 (0.243)	0.117 (0.412)
(17) Observations	2051	2051	1923	1923
(18) R-squared	0.046	0.051	0.334	0.347
(19) Mean in No Incentive, Small Grant Group	0.087		0.154	

NOTES. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). The dependent variable in columns 1 and 2 is a dummy variable indicating missing hemoglobin measurements at endline. The dependent variable in columns 3 and 4 is a dummy variable indicating missing household forms at endline conditional on a child's hemoglobin measurement being non-missing. In addition to what is shown regressions also control for county and randomization strata fixed effects. Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1%. based on adjusted p-values.

**Appendix Table 3: Effects of School Administrator Anemia Reduction Incentives and Block Grant Size on Student Hemoglobin Concentration and Anemia Prevalence (Full Sample)**

Dependent Variable:	Anemic at Endline (Hb<120 g/L)	Hemoglobin Concentration (g/L)
	(1)	(2)
<b>Panel A: Treatment Effect Regressions</b>		
(1) Small Incentive	-0.028 (0.020) [0.163] {0.587}	1.054 (0.987) [0.287] {0.747}
(2) Large Incentive	-0.045 (0.022) [0.046] {0.373}	0.918 (0.946) [0.333] {0.767}
(3) Large Grant	-0.073** (0.021) [0.001] {0.049}	2.872 (0.989) [0.004] {0.117}
(4) (Small Incentive)X(Large Grant)	0.027 (0.027) [0.321] {0.647}	-0.857 (1.340) [0.523] {0.829}
(5) (Large Incentive)X(Large Grant)	0.086 (0.031) [0.006] {0.149}	-3.312 (1.404) [0.019] {0.235}
(6) Observations	7945	7945
(7) Mean in No Incentive, Small Grant Group	0.176	136.334
<b>Panel B: P-values for Additional Hypotheses</b>		
(8) Large vs. Small Incentive	[0.383] {0.647}	[0.884] {0.908}
(9) Large Incentive vs. Large Grant	[0.146] {0.587}	[0.036] {0.301}
(10) Large Incentive vs. Large Incentive + Large Grant	[0.038] {0.373}	[0.013] {0.209}

NOTES. Table uses full sample of children tested for hemoglobin concentration. Rows 1-5 in Panel A show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for baseline hemoglobin concentration, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1%. based on adjusted p-values. Panel B shows unadjusted and adjusted p-values from tests between coefficients.

**Appendix Table 4: Child and Household Reported Receipt of Supplements and Iron-Rich Food (Full Sample)**

Dependent Variable:	Index: Supplements and Food	Sub-index: Supplements	Sub-index: Food	Sub-index: Food at School	Sub-index: Food at Home	Index: Information	Sub-index: Information to Students	Sub-index: Information to Households
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Small Incentive	0.128** (0.048) [0.008] {0.037}	0.191* (0.072) [0.008] {0.083}	0.047 (0.036) [0.192] {0.293}	0.004 (0.050) [0.933] {0.946}	0.126 (0.049) [0.011] {0.126}	0.079 (0.069) [0.250] {0.504}	0.197 (0.116) [0.092] {0.390}	-0.002 (0.076) [0.984] {0.986}
(2) Large Incentive	0.155** (0.049) [0.002] {0.031}	0.191* (0.075) [0.011] {0.083}	0.114* (0.040) [0.005] {0.075}	0.116 (0.055) [0.037] {0.245}	0.130 (0.047) [0.007] {0.107}	0.116 (0.065) [0.073] {0.394}	0.199 (0.086) [0.022] {0.204}	0.131 (0.084) [0.120] {0.519}
(3) Large Grant	0.189*** (0.043) [0.000] {0.004}	0.247*** (0.060) [0.000] {0.008}	0.109 (0.048) [0.023] {0.183}	0.139 (0.065) [0.033] {0.245}	0.100 (0.053) [0.062] {0.293}	0.197* (0.067) [0.004] {0.079}	0.226 (0.095) [0.019] {0.204}	0.187 (0.097) [0.055] {0.410}
(4) (Small Incentive)X(Large Grant)	-0.253** (0.066) [0.000] {0.012}	-0.364** (0.100) [0.000] {0.016}	-0.094 (0.058) [0.103] {0.286}	-0.120 (0.076) [0.119] {0.321}	-0.101 (0.076) [0.187] {0.443}	-0.123 (0.113) [0.280] {0.504}	-0.037 (0.165) [0.822] {0.859}	-0.216 (0.132) [0.105] {0.519}
(5) (Large Incentive)X(Large Grant)	-0.215** (0.066) [0.001] {0.031}	-0.259* (0.095) [0.007] {0.083}	-0.158 (0.069) [0.023] {0.183}	-0.229 (0.091) [0.012] {0.152}	-0.106 (0.077) [0.169] {0.443}	-0.139 (0.094) [0.144] {0.490}	-0.158 (0.129) [0.221] {0.526}	-0.200 (0.142) [0.161] {0.519}
(6) Observations	7965	7959	7949	7934	7947	7961	7943	6484
(7) Mean in No Incentive, Small Grant Group	-0.072	-0.118	-0.020	-0.041	0.008	-0.108	-0.152	-0.084

