The Cost of a School Meal

LONGITUDINAL EVIDENCE ON SPENDING, NUTRITIONAL QUALITY, AND ECONOMIES OF SCALE FROM 216 PROGRAMS

Biniam Bedasso and Amina Mendez Acosta

Abstract

School meals have proven effective in improving child outcomes, particularly in low-income settings. Yet concerns about funding adequacy and cost efficiency remain. This paper analyzes data from three waves of the Global Child Nutrition Foundation (GCNF) survey (2018–2023), covering 216 programs from 102 countries to document cost patterns and scaling dynamics. Additionally, we examine how cost per child varies with implementation models, sourcing strategies, and targeting approaches. We report five main findings. First, majority of the programs, especially in low-income and large-scale settings, are underfunded relative to the cost of a healthy meal. Second, school meal programs in lower-income countries tend to offer less diverse meals, and adjusting for nutritional diversity reveals that achieving comparable dietary quality would significantly raise their per-child costs. These adjustments are especially relevant for disadvantaged children, who face the greatest risk of nutrient deficiency and would benefit most from more diverse meals. Third, local food sourcing is associated with more cost-efficient implementation—after accounting for dietary diversity—while on-site meal preparation is linked to higher costs among better-resourced programs. Fourth, programs that target recipients individually tend to be cheaper, but only for higher-income countries. Finally, despite offering less diverse meals, programs in lower-income countries exhibit greater economies of scale—expanding coverage faster relative to cost increases.

KEYWORDS
School meals, cost efficiency, funding, low- and middle-income countries

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The Cost of a School Meal: Longitudinal Evidence on Spending, Nutritional Quality, and Economies of Scale from 216 Programs

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1. Introduction

School meal programs have become a core component of human development and social protection strategies across a wide range of countries. Over the past decade, coverage has expanded significantly in low- and middle-income countries, alongside advances in policy frameworks and increased domestic financing (WFP, 2013; WFP, 2022). In 2022 alone, school meal programs reached more than 400 million children in over 170 countries (GCNF, 2024). There is substantial evidence on the positive impacts of school meals on school access and learning, nutrition and physical well-being, and to some extent, social protection (Alderman, Bundy, and Gelli, 2024; Mendez Acosta and Bedasso, 2024; Snilstveit et al., 2015).

Yet as school meal programs grow in scale and ambition, important questions remain about how to finance them sustainably and deliver them efficiently. This is particularly important considering some evidence showing the provision of school meals as effective but relatively expensive intervention to improve specific outcomes when evaluated in isolation (Banerjee et al., 2023; Kristjansson et al., 2016). With growing pressure on public budgets and increasing demands on school feeding to meet multisectoral goals, understanding the cost dynamics and programming trade-offs is more critical than ever. Although previous studies have explored these issues, the most comprehensive global cost comparison to date by Gelli and Daryani (2013) is now over a decade old and predates the significant expansion of national school feeding systems. In today's context, where low- and middle-income countries are channeling scarce domestic resources into school meals, new comparative evidence is needed to inform decisions about how to balance cost, quality, and scale.

This paper uses data from three waves of the Global Survey of School Meal Programs conducted by the Global Child Nutrition Foundation (GCNF) between 2018 and 2023 to generate updated global benchmarks on school feeding costs and scaling dynamics. Drawing on responses from more than 200 programs in over 100 countries, we build a longitudinal dataset of standardized, annualized cost per child and adjust these figures for meal diversity using two alternative dietary quality frameworks. This allows us to examine both raw and quality-adjusted costs, and to assess how costs vary across income groups and program design features—such as targeting approach, procurement system, and delivery modalities. We also track changes in program coverage and cost over time to assess economies of scale.

The paper also contributes to a broader understanding of equity in school meal delivery. Since disadvantaged children are more likely to experience food insecurity and undernutrition, the cost implications of providing nutritionally adequate and diverse meals are especially salient. The analysis presented here highlights how program design and resource allocation intersect with the goal of reaching those who stand to benefit the most as efficiently as possible.

