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Kids eat free: School feeding and family spending on education

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ABSTRACT

We examine the relationship between children's participation in the Nutrition Improvement Programme (NIP) and household education expenditure on students under compulsory education in rural China. We find that participating in the school feeding programme can significantly increase household investment in children's education, especially in-school education expenditure. This positive relationship may be mediated by family economic status, parental time investment in children's education, and children's health status and cognitive ability. There is considerable heterogeneity in the impacts of the school feeding programme across subsamples. In general, male children and children from disadvantaged families, such as those in low- and middle-income households, those with less educated parents, and those left behind by migrant parents, are likely to benefit more from the school feeding programme. We also find suggestive evidence of intrahousehold resource reallocation away from eligible female children in response to the school feeding programme.

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Introduction

Meeting nutritional needs during the school year is critical for the development of children. Nonetheless, approximately 66 million schoolchildren across developing countries attend school hungry (Bundy et al., 2018). School feeding programmes, which aim to address schoolchildren attending classes hungry, are the world's most extensive social safety net. One in every two schoolchildren, or 388 million schoolchildren, across all income levels receives school meals every day in 161 countries (World Food Programme, 2020).

School feeding programmes promote macronutrient and micronutrient adequacy in the diet (Abizari et al., 2014). School feeding programmes are also beneficial for improving schoolchildren's cognitive functions (Cueto and Chinen, 2008; Grantham-McGregor et al., 1998), test scores (Aurino et al., 2020; Chakraborty and Jayaraman, 2019; Vermeersch and Kremer, 2005), psychosocial behaviour (Metwally et al., 2020), and school enrolment and attendance (Bundy et al., 2013;

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Jomaa et al., 2011). Some school feeding programmes that provide take-home rations also have positive nutrient spillovers on the siblings of eligible schoolchildren (Kazianga et al., 2014).

In evaluating the effectiveness of school feeding programmes, Alderman and Bundy (2012: 204) caution that ‘while school feeding programs can influence the education of schoolchildren and, to a lesser degree, augment nutrition for families of beneficiaries, they are best viewed as transfer programs that can provide a social safety net and help promote *human capital investments*’. However, most existing studies in China focus on the relationship between school feeding programmes and the individual health, dietary and nutritional outcomes of schoolchildren (Chen et al., 2020; Wang et al., 2020, 2021b, 2019). Unlike some other countries, the schooling feeding programme in China provides little or no direct income transfers to families. Thus, the school feeding programme may indirectly affect the household budget allocation in the absence of direct cash transfers to households. Nonetheless, little is known about whether, and the potential mechanisms through which, school feeding programmes affect the household expenditure on children’s education. This issue is an important gap because family spending on education is critical for children’s human capital accumulation, which is imperative for economic growth (Heckman, 2005; Zhang and Wang, 2021).

We examine the relationship between access to school feeding and household expenditure on children’s education using the Nutrition Improvement Programme (NIP) in China. Our analysis is based on child-level education expenditure data from the 2014 China Education Panel Survey (CEPS). We find that households with children in the NIP spend 0.159–0.296 standard deviations more on individual children’s education. Regarding impact heterogeneity, we find that participation in the NIP has a statistically significant association with household education spending amongst children who are male, in low- and middle-income households, of less-educated parents, and who are left behind by migrant parents. We find that more parental time spent with children and positive gains in cognition and health are important pathways through which the NIP affects household education expenditure. We conduct a series of robustness checks of our results, including the use of an alternative dataset to re-estimate the models.

Our study contributes to the literature in five ways. First, we add to the limited evidence on the effects of government-led large-scale interventions on human capital in resource-constrained settings such as developing countries (Aurino et al., 2020). A growing body of literature has examined the effects of school feeding programmes on children’s nutritional and health status and educational achievement (see Alderman and Bundy, 2012; Jomaa et al., 2011 for reviews). This study extends the existing literature by focusing on the benefits of China’s school feeding programme on household expenditure on children’s education, which has a broader impact on health, education and labour market outcomes and plays a pivotal role in future household development (Chi and Qian, 2016; Wei et al., 2021). Moreover, the rapid increase in household education expenditure and the associated rising inequality in China have sparked growing concern amongst researchers and policymakers (Brown and Park, 2002; Song and Zhou, 2019). Our results show that children from disadvantaged families benefit more from the school feeding programme, implying that the programme might facilitate intergenerational upward social mobility and reduce inequality in rural areas.

Second, we contribute to the literature on family spending on school children in response to external social and economic environments (Wang and Cheng, 2021). Consumption expenditures are regarded as direct measures of children’s material well-being because they provide insights into the process of intergenerational transfers from parents to children (Hao and Yeung, 2015). Existing studies find that wealthier households can increase their education spending on children, while those at the bottom of the income distribution have little capacity to do so (Kornrich, 2016). Our findings suggest that China’s school feeding programme increases poor households’ financial capacity in relation to spending on children’s education.

Third, we contribute to the literature on the relationship between public and private spending on education. Existing studies regard public and private spending in education as either (perfect) substitutes (De la Croix and Doepke, 2004; Epple and Romano, 1996a; Glomm and Kaganovich, 2003; Glomm and Ravikumar, 1992), or complements (Arclean and Schiopu, 2010; Epple and Romano, 1996b; Gouveia, 1997) to each other. In China, for example, increasing public education spending reduces the household tutoring spending amongst the top and bottom income households (Yuan and Zhang, 2015). We find that participating in the school feeding program increases the household education spending, which is consistent with the presence of an imperfect substitutability of public and private educational investments, and households complement state-funded services with additional out-of-pocket spending on education (Epple and Romano, 1996b; Gamlath and Lahiri, 2018; Gouveia, 1997).

Fourth, we contribute to the literature on household human capital investment behaviour. Most of the existing literature on the benefits of school feeding programmes for children has mainly focused on the direct impact of transfers. However, there is a dearth of research on the extent of the spillovers of these public transfers to other family members through intrahousehold resource redistribution. The unitary model of household behaviour assumes that altruistic parents choose the quantity and quality of their children (Becker and Tomes, 1976). As long as the household is treated as a single decision-making unit, parents are likely to pool household resources and reallocate them amongst children so that the marginal payoffs of human capital investment are identical for all children in the family. The extent of the redistribution of intrahousehold resources heavily depends on parental preference, such as traditional son preferences, and family characteristics, such as household size and composition (Chakraborty and Jayaraman, 2019). Moreover, the cooperative Nash bargaining model posits that intrahousehold resource allocation is a bargaining process amongst family members with different bargaining powers. Previous studies have provided limited evidence of intrahousehold resource reallocation from children who are eligible for school feeding programmes to other family members (Afridi, 2010; Chakraborty and Jayaraman, 2019;

Kazianga et al., 2014). In this study, we find suggestive evidence of intrahousehold resource reallocation away from eligible female children to other household members in response to the school feeding scheme in China.

Fifth, we add to the paucity of literature on the potential channels that may account for the impact of school feeding programmes on the expenditure on children's education. A small body of literature has examined how school feeding programmes affect scholastic achievements through increasing time spent in school, improving certain cognitive functions and attention to task and alleviating hunger (Buttenheim et al., 2011; Grantham-McGregor et al., 1998; Simeon, 1998). Our study responds to the call for an investigation on potential mechanisms through which the school feeding programmes contribute to individual and household outcomes (Wang et al., 2021b). We find that children's exposure to China's school feeding programme can significantly improve their cognitive ability and health status, which is important for generating a higher return on human capital investment. Given that parents' investment decisions are determined by efficiency, they may adopt a reinforcement strategy by investing more in children in response to the increased marginal payoffs of human capital investment. Moreover, China's school feeding programme can increase household economic status, which may ease the financial constraints on educational investment and allow parents to spend more time on their children's education. There is emerging evidence that more parental involvement in children's education can reduce parent-child information friction and, in turn, induce more educational investments.

