APPENDIX:
"A Cluster Randomized Trial of Provider Incentives for Anemia Reduction in Rural China"

This supplemental text presents additional statistical analyses referenced in the paper entitled "A Cluster Randomized Trial of Provider Incentives for Anemia Reduction in Rural China." First, it analyzes behavioral responses among principals to the study's interventions to reduce anemia. Second, it investigates the possibility of unintended consequences attributable to these interventions. Third, it examines factors correlated with local governments' use of test score incentives for principals.

Principals' Strategies to Reduce Anemia

Appendix Table 1 examines how principals in the Subsidy and Incentive arms used their subsidy payments to reduce anemia. (Control and Information schools lacked resources to conduct school-based interventions.) Although principals were free to do anything they chose, in practice they reported using one of three major strategies: (1) supplementation (with vitamins/minerals and iron-fortified wheat); (2) feeding (increasing the frequency of lunches with red meat, fruits and vegetables rich in vitamin C to promote the absorption of iron, etc.); and (3) a mixture of supplementation and feeding approaches.

Although our power to detect meaningful school-level changes is limited, two important stylized facts emerge from the table. First, Incentive school principals were more likely to pursue supplementation strategies that increased only students' multimicronutrient intake and not their caloric intake (for example, vitamins/minerals and iron-fortified wheat)—and less likely to pursue broad feeding strategies that increased both multimicronutrient and caloric intake (for example, with meat and other food added to school lunches)—to reduce anemia, presumably because of their more focused incentive to raise iron levels as opposed to overall nutritional status. Second, consistent with studies linking broader nutritional gains to school performance,[27] principals with test score incentives focused relatively more on feeding.

Appendix Table 2 then analyzes principals' efforts to reduce anemia by educating parents. Repeating the basic analyses shown in Table 3 (using probit models), the first two columns study whether or not parents knew about anemia in the follow-up wave, and the last to columns examine whether or not parents received nutrition-related information from the school in the preceding month (missing observations lead to smaller sample sizes than in Tables 2 and 3; however, the number of missing responses is balanced across arms). On average, Subsidy and Incentive schools were 22 and 23 percentage points (respectively) more likely to have educated parents about nutrition (a 65 percent increase in the Subsidy arm and a 68 percent increase in the Incentive arm over 34 percent at baseline). Parents in both groups were more likely to know specifically about anemia as well, by 12 and 14 percentage points (a 32 percent increase in the Subsidy arm and a 38 percent increase in the Incentive arm over 37 percent at baseline).

There are no statistically significant average increases in either outcome among Information school parents. However, the second and fourth columns show very large gains (of 23 percentage points) among parents of Information school students when principals had incentives for good test scores (a 35 percent increase in the likelihood of having been given nutritional information by the school and a 27 percent increase in reported knowledge of anemia). Interactions between test score incentives and other experiment arms are not statistically significant.

Overall, principals in all intervention schools appear to have educated parents about nutrition to reduce anemia. However, Information arm principals only did so in the presence of test score incentives – presumably because they understood the link between anemia and school performance (an explicit part of the information they received) and had incentives to improve test scores, but they lacked the resources to intervene in any way other than through parents.

Unintended Behavioral Responses among Parents and Principals

Appendix Tables 3 and 4 investigate the possibility of unintended (perverse) behavioral responses to incentives for anemia reduction. Appendix Table 3 examines net changes in students' diets (taking meals both at school and at home into account). The first column shows that meat consumption (a primary diet-based source of iron) increased among children in both Subsidy and Incentive schools—and relatively more so among Subsidy school children (consistent with greater emphasis on feeding strategies at these schools shown in Appendix Table 1). Importantly, these results also imply little offsetting reduction in dietary quality at home.[28 29] Among Information school students, meat consumption increased only when incentives for good test scores were present, presumably reflecting more vigorous efforts of these principals to reduce anemia by educating parents about nutrition (shown in Appendix Table 2).

Finally, Appendix Table 4 analyzes changes in school expenditures by study arm, finding no evidence of distortions in spending on administration or teaching in response to subsidies or incentives for anemia reduction.

Correlates of Test Score Incentives

When interpreting interactions between experiment arms and test score incentive dummy variables (Table 3), a natural concern is that these estimates reflect the role of variables correlated with test score incentives (because we did not randomly assign test score incentives). To investigate this possibility, Appendix Table 5 reports marginal effects from probit models relating the availability of incentive payments for good test scores and both principal and school characteristics. Although these school-level regressions are limited in power, we do not find meaningful correlations with observable characteristics of principals or schools measured by our surveys. These estimates should nevertheless be interpreted cautiously.