Our findings reveal wide disparities in both spending levels and nutritional quality. While spending in higher-income countries has increased by two to three times between 2018 and 2023, cost

increases in lower-income settings are more modest. Many lower-income countries provide meals that are less nutritionally diverse and often exclude costlier food groups, such as animal proteins. Evaluating school meal costs requires accounting for funding adequacy. Using both subjective and objective measures, we find that budget adequacy improves with income, but many programs—especially in low- and middle-income countries—remain underfunded, particularly at larger scale. Among program characteristics, we find that local food sourcing is linked to more cost-efficient implementation (after adjusting for meal diversity), while on-site meal preparation is associated with higher costs in better-funded programs. Individual targeting is associated with lower costs, but only in upper-middle and high-income countries. Finally, we find that programs in lower-income countries tend to exhibit greater economies of scale—that is, they expand coverage more rapidly relative to the increase in cost.

This paper contributes to the literature in two ways. First, by pooling and harmonizing data across three survey waves, we can construct a unique panel that captures time-dependent trends and allows for medium-term analysis of cost and coverage dynamics. Second, we introduce two new metrics—one for quality-adjusted cost and another for the cost of scaling—that can help policy makers and researchers compare programs in a more nuanced way, even in the absence of detailed data on meal composition or delivery models.

The rest of the paper is divided into the following sections: Section 2 provides an overview of the literature and policy debates around school feeding costs; Section 3 outlines the data source and the method of standardization that we employ together with the metrics we use for comparing cost and quality across programs; Section 4 discusses the results, and Section 5 concludes.

2. Literature review: cost and efficiency of school meal programs globally

The cost and efficiency of school meal programs have garnered increasing policy and academic attention, especially with the rapid expansion of these programs across diverse global contexts in recent decades. Researchers have attempted to map cost structures, identify determinants of cost variation, and analyze cost-efficiency trade-offs. This review synthesizes key findings from the empirical and policy literature, highlighting trends, challenges, and research gaps.

One of the earliest comparative cost analyses, conducted by Horton (1992), revealed substantial variation across programs. The annual cost of delivering 1,000 calories per student per day ranged from US$19.25 to US$208.59 (in 1989 dollars), with a mean cost of US$88.74. These findings positioned school meal programs as broadly comparable to other types of feeding interventions and established early benchmarks for further inquiry.

Subsequent work by Gelli et al. (2011), based on 78 school feeding projects across 62 countries, provided a more standardized global picture. The average annual cost per child for 200 days of provision was US$48, excluding school-level expenses. Cost varied by program modality: biscuit-based programs were the least expensive at US$23 per child for 300 kcal, while take-home rations were the most costly at US$75; combined modalities averaged US$61. Commodity costs accounted for approximately 58% of total program costs, underscoring how food type and delivery approach shape overall expenditures.

Gelli and Daryani (2013) extended this analysis across 74 countries, documenting sharp disparities by national income level. The average annual cost of school feeding was US$173 per child, but ranged from US$54 in low-income countries to US$693 in high-income countries. In poorer settings, school feeding represented a much larger fiscal commitment, equivalent to 68% of per capita spending on primary education, compared to 19% in middle-income and just 11% in high-income countries. Partly due to these higher relative investment requirements, coverage remained limited, with only 13% of primary school children reached in low-income countries compared to 18% in middle-income contexts (as of 2013). This suggests that while the unit cost of school feeding becomes relatively more manageable as economies grow, fiscal and infrastructural barriers constrain program scale in low-resource settings.

Recent data from the 2024 Global Survey of School Meal Programs by the Global Child Nutrition Foundation (GCNF, 2024) further illuminate these trends. The survey reports that across 169 countries, a total of 408.2 million children received food through their schools in the 2022 school year. The average annual cost per child varied significantly by region, with programs in low-income countries averaging US$46 per child per year, while those in high-income countries averaged US$429 per child per year. These figures highlight the persistent disparities in program costs and the challenges faced by lower-income countries in financing comprehensive school meal programs.