1. Background and related studies

In China, the ratio of undernourished children in both the stunted and underweight groups has declined significantly in the past three decades due to rapid socioeconomic development, which has dramatically improved the nutritional status of poor children (Dong et al., 2019; Wu, 2019). However, malnutrition is still prevalent amongst poor rural communities in China (Luo et al., 2009). Rural children are more likely than urban children to suffer from malnutrition (Chen et al., 2007). Moreover, rural students who eat lunch away from home are more likely to be anaemic due to inadequate diets (Luo et al., 2010). This is particularly the case in poor rural areas where students' diets are predominantly starch-based, containing little meat, vegetables and fruit (Luo et al., 2009). Rural children left behind in the countryside by parents who migrate to cities for work are also at a higher risk of being stunted and underweight (Wu and Guo, 2020).

Malnutrition is associated with poorer academic performance in rural China. For example, iron-deficiency anaemia, which impairs haemoglobin production and limits the amount of oxygen that red blood cells carry to the body and brain, can lead to poor academic performance amongst rural Chinese students through lethargy, fatigue, poor attention, and prolonged physical impairment (Kleiman-Weiner et al., 2013; Luo et al., 2012). Chronic undernutrition is also associated with poorer literacy acquisition and subsequent school persistence as well as more behavioural problems amongst students at rural schools in China (Hannum and Hu, 2017).

As the first nationwide school feeding programme in China, the NIP was launched in 2011 to address childhood malnutrition in poor rural communities. The NIP covers rural students at the nine-year compulsory education stage (i.e., six years in primary school and three years in junior high school).¹ The NIP was initially implemented in selected schools in 699 pilot counties and gradually expanded. The NIP, which is funded by the central and local governments, provides meal subsidies and associated funding. The initial subsidy standard was 3 RMB per day for 200 days per year for each student and later increased to 4 RMB per day for non-boarding students or 8–9 RMB per day for boarding students. The programme supplies lunches (and additional meals for boarding students) that contain eggs, milk, meat, vegetables and fruit. The programme also provides funds to improve the kitchen and canteen facilities at schools.

The findings on the effects of the NIP are limited and mixed. Wang et al. (2020) find that the malnutrition rates and height-for-age z-scores amongst the sample students did not decrease three years after the programme implementation. Wang et al. (2019) suggest that the NIP has improved the physical and mental health of students under compulsory education in rural areas, and it has been more beneficial for students in financial difficulties, left-behind children who were separated from migrant parents in rural areas and children with siblings. Wang et al. (2021b) find that participation in the NIP is associated with a higher height-for-age z-score but not with the body mass index (BMI)-for-age or weight-for-age z-score. The mixed findings on the impacts of the NIP on health outcomes in these studies may be due to the differences in sample populations, quality of food provided, and available financial and human resources across different regions (Wang et al., 2020). In addition, the long-term effects of the NIP may not have emerged since the national programme only officially started in 2011 (Wang et al., 2019).

2. Data and descriptive analysis

This study uses data from the 2014 CEPS, administered by the National Survey Research centre at Renmin University in China. The CEPS is a large-scale, nationally representative survey that employs a stratified, multistage sampling design with a probability proportional to size sampling method. The CEPS draws samples through three stages: the county (or district), then the school, and then classes. The 2014 CEPS wave covers 10,750 eighth-graders in 221 classes across 112 middle schools in 28 counties/districts in mainland China. The CEPS collected detailed information on household education

¹ See, e.g., Cheng and Smyth (2021) and Cheng (2021) for reviews of the nine-year compulsory education reforms in China.

Table 1
Summary statistics of expenditure on children's education, 2014 China Education Panel Survey.

	Students with free meals		Students without free meals		Mann-Whitney test	
	Mean	SD	Mean	SD	z-statistic	p-value
Total education expenditure	4.81	2.44	4.70	2.79	0.235	0.8143
In-school expenditures	4.27	2.40	4.18	2.74	-0.219	0.8267
Out-of-school expenditures	1.24	2.71	1.21	2.67	-0.253	0.8004

expenditure, government financial support for students such as free school meals and textbook fee exemptions and a wide range of personal, family, class and school characteristics.

Given that the NIP was launched to enhance rural students' health at the nine-year compulsory education stage, we restrict our sample to junior high school students in rural China. In the 2014 CEPS, students' access to the school feeding programme was identified by school principals' confirmation of whether free lunch was provided to students in 2013. The final sample employed in this study consists of 3,514 students from 51 schools in 22 counties, of whom 511 students in 9 schools were offered free school meals in 2013, accounting for 14.54 per cent of the final sample.

Individual-level education expenditure is measured by a series of survey questions regarding family spending on each student's education in the prior semester. The CEPS collects information on two broad categories of education expenditures, namely, in-school education expenditures (i.e., expenditures on tuition, textbooks, teaching aids, school uniforms, activities, accommodations, insurance premiums and other fees) and out-of-school education expenditures (i.e., expenditures on extra-curricular interest-based or academic-related classes and private tutoring). The total education expenditure on each child is the sum of the expenditures in these two categories.

Table 1 presents the summary statistics on the household expenditure on children's education across participation statuses in China's school feeding programme. In general, the household education expenditure on children who received free school meals in the prior year is slightly higher than that on children who did not receive free school meals. The total education expenditure in natural logarithmic form for students with access to the school feeding programme is 4.81, while that for students who did not participate in this programme is 4.70. In the total education expenditure, in-school expenditures account for a larger proportion, approximately 90 per cent. On average, the in-school and out-of-school education expenditures for school feeding programme participants are 4.27 and 1.24, respectively, and these values are 0.09 and 0.03 higher than those for non-participants. Although students who were offered free school meals are comparatively advantaged in terms of human capital investment, a Mann-Whitney test suggests that the group differentials are not significant in terms of both the total and specific categories of education expenditure on individual students.

3. Methods

To examine the relationship between the NIP and expenditure on children's education, we estimate the following function:

$$eduexp_i = \alpha + \beta NIP_i + \gamma X_i + \theta C_c + \varepsilon_i \quad (1)$$

where $eduexp_i$ denotes the total household education expenditure or one of the two specific categories of education expenditure in the previous semester on individual child i collected in the 2014 wave, depending on the exact empirical specification. To facilitate interpretation, we standardize expenditure on children's education to have a mean of zero and a standard deviation of one in the estimations. NIP_i is the primary variable of interest, defined as a binary variable equal to one if the respondents were offered free school meals in 2013 and zero otherwise. The lagged variable of NIP_i can help rule out the potential reverse causality of expenditure on children's education and participation in the school feeding programme. X_i is a vector of control variables that the existing literature suggests are correlated with education expenditure, including personal, household and school characteristics. We further control for whether the respondents were exempted from textbook fees in 2013 to rule out the impact of certain financial support programmes provided by the Chinese government. Table A1 in the Appendix presents the definitions and descriptive statistics of these control variables. Of the remaining variables, C_c is the county fixed effect, and ε_i is the error term.