NOTES. Table uses full sample of children tested for hemoglobin concentration. Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). The dependent variable in each regression is a summary index constructed using the GLS weighting procedure in Anderson (2008). Estimates for the individual components of each index are shown in Appendix Tables 5 and 6. Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

**Appendix Table 5: Child and Household Reported Receipt of Supplements and Iron-Rich Food, Index Components**

Index: Sub-index:	Supplements						Food					
	Household received supplements to give to child (Household Response)	School provided supplements to children (Child Response)	Times per week supplements distributed by school (Child Response)	School provided supplements to take home over the weekend (Child Response)	All classmates take supplements (Child Response)	Days given supplements last month (Child Response)	Times consumed meat at school in past week	Times consumed green vegetables at school in past week	Times consumed fruit in school in past week	Times consumed meat at home in past week	Times consumed green vegetables at home in past week	Times consumed fruit at home in past week
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Small Incentive	0.042 (0.101) [0.679] {1.000}	0.200 (0.065) [0.002] {0.569}	0.805 (0.439) [0.068] {0.995}	-0.025 (0.075) [0.738] {1.000}	-0.314 (0.522) [0.549] {1.000}	0.030 (1.774) [0.987] {1.000}	0.089 (0.216) [0.681] {1.000}	-0.678 (0.343) [0.050] {0.988}	-0.454 (0.343) [0.187] {1.000}	0.413 (0.403) [0.307] {1.000}	0.616 (0.711) [0.387] {1.000}	0.455 (0.562) [0.419] {1.000}
(2) Large Incentive	0.262 (0.086) [0.003] {0.596}	0.179 (0.061) [0.004] {0.661}	0.109 (0.444) [0.806] {1.000}	-0.084 (0.057) [0.147] {1.000}	-0.490 (0.426) [0.252] {1.000}	-0.350 (1.759) [0.843] {1.000}	0.330 (0.213) [0.123] {0.999}	0.418 (0.312) [0.182] {1.000}	0.263 (0.311) [0.398] {0.580}	1.120 (0.364) [0.002] {0.988}	1.393 (0.705) [0.050] {0.996}	0.988 (0.563) [0.081] {0.996}
(3) Large Grant	0.108 (0.093) [0.250] {1.000}	0.192 (0.075) [0.012] {0.866}	0.300 (0.435) [0.491] {1.000}	0.045 (0.066) [0.499] {1.000}	-0.675 (0.435) [0.123] {1.000}	2.732 (1.877) [0.147] {1.000}	0.227 (0.236) [0.339] {1.000}	0.872 (0.389) [0.026] {0.951}	1.037 (0.460) [0.025] {0.951}	1.048 (0.393) [0.008] {0.801}	1.634 (0.831) [0.051] {0.988}	1.039 (0.651) [0.113] {0.999}
(4) (Small Incentive)X(Large Grant)	-0.073 (0.142) [0.607] {1.000}	-0.445* (0.107) [0.000] {0.994}	-1.310 (0.681) [0.056] {1.000}	-0.042 (0.081) [0.599] {1.000}	0.265 (0.727) [0.716] {1.000}	1.084 (2.751) [0.694] {1.000}	0.121 (0.320) [0.705] {1.000}	-0.147 (0.561) [0.794] {1.000}	-0.880 (0.552) [0.113] {0.999}	-0.975 (0.569) [0.088] {0.997}	-1.160 (1.118) [0.301] {1.000}	-0.853 (0.970) [0.381] {1.000}
(5) (Large Incentive)X(Large Grant)	-0.388 (0.140) [0.006] {0.754}	-0.332 (0.093) [0.000] {0.283}	-0.398 (0.621) [0.522] {1.000}	0.025 (0.080) [0.753] {1.000}	0.383 (0.609) [0.530] {1.000}	0.117 (2.517) [0.963] {1.000}	-0.709 (0.293) [0.017] {0.910}	-1.499 (0.544) [0.007] {0.758}	-1.335 (0.581) [0.023] {0.940}	-1.620 (0.598) [0.007] {0.781}	-1.721 (1.136) [0.132] {0.999}	-2.146 (0.892) [0.017] {0.910}
(6) Observations	1496	1909	1920	1910	1842	1920	1925	1925	1923	1924	1924	1925
(7) Mean in No Incentive, Small Grant Group	0.500	0.842	3.216	0.152	1.506	8.915	0.577	1.265	1.297	3.837	11.519	7.414