Other studies have reinforced the importance of national income levels and program maturity in driving cost-efficiency. Bundy et al. (2011) observed a nonlinear decline in the share of school feeding costs in education spending relative to GDP, highlighting the role of economies of scale, administrative improvements, and procurement efficiencies. Yet opportunities for cost containment remain largest in low-income countries, where fragmentation and logistical challenges persist.

Innovations in delivery models also influence cost dynamics. Gelli and Suwa (2014) examined cluster kitchens, which emphasize community engagement while centralizing food preparation. Although these models offer quality improvements, their early-stage costs exceeded benchmarks for both low- and middle-income countries, largely due to high start-up and support costs. In an earlier contribution, Miller del Rosso (1999) emphasized that leveraging existing school infrastructure and logistics can be vital for containing costs. These findings underscore the importance of appraising capital investment in school meal programs across differentiated time horizons with due considerations for program quality and scale.

Understanding the relationship between school feeding costs and program impacts is essential for a comprehensive assessment of effectiveness and efficiency. Kristjansson et al. (2016) found that achieving meaningful improvements in child health outcomes through school meal programs was relatively costly: the median cost for gaining one kilogram of weight was between US$103 and US$121 annually, and one centimeter of height gain cost approximately US$43 to US$54. By contrast, school feeding showed stronger cost-effectiveness in education outcomes. The cost per additional day of attendance was modest, ranging from US$4 to US$8, while gains in academic achievement were also economically favorable, with an estimated US$97 cost per standard deviation improvement in math performance. These findings suggest that school meals deliver greater returns when assessed through educational, rather than strictly nutritional, lenses.

Despite substantial advances in understanding the cost structures of school meal programs, important gaps remain. Longitudinal research is needed to trace how costs evolve as programs scale and mature. Comparative studies examining the implications of alternative design features and operational models are limited, and few analyses fully incorporate broader social returns, such as impacts on local agriculture, gender equality, and long-term human capital accumulation.

3. Methodology

3.1 Dataset

We use all three waves of the Global Survey of School Meal Programs, an international effort by the Global Child Nutrition Foundation (GCNF) to collect standardized operational and financial data on large-scale school meal programs around the world.[1] The first data collection (wave 1) was launched in 2019 and covered 140 programs in 105 countries. The programs reported on more than 180 characteristics including program funding and budget sources, implementing agencies and partners, food and beverage menu, modality (in-school or take home), domestic or foreign sourcing, targets, and coverage. It also provided context on dimensions beyond implementation, such as complementary initiatives in health and education, inclusion of job creation and income-generating opportunities for women and youth, involvement of local farmers, allocation of school meals within the national budget, and existence of relevant national laws, policies, and standards. The second data collection in 2021 covered the 2020 school year for 184 programs in 139 countries. The survey was then updated to revise the menu list and add questions on the presence of climate-friendly menus,

1 The survey is administered through official government channels and captures detailed, self-reported information on school meal programs, including their scale, funding, implementation arrangements, and nutritional content. While the majority of reported programs are government-led and publicly financed, the survey also includes programs delivered by non-governmental organizations and supported by international donors—particularly in humanitarian or low-capacity settings. Respondents are typically government-appointed focal points, and when multiple programs exist within a country, the reporting entity is asked to provide information on the largest or most representative national program. In some cases, decentralized programs implemented at the subnational level are also included if they operate at significant scale.

waste reduction strategies, and strategies to address emergencies. The third and most recent survey round was released in 2024 covering the 2022 school year for 210 programs in 144 countries. All datasets are available for download from the GCNF website.

Our main variables of interest are program cost, coverage, funding structure, and several implementation characteristics for meals provided in school. We only focus on programs that provide on-site meals, excluding programs providing only snacks or take-home ration, for easier comparison. We have harmonized the variables across the waves where they differed, such as the food groups reported in the menu that was updated between wave 2 and wave 3. We have pooled the programs from the three waves. After excluding outliers, we have a final sample of 264 surveys in 102 countries that report on variables of interest (see Table 1).[2] We also merged the surveys to create a panel data of programs using the program's country, name, and implementing partners. We identified 216 unique programs. Twenty-two programs reported across all three survey waves while 34 programs have responses for waves 1 and 2, 30 programs have responses for waves 1 and 3, and 43 programs have responses for waves 2 and 3. Thirty-seven programs submitted a survey response for only one wave. We use the sample of programs with responses for waves 1 and 3 which are five-years apart (the longest time frame in the panel) to analyze changes in program coverage.