We first estimate the relationship between the school feeding programme and expenditure on children's education using ordinary least squares (OLS) regressions. However, there are two possible sources of bias associated with the OLS estimates. One major cause of concern in interpreting these results is the selection bias stemming from the non-random selection of participants in the NIP and children's non-random enrolment in schools in China. Since the school feeding programme aims to improve the nutritional status of students under compulsory education and from poverty-stricken rural areas, the counties covered by this programme are not randomly selected (Zhang et al., 2015). Moreover, there may be an endogenous sorting of students across schools. For example, schools may track students by their ability or other observed characteristics, and parents may endogenously choose the schools to send their children to (Wang et al., 2018). Another concern is that the OLS results might be biased by unobserved family and school heterogeneity, which may be the true driving force behind the changes in expenditure on children's education (Schanzenbach, 2009). For example, although we have controlled

for household socioeconomic status in our models, unobserved family wealth may bias the estimates on NIP downward because students who have access to the NIP tend to be from less wealthy families, which have a lower tendency to invest in children's education. Consequently, the presence of endogeneity due to selection and omitted variables is likely to bias downward the OLS estimates of the effects of the school feeding programme. Amongst the existing studies on the impacts of the NIP on child outcomes, Wang et al. (2020) employ the OLS regression and propensity score matching (PSM) to analyse cross-sectional data from randomly selected fourth- and fifth-graders in rural primary schools in northwestern China. Wang et al. (2019) and Wang et al. (2021b) utilise a difference-in-difference (DID) estimator to exploit county or individual variations in participation in the NIP using the CEPS and China Health and Nutrition Survey (CHNS) datasets, respectively. However, the DID estimator, which assumes parallel pre-treatment trends between treatment and control groups, may not be suitable for the present study, which focuses on the spending due to potential household consumption smoothing in response to the impacts of welfare programmes on their household budget (Parker, 2017; Stephens Jr, 2003) and universal application of public policy (Bilgrami et al., 2021). Thus, we resort to other approaches that do not rely on the parallel-trend assumption such as that in the DID approach. Future studies can use longer panel data to address the issues of potential consumption smoothing in estimating the impacts of the NIP on household expenditure.

To address this potential endogeneity issue, we employ the Lewbel (2012) approach using a two-stage least squares (2SLS) estimator.² The Lewbel (2012) approach relies on internally generated instruments based on a heteroskedastic covariance restriction to establish causality. It does not require satisfying any exclusion restriction. It has been widely used in the existing literature as a robustness check on findings with traditional instruments or when external instruments are unavailable (Churchill and Smyth, 2017; Loy et al., 2016; Umberger et al., 2015). The findings of previous studies using this method suggest that the resulting instrumental variable (IV) estimates are very close to those using conventional validated IVs (Mishra and Smyth, 2013; Umberger et al., 2015).

The estimation problem of the current study can be summarised as follows:

$$\text{eduexp}_i = \beta_1 X + \gamma_1 \text{NIP} + \epsilon_1 \quad \epsilon_1 = \alpha_1 U + V_1 \quad (2)$$

$$\text{NIP} = \beta_2 X + \epsilon_2 \quad \epsilon_2 = \alpha_2 U + V_2 \quad (3)$$

where U denotes the unobserved characteristics that can affect both the status of participation in the school feeding programme and household expenditure on children's education. V_1 and V_2 are idiosyncratic errors.

Lewbel (2012) suggests that there is a vector Z of observed exogenous variables that satisfy the conditions that $E(X\epsilon_1) = 0$, $E(X\epsilon_2) = 0$, $\text{Cov}(Z, \epsilon_1\epsilon_2) = 0$, and there is some heteroskedasticity in ϵ_j . The vector Z can be a subset of X or equal to X . Under these conditions, $[Z - E(Z)]\epsilon_2$ can be a vector of valid instruments that satisfy the standard rank condition. However, ϵ_2 is unobservable, and consistent estimates of ϵ_2 are required to create these instruments. In this study, we regress the school feeding programme participation status on X and then obtain the residuals $\hat{\epsilon}_2$, which are consistent estimates of the reduced form error ϵ_2 . The estimated residuals are then used to create $[Z - E(Z)]\hat{\epsilon}_2$ as instruments for estimation.

In addition to the Lewbel (2012) approach, we use five other approaches, i.e., PSM, the Oster (2019) test, a kinky least squares estimator for instrument-free causal inference, and an estimator for quantifiable bias in causal inference and a falsification test, to check the robustness of the baseline results. In addition, we employ an alternative dataset. We explain each of these approaches and present their results in the robustness checks.

4. Main Results

We first examine the relationship between participation in the NIP and the total and specific categories of expenditure on children's education for the full sample. Table 2 presents the OLS and Lewbel (2012) 2SLS estimates. In all estimations, we include a full set of controls, as specified in Table A1, as well as county fixed effects. After controlling for other factors that are potentially correlated with human capital investments, the OLS results in model 1 show that for rural children, the NIP is associated with an enhancement in total household education expenditure. Specifically, being offered free school meals in 2013 is associated with a 0.159 standard deviation increase in expenditure on children's education, corresponding to an increase of 43.57 percentage points in the mean household expenditure on children's education. In model 2, we further control for the lagged dependant variable to rule out the possibility that any unobserved individual, family, school and regional heterogeneity drives our estimates. The results show that while the inclusion of lagged expenditure on children's education slightly reduces the estimated coefficient for the school feeding programme participation status, it still has a significantly positive association with total household expenditure on children's education, suggesting that omitted variable bias may not be an issue of great concern in the present study.

In model 3, we employ the 2SLS approach using the Lewbel (2012) IVs to examine the causal effect of school feeding programme exposure. The Breusch–Pagan test for heteroskedasticity is significant, suggesting that the precondition for identification using the Lewbel (2012) IVs has been satisfied in our study.³ The instruments also passed the Kleibergen–Paap rk

² For a more detailed discussion of this approach, see Lewbel (2012).

³ Breusch–Pagan test result: Chi-squared value=59.00, $p = 0.0000$.

Table 2
Participation in the Nutrition Improvement Programme and expenditure on children's education.

Outcome variable	(1) OLS Total education expenditure	(2) OLS Total education expenditure	(3) 2SLS Total education expenditure	(4) OLS In-school expenditure	(5) OLS Out-of-school expenditure
Free school meals in 2013	0.1585*** (2.88)	0.1530*** (2.78)	0.2963*** (4.88)	0.2306*** (3.88)	-0.0463 (-0.64)
Lagged expenditure on children's education		0.1401*** (9.12)			
Control variables	Yes	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes	Yes
N	3514	3514	3514	3514	3514
adj. R ²	0.1803	0.2021	0.1787	0.2145	0.1187
Kleibergen-Paap rk Wald F statistic			370.8405		
p-Value			0.0000		
Hansen J statistic			22.8384		
p-Value			0.1181		

Notes: For the OLS results, the *t* or *z* statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include the full set of controls listed in Table A1. The full results of models 1–3 are presented in Appendix Table A2. The full results of models 4 and 5 are available upon request from the authors.

Wald F test for weak instruments and the Hansen J statistic requirement for over-identification, suggesting that the internally generated instruments are valid. The 2SLS estimates show that for students access to the school feeding programme is positively associated with household education expenditure, which is consistent with the OLS estimates. The estimated effect suggests that participating in the programme can increase the schooling investment in children by 0.296 standard deviations, which is almost double the magnitude of the OLS estimates. Our results imply that, as expected, the OLS estimates are biased downward in the presence of endogeneity issues due to selection and omitted variables; additionally, they are likely to reflect the lower bound of the effect of school feeding programme participation.