NOTES. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference across all tests corresponding to each index are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

Appendix Table 6: Child and Household Reported Receipt of Supplements and Iron-Rich Food, Index Components, Full Sample

Index: Sub-index:	Supplements						Food					
	Household received supplements to give to child (Household Response)	School provided supplements to children (Child Response)	Times per week supplements distributed by school (Child Response)	School provided supplements to take home over the weekend (Child Response)	All classmates take supplements (Child Response)	Days given supplements last month (Child Response)	Times consumed meat at school in past week	Times consumed green vegetables at school in past week	Times consumed fruit in school in past week	Times consumed meat at home in past week	Times consumed green vegetables at home in past week	Times consumed fruit at home in past week
Dependent Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Small Incentive	0.049 (0.092) [0.598] {1.000}	0.168 (0.061) [0.006] {0.646}	0.751 (0.441) [0.090] {0.993}	0.099 (0.057) [0.084] {1.000}	-0.105 (0.424) [0.804] {0.999}	2.194 (1.555) [0.160] {1.000}	0.168 (0.247) [0.499] {1.000}	-0.121 (0.344) [0.726] {1.000}	-0.114 (0.230) [0.622] {1.000}	0.686 (0.309) [0.028] {0.912}	0.824 (0.492) [0.096] {0.993}	0.915 (0.398) [0.023] {0.887}
(2) Large Incentive	0.215 (0.066) [0.001] {0.344}	0.128 (0.066) [0.052] {0.976}	0.427 (0.477) [0.372] {1.000}	-0.022 (0.047) [0.634] {1.000}	-0.480 (0.304) [0.116] {0.998}	1.596 (1.791) [0.374] {1.000}	0.550 (0.249) [0.028] {0.914}	0.459 (0.348) [0.190] {0.999}	0.054 (0.219) [0.805] {1.000}	0.732 (0.271) [0.008] {0.699}	0.708 (0.464) [0.129] {0.997}	0.799 (0.398) [0.046] {0.965}
(3) Large Grant	0.161 (0.077) [0.038] {0.955}	0.153 (0.065) [0.019] {0.866}	0.567 (0.418) [0.177] {1.000}	0.071 (0.048) [0.136] {0.998}	-0.273 (0.336) [0.417] {1.000}	4.394 (1.758) [0.013] {0.822}	0.107 (0.288) [0.257] {1.000}	0.441 (0.389) [0.012] {1.000}	0.772 (0.305) [0.070] {0.803}	0.565 (0.310) [0.070] {0.987}	0.062 (0.521) [0.905] {1.000}	1.053 (0.438) [0.017] {0.851}
(4) (Small Incentive)X(Large Grant)	-0.168 (0.121) [0.166] {0.999}	-0.402* (0.098) [0.000] {0.063}	-1.452 (0.602) [0.017] {0.857}	-0.192 (0.069) [0.006] {0.646}	-0.021 (0.532) [0.969] {1.000}	-2.005 (2.498) [0.423] {1.000}	-0.040 (0.360) [0.911] {1.000}	-0.237 (0.493) [0.631] {1.000}	-0.783 (0.399) [0.052] {0.972}	-0.633 (0.452) [0.163] {0.999}	-0.179 (0.745) [0.810] {1.000}	-0.991 (0.637) [0.122] {0.997}
(5) (Large Incentive)X(Large Grant)	-0.272 (0.110) [0.014] {0.833}	-0.263 (0.088) [0.003] {0.499}	-0.641 (0.626) [0.307] {1.000}	-0.033 (0.067) [0.629] {1.000}	0.032 (0.421) [0.939] {1.000}	-2.117 (2.600) [0.417] {1.000}	-0.577 (0.398) [0.149] {0.998}	-0.626 (0.520) [0.230] {1.000}	-0.851 (0.377) [0.025] {0.902}	-0.637 (0.456) [0.164] {0.999}	0.529 (0.743) [0.478] {1.000}	-1.359 (0.578) [0.020] {0.869}
(6) Observations	6271	7853	7902	7829	7650	7857	7932	7932	7932	7944	7944	7938
(7) Mean in No Incentive, Small Grant Group	0.429	0.799	2.900	0.132	1.245	6.839	0.842	1.002	1.126	4.118	12.336	7.610