APPENDIX TABLE 1: Principal Strategies by Experiment Arm and Test Score Incentives

			Principal has Test Score Incentive		Difference between Schools with and without Principal Test Score Incentives
	Strategy	**All (n=30)**	**No (n=25)**	**Yes (n=5)**	
All (n=30)	**Mixed**	60.0% (9.9)	56.0% (10.1)	80.0% (20.0)	-24.0% (21.2)
	Feeding	16.6% (6.9)	16.0% (7.5)	20.0% (20.0)	-4.0% (20.0)
	Supplementation	23.3% (7.9)	28.0% (9.2)	0.0% (0.0)	28.0% (9.3)***
Subsidy Treatment School (n=15)	**Mixed**	53.3% (13.3)	50.0% (15.1)	66.7% (33.3)	-16.7% (33.1)
	Feeding	26.6% (11.8)	25.0% (13.1)	33.3% (33.3)	-8.3% (32.2)
	Supplementation	20.0% (10.7)	25.0% (13.1)	0.0% (0.0)	25.0% (13.4)*
Incentive Treatment School (n=15)	**Mixed**	66.7% (12.6)	61.5% (14.0)	100% (0.0)	-38.5% (14.5)**
	Feeding	6.67% (6.67)	7.7% (7.7)	0.0% (0.0)	7.7% (7.9)
	Supplementation	26.6% (11.8)	30.8% (13.3)	0.0% (0.0)	30.8% (13.8)**
Difference between Subsidy and Incentive Schools	**Mixed**	-13.3% (18.3)	-11.5% (20.6)	-33.3% (35.1)	21.8% (36.1)
	Feeding	20% (13.6)	17.3% (15.1)	33.3% (35.1)	-16.0% (33.1)
	Supplementation	-6.6% (15.9)	-5.8% (18.7)	0.0% (0.0)	-5.8% (19.2)

Notes: Robust standard errors in parentheses. A principal used a "mixed strategy" if he chose an equal number of feeding and supplementation-based anemia reduction approaches, a "feeding" strategy if using a majority of feeding-based approaches, and a "supplementation" approach if using a majority of approaches involving iron fortification or iron-containing vitamin supplements. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

APPENDIX TABLE 2: Provision of Nutrition Information and Parent Knowledge about Anemia by Experiment Arm and Pre-existing Test Score Incentives

	Dependent Variable:			
	Parents Know about Anemia		Parents Given Nutritional Information in Past Month	
Experiment Arm Dummy Variables				
Student in Information Treatment School	0.03	-0.02	0.03	-0.01
	(0.04)	(0.05)	(0.03)	(0.04)
Student in Subsidy Treatment School	0.12**	0.07	0.22***	0.19***
	(0.05)	(0.04)	(0.04)	(0.04)
Student in Incentive Treatment School	0.14***	0.13***	0.23***	0.23***
	(0.04)	(0.04)	(0.04)	(0.04)
Interactions between Experiment Arm and Test Score Incentive Dummy Variables				
Principal has test score incentive	0.01	-0.09	-0.05	-0.12**
	(0.04)	(0.06)	(0.04)	(0.05)
Information School * Test Score Incentive		0.23***		0.23***
		(0.08)		(0.09)
Subsidy School * Test Score Incentive		0.19		0.12
		(0.18)		(0.14)
Incentive School * Test Score Incentive		0.10		-0.05
		(0.07)		(0.11)
Control Variables				
County Fixed Effects	yes	yes	yes	yes
Other Controls	yes	yes	yes	yes
Observations	2,894	2,894	2,899	2,899
P-value: Incentive=Subsidy	0.68	0.64	0.85	0.29
P-value: Subsidy=Information	0.17	0.79	<0.001***	0.43
P-value: Incentive=Information	0.03**	0.06*	<0.001***	0.02**

Notes: The dependent variable in the first two columns is 1 if parents report having knowledge of anemia and 0 otherwise. The dependent variable in columns 3 and 4 is 1 if parents report receiving nutrition-related information from the school in the past month. All cells report marginal probabilities calculated as averages over the sample values using probit estimates obtained by maximum likelihood estimation. Controls include whether or not principal has test score incentives, student age (in months); the baseline value of the dependent variable; student gender, whether or not the student is boarding, whether the student's mother has migrated, and whether the student's mother has an education level at primary or below. The last 3 rows report p-values for tests of equality between the coefficients for treatment group estimates. In columns 2 and 4, these are for tests between the interaction terms with test score incentives. Cluster robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