Our results are in line with previous findings that the presence of the Dutch Child Benefit System has enhanced parents' marginal propensities to consume child clothing (Kooreman, 2000). One possible explanation for the programme's benefits is that the NIP may considerably relax families' credit constraints by reducing the financial burden imposed by buying children's food, which enables parents to invest more in their children's human capital development, as education is one of the most important means of upward social mobility in rural China (Hou et al., 2020; Mok and Wu, 2016). Another potential reason is the labelling effect, as proposed by Kooreman (2000); that is, the school feeding programme may change parents' preferences for children's human capital investment by making them aware of their children's health and nutrient deficiency and their lower educational performance and cognitive ability (Afridi, 2010).

The magnitude of the estimated effect of the NIP on expenditure on children's education is comparable to the size of the effect of various school feeding programmes in both China and other countries on a wide array of health, nutritional and educational outcomes reported in the previous literature. For instance, existing studies have shown that participating in the NIP can lead to a 0.144 standard deviation increase in height and an increase of 0.22–0.42 standard deviations in height-for-age (Wang et al., 2019). Moreover, Chakraborty and Jayaraman (2019) find that up to five years of exposure to India's midday meal programme can generate an increase of 0.17 standard deviations in students' reading test scores in primary school. This programme has also reduced the level of nutrient deficiency by 10–100 percentage points (Afridi, 2010). Gelli et al. (2019) reveal that the school feeding intervention implemented in Ghana has increased the height-for-age *z* scores of five- to eight-year-old children by 0.12 standard deviations by changing food allocation and sharing at the household level, with the impact being stronger for children from disadvantaged families.

Next, we examine the impact of the school feeding programme on the composition of expenditure of children's education. The results of models 4 and 5 in Table 2 show that programme participation is associated with a 0.23 standard deviation increase in-school education expenditures, while its impact on out-of-school expenditures is not significant. The investigation on the impact of this school feeding programme on extracurricular interest- or academic-related class attendance provides supportive evidence for this finding. We find that students with access to the NIP are 6.49 per cent less likely to enrol in extracurricular classes.⁴ One plausible explanation for this finding is that there is limited availability of shadow education in rural China, especially in the economically poor rural areas targeted by the NIP. However, Zhang and Bray (2015) suggest that the side effects of the 2010 curricular reform, which emphasised the overall development of students, including knowledge, skills, problem-solving activities and moral values, have increased the demand for private supplementary tutoring. To circumvent this problem, schools in rural areas are given the discretion to provide tutoring free of charge or at a very low cost to students on a voluntary basis. With higher trust in schoolteachers, parents are more likely to

⁴ The estimation results are available upon request from the authors.

Table 3
Heterogeneous impacts of the Nutrition Improvement Programme on expenditure on children's education.

	Coefficient	
Panel A: Gender		
Male	0.2310***	(2.90)
Female	0.0717	(0.95)
Panel B: Family economic status		
Low	0.3385***	(2.68)
Medium	0.1605**	(2.49)
High	-0.3034	(-1.12)
Panel C: Parental education		
≤9 years	0.2452***	(3.67)
>9 years	0.0153	(0.14)
Panel D: Left-behind status		
Left-behind children	0.2772***	(3.16)
Non-left-behind children	0.0945	(1.30)
Panel E: Hukou status		
Local students	0.1728***	(3.02)
Non-local students	0.0366	(0.13)
Panel F: Region		
Eastern	-0.2467**	(-2.33)
Central	0.4267***	(2.71)
Western	0.3060***	(3.14)

Notes: The *t* statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include the full set of controls listed in Table A1 as well as county fixed effects. The full results are available upon request from the authors.

arrange in-school tutoring for their children and increase their associated education expenditures. Furthermore, the existing literature has shown that as family income relatively increases, parents tend to increase expenditures on their children's education, health and living conditions, which in this study are crucial components of in-school education expenditures (Qian and Smyth, 2011).

5. Heterogeneity

This section further examines the heterogeneous effects of the school feeding programme on the total expenditure on children's education across subsamples. Panel A in Table 3 presents the heterogeneous effects by child gender based on OLS. The results show that access to the school feeding programme for male children is associated with a 0.231 standard deviation higher household educational expenditure. In contrast, the programme's benefits for female children are not significant, which is consistent with previous findings that boys enjoy higher marginal benefits from NIP exposure in China (Wang et al., 2019). The reason for this result may be related to a strong son preference and high dependence on sons for old-age support in China, particularly in rural areas (Murphy et al., 2011). Moreover, given that rural households have a lower income level than their urban counterparts, rural parents are more likely to allocate the relatively increased household income resulting from participation in the school feeding programme to boys' education (Li et al., 2013).

Panel B in Table 3 presents the estimates of the effects of the school feeding programme on expenditure on children's education by family income level. The results suggest that the positive programme impact is mainly driven by educational investment in children amongst medium- and low-income families. Furthermore, the lower the family income level is, the stronger this positive effect. The F-test results suggest that the differences in effect size between low-income families and medium-income families are not significant, while all differences between low-income/medium-income families and high-income families are statistically significant.⁵ This result is consistent with prior research showing that the nutritional benefits of school feeding programmes are likely to be greater for disadvantaged children than for privileged children, as the former usually start from a lower baseline (Chakraborty and Jayaraman, 2019; Gelli et al., 2019). One possible explanation for our findings is that the household educational investment amongst relatively disadvantaged families is more susceptible to the influence of a relative increase in income as a result of programme exposure (Song and Zhou, 2019). This finding implies that the school feeding programme can substantially relax household budgetary constraints amongst medium- and low-income families, which might facilitate intergenerational upward social mobility for these families through higher human capital investments in their children (Goldthorpe, 2013).

In Panel C in Table 3, we examine whether the impacts of the school feeding programme differ by parental education. The results show that exposure to the school feeding programme can significantly raise educational investment in children with lower parental education, while the programme's effect on educational investment in children with higher parental education is not significant. This result is consistent with our findings of different treatment effects across family income

⁵ F-test results for the difference in effect size of the school feeding programme between low-income families and medium-income families: F -statistic=1.60, $p = 0.2064$; between low-income families and high-income families: F -statistic=5.21, $p = 0.0225$; between medium-income families and high-income families: F -statistic=3.18, $p = 0.0747$.

Table 4
Heterogeneous treatment effects by the gender composition of children amongst families with two or more children.

	(1) Has only female children	(2) Has only male children	(3) Has both female and male children
Female child	0.0396 (0.27)		0.1436 (1.37)
Male child		0.2869* (1.68)	0.3623*** (3.04)

Notes: The *t* statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include the full set of controls listed in Table A1 as well as county fixed effects.

levels in Panel B, as parents with lower educational attainment usually earn less. Similarly, we interpret this finding as possibly the result of a higher impact of the school feeding programme on family credit constraints and parents' preferences for children's health and educational investment.

Moreover, we more closely examine whether the school feeding programme differentially affects household educational expenditure on left-behind children and non-left-behind children. The results in Panel D in Table 3 suggest that school feeding programme participation has a significant and positive association with parental education expenditure on left-behind children, who have been well documented in the existing literature as a vulnerable group in rural China (Song et al., 2014; Wang et al., 2021a). In contrast, the impact of programme participation on education expenditure on non-left-behind children is not significant. The results are consistent with previous findings that the NIP can significantly improve the height of left-behind children, as opposed to that of non-left-behind children, by approximately 0.243 standard deviations (Wang et al., 2019). As suggested by our findings above on the heterogeneous effects of the school feeding programme across family income levels, parental migration can increase family income and relax credit constraints, which may result in a higher schooling investment in left-behind children (Hou et al., 2020) and thus decrease the positive impact of the school feeding programme. However, migrant parents tend to gain more health-related knowledge in urban destinations, reinforcing the labelling effect (Hildebrandt and McKenzie, 2005). Our findings suggest that the latter plays a more prominent role in determining the effects of the school feeding programme on education expenditure on left-behind children.