NOTES. Table uses full sample of children tested for hemoglobin concentration. Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference across all tests corresponding to each index are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

**Appendix Table 7: Nutritional Information to Students and Households, Index Components**

Dependent Variable:	Index:										
	Information to Households										
	Number of school-wide parent meetings attended this semester (Household response)	Number of individual meetings with teacher or administrator this semester (Household response)	School contacted household about student nutrition this semester (Household response)	Household told to give student foods rich in iron (Household response)	Parent reports knowing of anemia (Household response)	Parent correctly identifies foods that can prevent anemia (iron-rich foods) (Household response)	School provided nutritional information to student (Student reported)	Times school spoke with students about nutrition in past semester (Student reported)	Students told to eat meat (Student reported)	Student reports knowing of anemia (Student reported)	School provided information to students on anemia (Student reported)
(1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Small Incentive	0.013 (0.206) [0.949] {1.000}	0.135 (0.189) [0.477] {1.000}	-0.010 (0.077) [0.893] {1.000}	0.030 (0.067) [0.651] {1.000}	0.059 (0.045) [0.198] {0.995}	-0.020 (0.199) [0.920] {1.000}	0.031 (0.070) [0.653] {1.000}	0.155 (0.474) [0.744] {1.000}	-0.086 (0.057) [0.132] {0.975}	0.026 (0.082) [0.757] {1.000}	0.177 (0.087) [0.043] {0.833}
(2) Large Incentive	0.021 (0.198) [0.915] {1.000}	0.520 (0.231) [0.026] {0.786}	0.122 (0.066) [0.069] {0.919}	0.107 (0.056) [0.055] {0.895}	-0.045 (0.042) [0.296] {0.998}	0.294 (0.236) [0.215] {0.995}	0.029 (0.066) [0.663] {1.000}	0.039 (0.355) [0.913] {1.000}	0.005 (0.065) [0.937] {1.000}	0.048 (0.065) [0.459] {1.000}	0.194 (0.065) [0.003] {0.347}
(3) Large Grant	0.685 (0.205) [0.001] {0.290}	0.697 (0.246) [0.005] {0.523}	0.072 (0.095) [0.452] {1.000}	0.138 (0.069) [0.049] {0.881}	0.016 (0.047) [0.737] {1.000}	0.186 (0.235) [0.430] {1.000}	0.021 (0.058) [0.719] {1.000}	0.001 (0.352) [0.999] {1.000}	0.020 (0.070) [0.772] {1.000}	0.087 (0.061) [0.159] {0.981}	0.213 (0.090) [0.019] {0.679}
(4) (Small Incentive)X(Large Grant)	-0.970 (0.298) [0.001] {0.322}	-0.727 (0.320) [0.025] {0.786}	-0.062 (0.123) [0.614] {1.000}	-0.084 (0.103) [0.418] {1.000}	-0.051 (0.068) [0.452] {1.000}	-0.055 (0.313) [0.860] {1.000}	-0.013 (0.098) [0.897] {1.000}	0.271 (0.608) [0.656] {1.000}	0.256 (0.093) [0.006] {0.455}	0.098 (0.104) [0.351] {1.000}	0.004 (0.130) [0.976] {1.000}
(5) (Large Incentive)X(Large Grant)	-0.693 (0.285) [0.016] {0.729}	-0.904 (0.372) [0.017] {0.729}	-0.152 (0.125) [0.227] {0.995}	-0.267 (0.099) [0.008] {0.593}	0.038 (0.065) [0.562] {1.000}	-0.422 (0.328) [0.201] {0.995}	0.018 (0.080) [0.821] {1.000}	0.742 (0.505) [0.143] {0.976}	0.001 (0.095) [0.988] {1.000}	-0.062 (0.088) [0.480] {1.000}	-0.233 (0.114) [0.043] {0.833}
(6) Observations	1366	1354	1464	1209	1481	1525	1916	1909	1925	1914	1913
(7) Mean in No Incentive, Small Grant Group	1.401	0.886	0.427	0.277	0.769	1.776	0.792	1.956	0.257	0.587	0.199