TABLE 1. Annualized cost per child by income group and survey period

	Annualized Cost per Child (in USD)				Annualized Cost per Child (in PPP)			
	Wave 1 (2018)	Wave 2 (2021)	Wave 3 (2023)	Waves 1–3	Wave 1 (2018)	Wave 2 (2021)	Wave 3 (2023)	Waves 1–3
Low income	37.2	33.7	43.9	38.6	99.4	96.5	129.9	110.0
	(33.9)	(24.9)	(35.2)	(31.8)	33.9	24.9	35.2	31.8
	N = 25	N = 25	N = 30	N = 80	N = 25	N = 25	N = 30	N = 80
Lower middle income	35.84	35.91	50.16	42.02	106.4	105.0	153.5	126.2
	(30.9)	(28.9)	(39)	(34.5)	30.9	28.9	39.0	34.5
	N = 24	N = 29	N = 40	N = 93	N = 24	N = 29	N = 40	N = 93
Upper middle income	82.04	115.98	128.75	107.40	178.3	285.7	296.3	247.8
	(62.2)	(71.5)	(97.6)	(79.5)	62.2	71.5	97.6	79.5
	N = 14	N = 9	N = 13	N = 36	N = 14	N = 9	N = 13	N = 36
High income	239.07	327.29	556.04	425.80	272.9	448.8	946.8	665.0
	(202.1)	(262.8)	(360.9)	(329.2)	202.1	262.8	360.9	329.2
	N = 6	N = 23	N = 26	N = 55	N = 6	N = 23	N = 26	N = 55
All countries	63.37	121.56	178.48	129.85	132.9	213.4	353.3	250.1
	(88.2)	(187.2)	(279)	(217.9)	88.2	187.2	279.0	217.9
	N = 69	N = 86	N = 109	N = 264	N = 69	N = 86	N = 109	N = 264

Note: Standard deviations are in parenthesis.

2 We excluded outliers based on the total program cost in USD per child and total meal days using the interquartile range (IQR) method. The method defines the IQR to be the difference between the 75th percentile (Q3) and the 25th percentile (Q1) of the data. The lower and upper thresholds are defined by subtracting and adding 1.5 times the IQR from Q1 and Q3, respectively, and any data points falling outside this range are considered potential outliers.

3.2 Standardizing cost per child

For this study, our primary outcome is the annualized program-level cost per child. When both total program funding for the year and actual spending in the most recent school year were reported, we used the lower of the two figures. We chose the lower value for two reasons. First, when reported funding exceeds actual spending, it often reflects multi-year budgets being presented as annual figures, based on how programs structure their finances. Second, when actual spending exceeds reported funding, the resulting cost per child (based on actual spending) is frequently a statistical outlier, suggesting possible measurement error.

Program budget or spending figures were reported either in local currency or in USD. We converted all values to purchasing power parity (PPP) terms using the applicable exchange rate for that survey year. To calculate the cost per child per day, we divided total program expenditure by the product of the number of children receiving school meals and the total number of days meals were provided in the most recent school year. Following the approach used in previous studies (e.g., Gelli et al., 2011; Gelli and Daryani, 2013), we standardized the daily per-child cost to an annualized figure by multiplying it by 200, representing the average number of school days per year. In summary, the standardized per-child cost, c_s, is computed as:

$$c_s = \left(\frac{C}{N}\right) \cdot \left(\frac{200}{d}\right) \quad (1)$$

Where C is the annual program cost in PPP, N is the total number of children that have received on-site meals and d is the total number of days school meals were provided in that year.