Since the NIP is funded by both central and local governments, there is a substantial variation in the financial support and quality of the programme across regions (Huang and Han, 2021). In addition, previous research has shown that students without local *hukou* usually have restricted or no access to many public benefits that are mainly funded by local governments (Wang et al., 2018). Therefore, it is imperative to understand better the heterogeneous effects of the school feeding programme on the household expenditure for children's education based on the *hukou* status and region. The results in Panel E in Table 3 suggest that access to the school feeding programme can significantly increase the household expenditure on local children's education, while its impact on the educational investment for non-local children is not significant. The reason may be the lower NIP coverage for those non-local children in rural China. In our sample, 15.83 per cent of local children were offered free school meals in 2013, which is much higher than the non-local children (8.46 per cent). In Panel F in Table 3, the school feeding programme leads to a sizeable and statistically significant increase in household investment in children's education in the central and western regions, but a significant decrease in household education expenditure on children in the eastern region. There has been a reorientation of migration routes from the coastal provinces towards inland provinces in recent years (Csanádi et al., 2015). Thus, our results imply that the school feeding programme may have promoted socioeconomic development in the central and western provinces and reduced the regional inequality in China.

Thus far, the underlying assumption of this study is that the school feeding programme can promote household education expenditure on children who are directly exposed to this programme. However, as discussed above, both the theoretical models and the empirical results suggest that there might be intrahousehold resource reallocation in response to the school feeding programme, leading to smaller gains for programme participants. To test whether this is the case in China, we examine the different effects of the school feeding programme across different types of families, as defined by the gender composition of children amongst families with more than one child. The results of this analysis are shown in Table 4. We find that participating in the school feeding programme can significantly increase education expenditure on male children, especially for those with female siblings, while it has no significant association with that on female children. Our findings are likely to imply the presence of intrahousehold resource reallocation away from female children receiving free school meals to other household members and that amongst families with all male children, parents may withdraw more resources from male free meal recipients than those amongst families with both male and female children. This result is consistent with previous findings in South Asia and Africa countries with a well-known male bias (Chakraborty and Jayaraman, 2019; Kazianga et al., 2014).

6. Mechanisms

In this section, we explore the potential channels through which the school feeding programme can affect household expenditure on children's education. Specifically, we examine whether family economic status, parental time investment in children's education, and children's health status and cognitive ability mediate the relationship between school feeding programme participation and expenditure on children's education. Table 5 presents the results of the mechanism analysis.

Table 5
Mechanism analysis.

	(1) Family economic status	(2) Cognitive ability	(3) Body mass index (BMI)	(4) Mental health	(5) Homework tutoring	(6) Hours spent on homework tutoring
Free meals in 2013	0.1293*** (3.28)	0.2803*** (5.77)	0.0751** (2.04)	1.8477*** (3.29)	0.0736** (2.14)	0.1015** (2.30)
N	3514	3485	3514	3426	3476	3490
adj. R ²	0.1975	0.4727	0.0221	0.1090	0.0764	0.0647

Notes: The *t* statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include the full set of controls listed in Table A1 as well as county fixed effects. The specification in column 1 does not include family economic status, and the specifications in columns 3–4 do not include self-reported health status. The full results are available upon request from the authors.

First, we examine the mediating role of family economic status in the observed association in the present study. We find that children's exposure to the school feeding programme can significantly improve the family economic status assessed by their parents. This result is consistent with a large body of literature finding a remarkable income effect produced by school feeding programmes (Afridi, 2010; Kazianga et al., 2014). However, the results presented in Table A2 show that family economic status has no significant effect on expenditure on children's education. One possible reason for this result might be the presence of misclassification bias associated with self-reported family economic status (Rosenman et al., 2011). To attenuate the risks of over-reporting or under-reporting of family income status, we recode this variable as a dummy variable equal to one if parents reported that their family economic status was 'high' or 'very high' and zero otherwise. We re-estimate model 1 in Table 2 and find that both the school feeding programme and family economic status have a significant and positive effect on household spending on children's education. The estimated coefficient for the school feeding programme is 0.1539 and significant at the 1 per cent level, and the coefficient for family economic status is 0.1219 and significant at the 10 per cent level. The estimated programme benefits are quantitatively similar to those when the family economic status is measured on a scale.

Second, we examine whether the effects of the school feeding programme are channelled through children's health status and cognitive ability.⁶ Two salient measures of health outcomes, BMI and mental health, are employed to examine the impact of the school feeding programme on children's health status.⁷ The results in models 2–4 in Table 5 show that school feeding programme exposure is associated with higher cognitive ability, better mental health scores and a higher probability of having a BMI within the healthy range.⁸ The Becker and Tomes (1976) model posits that the investment decisions of parents are determined by efficiency. An increase in children's cognitive ability and health status may imply a higher return on human capital investment. Consequently, parents may adopt a reinforcement strategy by investing more in their children in response to the improvement in their children's cognitive and health conditions (Rosales-Rueda, 2014). In addition, the significant improvement in cognitive ability and health status might make parents more aware of their children's deficiency in these areas and, in turn, induce more human capital investment. This finding may provide suggestive evidence for our argument above on the labelling effect.

Third, we explore whether parental time investment in children's education is a potential mechanism underlying the estimated effects of the school feeding programme. We investigate the impact of programme participation on whether parents were involved in homework tutoring in the previous week and the number of hours parents spent on homework tutoring with their children (in logarithmic form). The results in models 5–6 in Table 5 suggest that parents whose children are enrolled in the school feeding programme are more likely to supervise their children's homework and that their time spent on homework tutoring increases by approximately 10 per cent. There is extensive evidence for the existence of parent-child information friction, especially amongst poor parents (Dizon-Ross, 2019), which can affect their decision-making in many domains, including education (Bergman, 2021) and health (Fitzsimons et al., 2016). As evidenced by our findings above, school feeding programme participation can improve family economic status and ease parents' financial burden, allowing parents to spend more time on their children's education. More parental involvement in homework tutoring can considerably reduce the information barriers between parents and their children, significantly promoting investments in children's education and improving their academic performance (Bergman, 2021; Dizon-Ross, 2019).

⁶ The CEPS conducted a standardized cognitive ability test for each student based on the three-parameter logistic (3PL) model.

⁷ The CEPS collected information on students' frequency of experiencing the following feelings during the previous seven days on a scale from 1 (always) to 5 (never): depressed, unable to concentrate, blue, unhappy, not enjoying life, unexcited, sad, nervous, excessively worried, feeling that something bad will happen, and inattentiveness in class. The total mental health scores are constructed by summing these item scores. The higher the total scores are, the better the mental health.

⁸ We also employ a factor analysis to construct a summary index of children's mental health. The estimation results are qualitatively similar to those reported in model 4 in Table 5. These results are available upon request from the authors.

Table 6
Robustness check – Results from propensity score matching.

	Expenditure on children's education
Nearest neighbour matching	0.1183*** (3.06)
Kernel matching	0.1225*** (2.97)
Stratification matching	0.1261*** (3.17)
N	3514

Notes: The t statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The full results are available upon request from the authors.

Table 7
Robustness check – The Oster (2019) test.