NOTES. Table uses sample of children testing anemic at baseline. Children are considered anemic if they have an altitude-adjusted hemoglobin concentration below 120 g/L (per WHO guidelines). Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference across all tests corresponding to each index are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

**Appendix Table 8: Nutritional Information to Students and Households, Index Components (Full Sample)**

Dependent Variable:	Information to Households											Information to Students			
	Index:	Number of school-wide parent meetings attended this semester (Household response)	Number of individual meetings with teacher or administrator this semester (Household response)	School contacted household about student nutrition this semester (Household response)	Household told to give student foods rich in iron (Household response)	Parent reports knowing of anemia (Household response)	Parent correctly identifies foods that can prevent anemia (iron-rich foods) (Household response)	School provided nutritional information to student (Student reported)	Times school spoke with students about nutrition in past semester (Student reported)	Students told to eat meat (Student reported)	Student reports knowing of anemia (Student reported)	School provided information to students on anemia (Student reported)			
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)			
(1) Small Incentive		0.140 (0.174) [0.422] {1.000}	-0.090 (0.169) [0.593] {1.000}	-0.034 (0.067) [0.618] {1.000}	0.030 (0.058) [0.600] {1.000}	-0.012 (0.040) [0.756] {1.000}	-0.012 (0.153) [0.935] {1.000}	0.084 (0.065) [0.196] {0.966}	0.584 (0.430) [0.176] {0.959}	0.031 (0.053) [0.559] {0.996}	0.098 (0.065) [0.133] {0.932}	0.136 (0.076) [0.075] {0.854}			
(2) Large Incentive		-0.027 (0.176) [0.878] {1.000}	0.356 (0.180) [0.050] {0.868}	0.097 (0.064) [0.132] {0.973}	0.130 (0.056) [0.023] {0.720}	0.010 (0.035) [0.772] {1.000}	0.296 (0.196) [0.133] {0.973}	0.114 (0.056) [0.041] {0.754}	0.344 (0.302) [0.256] {0.975}	0.103 (0.053) [0.054] {0.798}	0.033 (0.053) [0.531] {0.996}	0.157 (0.059) [0.008] {0.399}			
(3) Large Grant		0.612 (0.177) [0.001] {0.174}	0.378 (0.207) [0.069] {0.915}	0.055 (0.075) [0.465] {1.000}	0.089 (0.060) [0.140] {0.973}	0.024 (0.038) [0.518] {1.000}	0.152 (0.184) [0.410] {1.000}	0.094 (0.052) [0.072] {0.854}	0.473 (0.371) [0.203] {0.966}	0.099 (0.059) [0.092] {0.887}	0.084 (0.054) [0.122] {0.929}	0.163 (0.077) [0.035] {0.722}			
(4) (Small Incentive)X(Large Grant)		-0.904 (0.289) [0.002] {0.295}	-0.167 (0.272) [0.539] {1.000}	-0.024 (0.098) [0.803] {1.000}	-0.111 (0.083) [0.186] {0.984}	-0.002 (0.059) [0.970] {1.000}	-0.232 (0.260) [0.374] {0.999}	-0.076 (0.087) [0.383] {0.990}	-0.330 (0.551) [0.550] {0.996}	0.064 (0.088) [0.470] {0.994}	-0.031 (0.090) [0.730] {0.996}	0.022 (0.116) [0.853] {0.996}			
(5) (Large Incentive)X(Large Grant)		-0.424 (0.276) [0.127] {0.973}	-0.554 (0.316) [0.082] {0.934}	-0.069 (0.103) [0.506] {1.000}	-0.125 (0.085) [0.144] {0.973}	0.033 (0.053) [0.528] {1.000}	-0.332 (0.279) [0.236] {0.993}	-0.077 (0.068) [0.255] {0.975}	-0.037 (0.531) [0.944] {0.996}	-0.094 (0.078) [0.228] {0.969}	-0.018 (0.071) [0.798] {0.996}	-0.196 (0.097) [0.044] {0.758}			
(6) Observations	5750	5734	6187	5129	6211	6372	7870	7861	7923	7878	7855				
(7) Mean in No Incentive, Small Grant Group	1.434	0.966	0.422	0.255	0.746	1.817	0.692	1.479	0.199	0.539	0.200				