APPENDIX TABLE 3: Food Consumption by Experiment Arm

	Dependent Variable:					
	Meat		Tofu		Fruit	
Experiment Arm Dummy Variables						
Student in Information Treatment School	-0.07**	-0.10***	-0.01	-0.01	-0.02	-0.01
	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
Student in Subsidy Treatment School	0.17***	0.14***	-0.01	0.01	0.00	-0.03
	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)
Student in Incentive Treatment School	0.11***	0.11***	0.09***	0.10***	0.07*	0.05
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Interactions between Experiment Arm and Test Score Incentive Dummy Variables						
Principal has test score incentive	-0.00	-0.06	-0.02	0.01	0.03	-0.01
	(0.03)	(0.04)	(0.02)	(0.03)	(0.04)	(0.04)
Information School * Test Score Incentive		0.16***		0.00		-0.04
		(0.05)		(0.06)		(0.07)
Subsidy School * Test Score Incentive		0.11		-0.07		0.16
		(0.11)		(0.05)		(0.13)
Incentive School * Test Score Incentive		-0.00		-0.15***		0.22
		(0.05)		(0.05)		(0.15)
Control Variables						
County Fixed Effects	yes	yes	yes	yes	yes	yes
Other Controls	yes	yes	yes	yes	yes	yes
Observations	2,929	2,929	2,908	2,908	2,902	2,902
P-value: Incentive=Subsidy	0.24	0.30	0.002***	0.24	0.15	0.79
P-value: Subsidy=Information	<0.001***	0.66	0.92	0.20	0.55	0.13
P-value: Incentive=Information	<0.001***	0.008***	0.007***	0.03**	0.03**	0.10*

Notes: All cells report marginal probabilities calculated as averages over the sample values using probit estimates obtained by maximum likelihood estimation. Meat, Tofu and Fruit are 1 if consumed at least once a week and 0 otherwise. Controls include whether or not principal has test score incentives, student age (in months); the baseline value of the dependent variable; student gender, whether or not the student is boarding, whether the student's mother has migrated, and whether the student's mother has an education level at primary or below. The last 3 rows report p-values for tests of equality between the coefficients for treatment group estimates. In columns 2, 4, and 6, these are for tests between the interaction terms with test score incentives. Cluster robust standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

APPENDIX TABLE 4: Change in School Expenditures by Type, Experiment Arm, and Pre-Existing Test Score Incentives

	Dependent Variable: Change in Expenditures per Student					
	Administrative		Teaching		Food-related	
Experiment Arm Dummy Variables						
Student in Information Treatment School	-69.18	-101.66	1.81	-0.19	29.21	40.77
	(68.45)	(87.06)	(32.96)	(40.49)	(36.89)	(41.06)
Student in Subsidy Treatment School	49.59	-20.65	29.02	36.05	86.80	97.04
	(83.84)	(81.67)	(31.95)	(38.63)	(77.19)	(97.10)
Student in Incentive Treatment School	-14.08	-32.22	30.48	29.33	30.58	17.84
	(62.20)	(79.25)	(33.53)	(40.98)	(36.85)	(43.10)
Interactions between Experiment Arm and Test Score Incentive Dummy Variables						
Principal has test score incentive		-61.27		-13.95		-29.35
		(85.65)		(59.45)		(70.48)
Information School * Test Score Incentive		155.56		8.46		-61.06
		(110.07)		(69.15)		(91.89)
Subsidy School * Test Score Incentive		344.35		-36.68		-54.44
		(258.11)		(67.06)		(121.46)
Incentive School * Test Score Incentive		95.24		-0.65		75.96
		(121.69)		(62.97)		(80.26)
Observations	72	72	72	72	72	72
R-squared	0.030	0.095	0.020	0.030	0.037	0.060
P-value: Incentive=Subsidy	0.33	0.34	0.95	0.34	0.45	0.22
P-value: Subsidy=Information	0.10*	0.46	0.21	0.34	0.44	0.95
P-value: Incentive=Information	0.20	0.59	0.24	0.83	0.97	0.06*

Notes: Administrative expenditures reported in RMB include spending on utilities, facility improvements, equipment, non-teaching staff salaries, and office supplies; Teaching expenditures include spending on teaching supplies, books, teacher salaries, and teacher education; Food-related expenditures include food costs, cafeteria utilities, and cafeteria worker salaries. Robust standard errors are in parentheses. The last 3 rows report p-values for tests of equality between the coefficients for treatment group estimates. In columns 2, 4, and 6, these are for tests between the interaction terms with test score incentives. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.

APPENDIX TABLE 5: The Correlates of Test Score Incentives

	Dependent Variable: Principal Has Test Score Bonus Incentive	
Principal Characteristics		
Age (years)	-0.001 (0.016)	-0.000 (0.016)
Education – College or above	-0.081 (0.157)	-0.048 (0.168)
Education – Vocational School	-0.112 (0.143)	-0.079 (0.156)
Years Teaching	0.003 (0.011)	0.004 (0.012)
School Characteristics		
Total Number of Students		-0.000 (0.000)
Student/Teacher Ratio		0.002 (0.008)
Has Canteen		0.023 (0.209)
Distance to Farthest Village Served (km)		-0.000 (0.003)
Percent Boarding Students		-0.001 (0.002)
Observations	72	72

Notes: All cells report marginal probabilities calculated as averages over the sample values using probit estimates obtained by maximum likelihood estimation. Excluded education category is high school. Standard errors in parentheses. *, **, and *** indicate significance at 10%, 5% and 1%, respectively.