	(1) Baseline effect $\hat{\beta}$ (S.E.) [R^2]	(2) Controlled effect $\tilde{\beta}$ (S.E.) [R^2]	(3) Bias-adjusted $\hat{\beta}^* R_{max}=1.3R$ (bootstrapped S.E.)	(4) δ for $\beta=0$ given R_{max}
Total education expenditure	0.0326 (0.0370) [0.0002]	0.1585 (0.0550) [0.1803]	0.2833 (0.0933)	-9.02
In-school expenditures	0.0305 (0.0408) [0.0001]	0.2306 (0.0595) [0.2145]	0.4442 (0.1184)	-5.82
Out-of-school expenditures	0.0146 (0.0508) [0.0000]	-0.0463 (0.0727) [0.1187]	-0.0948 (0.1160)	-2.80

7. Robustness Checks

We conduct several robustness checks to examine the reliability of our results. First, we employ PSM to mitigate the potential selection bias generated by the observed individual, school and county heterogeneity. We use the kernel, nearest neighbour and stratification methods separately to perform the matching and then compare the mean difference in total expenditure on children's education for all matched pairs. The results based on all three matching methods, which are presented in Table 6, suggest that exposure to the school feeding programme is associated with higher expenditure on children's education, which is consistent with our main findings presented in Table 2.⁹ Notably, PSM eliminates the potential selection bias based only on observed characteristics rather than unobserved heterogeneity, and it compares only the matched observations, ignoring unmatched observations (Wang et al., 2016).

Second, we employ the method proposed by Oster (2019) to check whether our main results are biased by unobserved heterogeneity.¹⁰ The results of this test are presented in Table 7. Columns 1–3 report the estimated effects of the school feeding programme with no controls, the complete set of controls listed in Table A1, and both the full set of controls and unobservables, respectively. The bias-adjusted treatment effects on the total education expenditure and in-school education expenditures in column 3 are still significant and positive, meeting the robustness standards suggested by Oster (2019) because the bounds of the set $[\tilde{\beta}, \hat{\beta}^*(R_{max}, 1)]$ do not include zero and fall within ± 2.8 standard errors of the controlled estimates. The values of δ are all negative, while their absolute values exceed one. The reason is that the inclusion of controls moves the coefficient on the school feeding programme away from zero instead of towards zero. This finding further strengthens our argument that the OLS estimates are likely to reflect the lower bound of the effect of the school feeding programme. The magnitude of the bias-adjusted treatment effects suggests that participating in the school feeding programme can increase the total education expenditure and in-school education expenditures by 0.283 and 0.444 standard deviations, respectively, which is very close to the 2SLS estimates in model 3 in Table 2. The Oster (2019) test results suggest that the estimated impacts of the school feeding programme are robust and unlikely to be severely confounded by unobserved characteristics.

The Oster (2019) approach imposes restrictions on the magnitude of the correlation between the endogenous variable and other control variables compared to the correlation between the endogenous variable and the structural error term to bound this sensitivity parameter. In the third robustness check, we employ a kinky least squares model, which places bounds directly on the correlation between the endogenous variable and the error term (Kiviet, 2013;2020; Kripfganz and Kiviet, 2021). Since unobservables (e.g., unobserved family wealth) might bias the estimate downward, the correlation between the NIP and error term should be negative. Thus, we set the postulated endogeneity of NIP to be negative and in the range of -0.5 to zero. Fig. 1 illustrates the kinky least squares estimates, which are consistent with the findings from the IV results using the Lewbel (2012) approach and the Oster (2019) approach that the NIP has a positive effect on total education expenditure.

⁹ Table A3 reports the balancing test results for each observed covariate and the overall balancing properties of the matching. The results demonstrate that the programme participants and non-participants are well balanced.

¹⁰ For a detailed discussion of this approach, see Oster (2019).

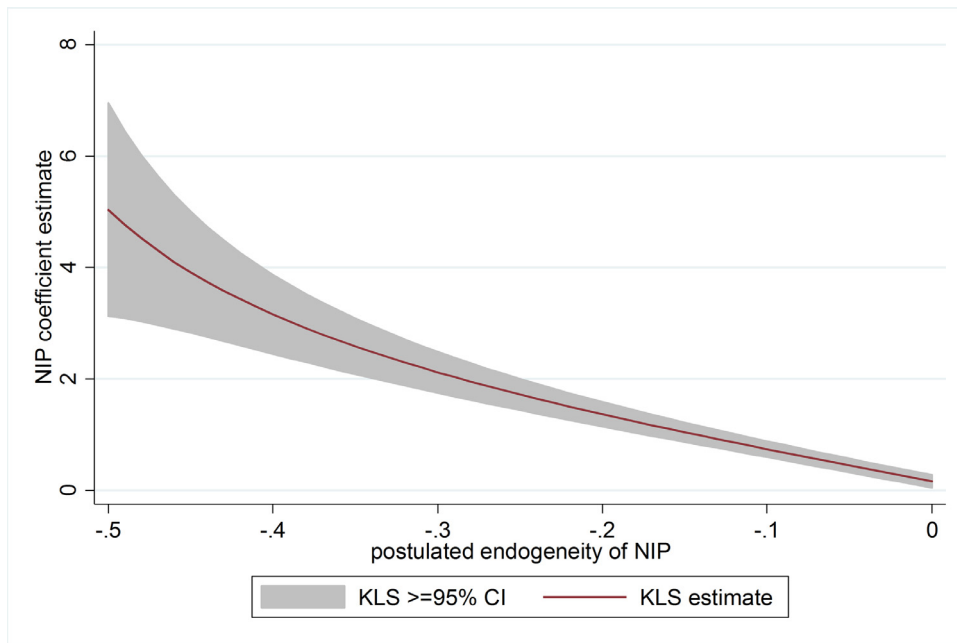


Fig. 1. Kinky least squares coefficient estimates for the Nutrition Improvement Programme.

Fourth, we employ an approach to quantify the per cent bias necessary to invalidate an inference from a Rubin causal model framework (Frank et al., 2013; Xu et al., 2019). The results show that, to invalidate the inference of a positive effect of the NIP on total education expenditure, 43 per cent of the estimates would have to be caused by bias at the 10 per cent significance level. In other words, to invalidate the inference, 43 per cent of the cases would have to be replaced with cases for which there is a zero effect. In sum, the results from this approach suggest that our findings are consistent with findings from the checks using Oster (2019) and the kinky least squares model.

Fifth, we perform a falsification test following Chakraborty and Jayaraman (2019), who checked whether the true treatment effect of the midday meal programme was biased downward or upward by examining the impact of the placebo program exposure on the learning achievement of children. We restrict our sample to students who do not participate in the NIP, and then, 14.54 per cent of students, which is based on the actual programme proportion rate, are randomly assigned to the treatment group. We estimate the effects of the falsified school feeding programme participation status on expenditure on children's education and conduct the regression with a reduced sample 2000 times. We expect a null treatment effect, as these students were potentially not exposed to the programme. Fig. 2 plots the distribution of the estimated coefficients on the effects of falsified school feeding programme exposure. We see that the distribution of the estimated coefficients from the reduced samples centres around zero and that approximately 90 per cent of the estimated coefficients are not significant. The findings of this falsification exercise provide strong evidence that our main results are robust.

Finally, we employ another dataset, namely, the 2017 China Institute for Educational Finance Research-Household Survey (CIEFR-HS), to examine the relationship between the school feeding programme and the expenditure on children's education. The CIEFR-HS is a nationally representative survey conducted jointly by the China Institute for Educational Finance Research and the Survey and Research Centre for China Household Finance at Southwestern University of Finance and Economics in China. The survey employs a stratified three-stage probability proportion to size random sample design. The 2017 wave covers 127,000 individuals and 40,011 households from 355 cities/districts/counties across 29 mainland provinces. The CIEFR-HS collects detailed information on household education expenditure, the school feeding programme participation status in the previous year, and a wide range of personal, family and school characteristics.