NOTES. Table uses full sample of children tested for hemoglobin concentration. Rows 1-5 show estimated coefficients for treatment group indicators and interactions obtained by estimating equation (12) (controlling for the baseline value of the dependent variable, student age, student grade, student sex, number of students in the school, whether the school has a canteen, student teacher ratio, distance to the furthest village served, percent of boarding students, whether the school has implemented the "Free Lunch" policy, county dummy variables, and dummy variables for randomization strata). Standard errors are shown in parentheses, unadjusted p-values are shown in square brackets and p-values adjusted for multiple inference across all tests corresponding to each index are shown in curly brackets. Adjusted p-values were constructed using the free step-down resampling method of Westfall and Young (1993) with 10,000 iterations. \*, \*\*, and \*\*\* indicate significance at 10%, 5% and 1% based on adjusted p-values.

**Appendix Table 9: Cost Effectiveness Calculations**

	Incremental Amount Relative to Comparison (Small Block Grant, No Incentives) Group				
	Small Block Grant, Small Incentives	Small Block Grant, Large Incentives	Large Block Grant, No Incentives	Large Block Grant, Small Incentives	Large Block Grant, Large Incentives
<b>Panel A: Costs</b>					
<i>Programmatic Costs</i>					
(1) Block Grant	0.0	0.0	48.0	48.0	48.0
(2) Incentive Payments	1.1	15.7	0.0	1.4	17.5
<i>Cost of Public Funds</i>					
(3) Cost of Public Funds	0.3	4.7	14.4	14.8	19.7
<i>Costs to Households</i>					
(4) Full Sample	45.5	60.7	90.8	38.3	62.7
(5) Anemic Sample	34.6	95.0	147.5	26.6	49.4
<b>Total Costs</b>					
(6) Programmatic	1.1	15.7	48.0	49.4	65.5
(7) Social - Full Sample	45.8	65.4	153.2	101.1	130.3
(8) Social - Anemic Sample	34.9	99.7	209.9	89.5	117.0
<b>Panel B: Anemia Reduction (Percentage Point Reduction)</b>					
(9) Full Sample	0.028	0.045	0.073	0.074	0.032
(10) Anemic Sample	0.012	0.138	0.145	0.199	0.087
<b>Panel C: Cost Effectiveness (Cost of Averting One Anemia Case)</b>					
<i>Full Sample</i>					
(11) Programmatic	N.S.	349.6	657.5	668.1	2,047.4
(12) Social	N.S.	1,452.7	2,098.6	1,366.1	4,072.4
<i>Anemic Sample</i>					
(13) Programmatic	N.S.	114.0	331.0	248.4	753.1
(14) Social	N.S.	722.5	1,447.3	449.6	1,345.1

NOTES. All costs in renminbi per child (exchange rate as of Sept. 2012 was 6.3 USD/RMB). Costs of the information intervention and anemia testing are excluded as these are constant across treatments. The cost of the information intervention was 1,020 yuan per school and the cost of anemia testing was 6.7 yuan per child. Additional administrative costs are assumed to be negligible as administration of block grants could be built into the administration of other school finances and administrative costs of incentives into administration of existing school administrator evaluation and performance pay policies. In the absence of good estimates for China (and other developing countries), the cost of public funds is assumed to be 0.3 based on estimates for the US (Ballard, Shoven and Whalley, 1985). Social costs include costs incurred by households and exclude incentive payments (except the deadweight loss to taxation) considering them a transfer. Costs to households include costs of purchasing additional food and additional time spent attending parent meetings. Estimates for additional food costs are based on estimates for impact on meat, vegetable, and fruit consumption at home reported in Appendix Tables 5 & 6. Reported increases in times foods were consumed in the past week are assumed to be constant across all 24 weeks of the program. Serving sizes are assumed to be half of the recommended daily consumption (25g of meat, 150g of vegetables and 100g of fruit). Food prices are based on prices in local markets as reported by the school accountant at baseline. Time spent in parent meetings is based on estimates in Appendix Tables 7 & 8. One meeting is assumed to have an opportunity cost of 60 yuan (approximately half of local daily wages). Anemia reduction estimates in Panel B are calculated from estimates in Table 2 and Appendix Table 3. Effects not significant (N.S.) for the Small Block Grant, No Incentives intervention.