We focus on primary and junior high school students under compulsory education in rural areas. In total, there are 4071 valid responses in our analytical sample. Amongst them, 491 students (12.06 per cent) participated in the school feeding programme in the previous year. The proportion of students participating in the school feeding programme in the CIEFR-HS data is close to that in the CEPS data. The total education expenditure in logarithmic form for students with access to the school feeding programme is 6.98, while that for non-participants is 5.27, which is qualitatively consistent with but slightly higher than the findings based on the CEPS. Column 1 in Table 8 presents the OLS and PSM estimates of the effect of the school feeding programme on expenditure on children's education for the full sample. We find that exposure to this programme can significantly increase household expenditures on children's education by 0.20–0.25 standard deviations. Given that our main findings are derived from junior high school students, we further examine the heterogeneous effects of the school feeding programme across primary and junior high school students, drawing on the 2017 CIEFR-HS.

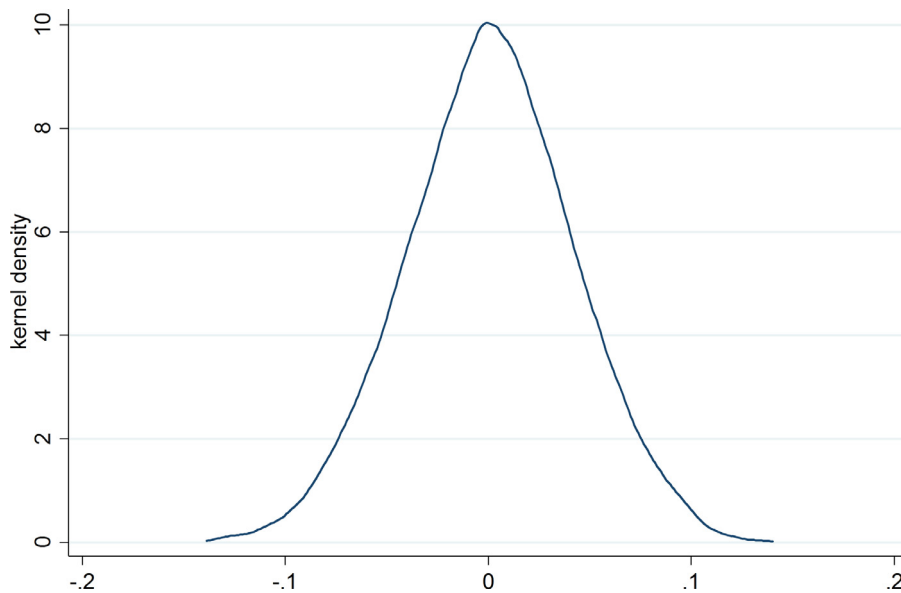


Fig. 2. Distribution of the estimated coefficients on falsified exposure to the Nutrition Improvement Programme.

Table 8

Robustness check – Results based on data from the 2017 China Institute for Educational Finance Research-Household Survey.

Dependant variable: expenditure on children's education	(1) full sample: primary and junior high school students	(2) subsample: primary school students	(3) subsample: junior high school students
Panel A: OLS results			
Free meals in the prior year	0.2507*** (7.57)	0.2213*** (5.45)	0.3308*** (5.77)
N	4071	2909	1162
adj. R ²	0.4583	0.4537	0.4548
Panel B: PSM results			
Nearest neighbour matching	0.2170*** (4.98)	0.1907*** (3.54)	0.2442*** (2.91)
Kernel matching	0.2052*** (5.01)	0.1872*** (3.63)	0.2434*** (3.03)
Stratification matching	0.2000*** (4.52)	0.1970*** (3.51)	0.2398*** (2.74)

Notes: The *t* statistics are in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The full results are available upon request from the authors.

The results in columns 2–3 in Table 8 show that being offered free school meals in the previous year has a significant and positive association with schooling investments in both primary and middle school students. This result implies that our main conclusions may be generalised to students at all grades of compulsory education. In general, the results based on the 2017 CIEFR-HS reaffirm our findings in Table 2.

8. Conclusion

In this study, we examine the impact of the NIP on household education expenditure on students under compulsory education. We find that exposure to this school feeding programme can significantly increase investment in children's education, especially in-school education. There is considerable heterogeneity in the treatment effects across subsamples. In general, males and vulnerable children, such as children from medium- and low-income families with lower parental education and left behind by their parents, are likely to benefit more from this school feeding programme. It appears that this programme may facilitate intergenerational upward social mobility for disadvantaged families through higher human capital investments in their children. We also find suggestive evidence of intrahousehold resource reallocation away from eligible female children to other household members in response to the school feeding scheme. We conduct several robustness checks to address the potential selection bias and omitted variable bias in examining the association between programme participation and expenditure on children's education and employ data from another nationally representa-

tive survey to examine both the internal and external reliability of our main conclusions. The results confirm our general findings.

The mechanism analysis shows that the positive relationship between the school feeding programme and expenditure on children's education can be mediated by family economic status, parental time investment in children's education, and children's health status and cognitive ability. Children's exposure to the school feeding programme can relax family credit constraints on educational investment and significantly improve children's cognitive ability and health status. Parents are likely to adopt a reinforcement strategy by investing more in their children in response to the children's human capital improvement. Moreover, participating in the programme can increase parental time investment in children's education, which might considerably reduce parent-child information friction and, in turn, induce more educational investments.

Our results have some important practical implications. In addition to the promotion of intergenerational upward social mobility mentioned above, our findings imply that the school feeding programme might narrow the income inequality within rural areas and between rural and urban areas by promoting human capital investment in rural areas, especially for disadvantaged children. Therefore, the Chinese government needs to allocate more generous financial support, enhance the standard of the nutritional dietary allowance and extend the coverage of the NIP to promote the programme's benefits further. However, the findings of this study suggest that females benefit little from this programme. To circumvent this problem, China's central and local governments should introduce more policies to reduce the degree of son preference in rural areas and improve the NIP to realise equal benefits for all rural children.

Some main challenges facing the NIP are the quality of meals and a lack of sufficient financial and human resources (Wang et al., 2020). Indeed, the rapidly increased prices for staple foods have added much financial pressure on the sustainability of the programme (Huang and Han, 2021). Although the Chinese government covers most of the food spending, the participating schools must cover most of the running costs for their canteens, such as electricity, water and labour. Some suggest co-contribution from students' families to the school feeding programme to maintain its financial viability. However, our findings imply that requiring families to make co-contribution may reduce their private education spending. The implementation of the NIP mainly depends on the attitudes of local officials because it is not a legislative requirement to provide school feeding (Huang and Han, 2021). Thus, one potential approach to strengthen the NIP is legislating the financial and logistic support for providing school feeding. In 2020, the school feeding programmes cost 161 countries 43 billion USD, where 90 per cent of the funding came from governments (World Food Programme, 2020). The overall costs of school feeding programmes are low or moderate in low- and middle-income countries relative to the overall public expenditure on education (Gelli and Daryanani, 2013). As China grows richer, there should be sufficient fiscal capacity to widen and improve its school feeding programme. More importantly, the school feeding programme can potentially provide additional benefits beyond improved health and academic outcomes.¹¹

Author agreement

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We understand that the Corresponding Author is the sole contact for the Editorial process. He is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

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Appendix

¹¹ Since the economic reforms, the Party-state has retreated from welfare equality in areas such as free provisions of housing, jobs, health care and higher education (Cheng & Beresford, 2012; Cheng et al., 2015; Gao et al., 2013). The proportion of government total expenditure on education relative to GDP decreased from 4.1 per cent in 2017 to 3.5 per cent in 2019 (UNESCO Institute for Statistics, 2020), which raises concerns about the commitment of the Party-state to public spending on education. This value is considerably lower than the average public spending on education (approximately 5 per cent of GDP) in OECD countries. Our findings suggest that investing more public funds on education is beneficial for encouraging private spending on education.

Table A1
Summary statistics of the control variables, 2014 China Education Panel Survey.

Variable	Definition	Mean	SD
Male	Male =1, female=0	0.51	0.50
Age	Years	13.65	0.75
Health status	Scale: very unhealthy=1; very healthy=5	3.82	0.92
Local <i>hukou</i>	Local <i>hukou</i> (household registration) =1, non-local <i>hukou</i> =0	0.82	0.38
Left-behind child	Being left behind by at least one parent=1, otherwise=0	0.24	0.43
Boarding status	Boarding school student=1, otherwise=0	0.05	0.22
Scores	Average test scores in Chinese, math and English in logarithmic form in 2013	4.25	0.12
Free books	Exempted from paying fees for textbooks in 2013=1, otherwise=0	0.15	0.35
Family economic status	Family economic status (scale: very poor=1, very rich=5)	2.82	0.61
Siblings	Number of siblings	0.97	0.88
Parental education	Highest number of years of parental education	9.73	2.37
Parental expectations	Parents' educational expectations of their children (scale: very low=1, very high=9)	6.62	1.74
Class size	Class size	38.54	13.33
Class rank	The ordinal class ranking in academic records within the same grade (scale: worst=1, best=5)	3.49	1.04
public school	enrolled in a public school=1, otherwise=0	0.92	0.27
School rank	The ordinal school ranking in academic records within the same county (scale: worst=1, best=5)	3.62	0.84
Region			
Urban–rural fringe	Reference group	0.21	0.41
Town outside the city		0.40	0.49
Village		0.39	0.49

Table A2
Participation in the Nutrition Improvement Programme and expenditure on children's education – Full results.

	(1) OLS	(2) OLS	(3) Lewbel-2SLS
Free meals in 2013	0.1585*** (2.88)	0.1530*** (2.78)	0.2963*** (4.88)
Lagged expenditure on children's education		0.1401*** (9.12)	
Male	-0.0580** (-2.11)	-0.0495* (-1.82)	-0.0583** (-2.15)
Age	-0.0980 (-0.26)	-0.0849 (-0.23)	-0.1382 (-0.37)
Age ²	0.0028 (0.20)	0.0025 (0.19)	0.0044 (0.32)
Health status	0.0112 (0.76)	0.0082 (0.56)	0.0122 (0.83)
Local <i>hukou</i>	0.0465 (1.15)	0.0343 (0.85)	0.0473 (1.18)
Left-behind child	0.0211 (0.64)	0.0155 (0.48)	0.0214 (0.66)
Boarding status	0.8277*** (18.92)	0.7917*** (17.66)	0.8287*** (18.94)
Scores	0.1857 (1.51)	0.2010* (1.66)	0.1950 (1.60)
Free books	0.0300 (1.06)	0.0343 (1.23)	0.0287 (1.02)
Family economic status	0.0282 (1.15)	0.0298 (1.23)	0.0275 (1.14)
Siblings	-0.0322* (-1.91)	-0.0241 (-1.50)	-0.0237 (-1.48)
Parental education	0.0050 (0.77)	0.0061 (0.97)	0.0060 (0.94)
Parental expectations	0.0253*** (3.03)	0.0215*** (2.60)	0.0261*** (3.14)
Class size	0.0004 (0.23)	0.0017 (1.04)	0.0006 (0.36)
Class rank	0.0332** (2.38)	0.0310** (2.24)	0.0330** (2.37)
Public school	-0.4551*** (-4.57)	-0.3734*** (-3.80)	-0.4652*** (-4.72)
School rank	0.0186 (0.85)	0.0188 (0.88)	0.0277 (1.29)

(continued on next page)

Table A2 (continued)

	(1) OLS	(2) OLS	(3) Lewbel-2SLS
Region			
Town outside the city	-0.0115 (-0.18)	0.0041 (0.07)	-0.0045 (-0.07)
Village	-0.0098 (-0.14)	-0.0138 (-0.20)	-0.0229 (-0.32)
Constant	0.0827 (0.03)	-0.1808 (-0.07)	-0.3023 (-0.11)
County fixed effects	Yes	Yes	Yes
N	3514	3514	3514
adj. R ²	0.1805	0.2023	0.1787
Kleibergen-Paap rk Wald F statistic			370.8405
p-Value			0.0000
Hansen J statistic			22.8384
p-Value			0.1181

Notes: The *t* statistics are in parentheses; * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Table A3

Balance test for propensity score matching.

Panel A: Testing the balancing property for each observed covariate					
Variable	Matched (M) or Unmatched (U)	Treated (access to free meals)	Control (no access to free meals)	<i>t</i>	<i>p</i> > <i>t</i>
Male	U	0.4677	0.5138	-1.9300	0.0540
	M	0.4677	0.4687	-0.0300	0.9750
Age	U	13.8240	13.6170	5.7500	0.0000
	M	13.8240	13.7950	0.5700	0.5670
Age ²	U	191.7500	185.9800	5.7900	0.0000
	M	191.7500	190.9500	0.5700	0.5700
Health status	U	3.8200	3.8198	0.0000	0.9980
	M	3.8200	3.8035	0.2800	0.7770
Local hukou	U	0.8982	0.8125	4.7300	0.0000
	M	0.8982	0.8942	0.2100	0.8320
Left-behind child	U	0.3033	0.2274	3.7300	0.0000
	M	0.3033	0.2955	0.2700	0.7850
Boarding status	U	0.0196	0.0566	-3.5200	0.0000
	M	0.0196	0.0218	-0.2500	0.8030
Scores	U	4.2438	4.2521	-1.3900	0.1630
	M	4.2438	4.2452	-0.1800	0.8590
Free books	U	0.5734	0.4925	3.3800	0.0010
	M	0.5734	0.5666	0.2200	0.8280
Family economic status	U	2.7554	2.8332	-2.6500	0.0080
	M	2.7554	2.7496	0.1500	0.8800
Siblings	U	1.0294	0.9634	1.5600	0.1180
	M	1.0294	1.0250	0.0700	0.9410
Parental education	U	9.3151	9.8055	-4.3400	0.0000
	M	9.3151	9.3977	-0.5500	0.5830
Parental expectations	U	6.4540	6.6487	-2.3400	0.0190
	M	6.4540	6.4590	-0.0400	0.9650
Class size	U	37.8470	38.6610	-1.2800	0.2020
	M	37.8470	37.0060	1.0000	0.3180
Class rank	U	3.7886	3.4422	6.9800	0.0000
	M	3.7886	3.7750	0.2500	0.8050
School rank	U	3.5851	3.6230	-0.9400	0.3480
	M	3.5851	3.5750	0.2000	0.8380
Town outside the city	U	0.2740	0.4199	-6.2600	0.0000
	M	0.2740	0.2810	-0.2500	0.8010
Village	U	0.6008	0.3573	10.5800	0.0000
	M	0.6008	0.5851	0.5100	0.6090
Panel B: Testing the overall balance					
	Pseudo R ²	LR chi ²	<i>p</i> > chi ²	Mean Bias	Med Bias
Unmatched	0.0790	229.2300	0.0000	76.3	0.7300
Matched	0.0010	1.9100	1.0000	8.6000	1.9400

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