3.3 Adjusting for meal quality

Not all school meals are created equal. Some school meal programs provide only basic grains and cereals, such as corn porridge, while others include fresh fruits and vegetables, protein, and dairy. Ideally, we account for nutritional content and diversity when comparing cost. Some studies report cost per calorie (for example, Gelli et al., 2011), but even that method does not account for micronutrients such as vitamins and minerals that are necessary for growth and development. The GCNF survey provides information on whether certain food groups were included in the meals but does not capture quantities. As a result, our closest proxy for meal quality is the diversity of food groups included.

We apply two alternative methods to assess meal diversity. The first uses the Cost of a Healthy Diet (CoHD) database, which estimates the daily cost of a balanced diet in each country for two time points (2017 and 2021) corresponding to waves 1 and 3 of the GCNF survey (see Appendix Table A1 Panel A for the food groups). The database also provides the cost of each of the six recommended food group components, based on the prices of the three least expensive locally available items in each category (Herforth et al., 2020). For wave 2, which is not covered by the CoHD database, we imputed the

missing values by taking the average of the 2017 and 2021 figures for each country and food group. The standardized per-child cost in equation (1) is, therefore, adjusted for healthy diet as follows:

$$c_{cohd} = \frac{c_s}{f_{cohd}} \tag{2}$$

Where c_s is the unadjusted per-child cost and f_{cohd} is the share of the cost of healthy diet (for that particular country and year) which is already included in the school meals. This share is determined by the number of diet components included and their relative cost in that country. f_{cohd} ranges between 0 and 1, with a higher share indicating the inclusion of more or relatively expensive healthy food groups or both. As an illustration, consider a school meal program in country *x* where the standard meal includes only starchy staples and vegetables which are two of the six food groups defined in the CoHD framework. Suppose the cost shares of these two components in the healthy diet basket for country *x* are 0.15 and 0.25, respectively. This implies that the portion of the healthy diet cost already covered by the school meal, denoted as f_{cohd} is 0.40. According to the adjustment formula in Equation (2), the standardized per-child cost, c_s, must be scaled up by a factor of 2.5 to make it comparable to a fully diverse, nutritionally balanced meal.

Second, as an alternative method, we use the 10-food-group guideline adopted by the United Nations to measure Minimum Dietary Diversity (MDD) for the Sustainable Development Goals to adjust for diversity (FAO and UNICEF, 2025). We reconstructed the 10 food groups into 8 food groups consistently covered by GCNF surveys across the last three rounds (see Appendix Table A1 Panel B for the food groups). As such, we adjust the standardized per-child cost for diet diversity as follows:

$$c_{dd} = \frac{c_s}{f_{mdd}} \tag{3}$$

Where c_s is the unadjusted per-child cost and f_{dd} is the proportion of the 8 food groups already included in the school meals. f_{mdd} ranges between 0 and 1, with a higher value indicating more dietary diversity. The baseline measure assumes that the per-child cost of a meal increases linearly with the inclusion of an additional food group. In practice, adding a new nutritious item—such as animal protein—would typically involve substituting part of an existing component, such as porridge. However, because the replaced items are often less expensive, while the added items tend to be costlier (as suggested by the CoHD adjustment), the overall unit cost of the meal is still likely to rise, even if the total quantity of food remains unchanged. To test the robustness of our results using the Minimum Dietary Diversity (MDD), we also consider adjustments such that the impact on costs associated with adding additional food groups is smaller.

In both cases, we adjusted the cost per child by the diversity score of each program to reflect how much it would cost to attain "full diversity" (i.e. all 6 groups for the CoHD guideline and all 8 food groups for the MDD guideline). The CoHD adjustment has the following advantages: (1) the cost varies by food group, allowing for more expensive food groups such as meat and dairy to be properly accounted for, instead of all food groups being equal as is the case in the MDD index; (2) the cost varies by country and time period, allowing for sensitivity across different markets and time periods.

In contrast, the MDD adjustment allows for a wider range of food groups, such as a separate indicator for the presence of milk products and another for eggs, instead of both food groups being classified together with meat under animal-sourced foods, and an additional indicator for dark leafy vegetables separate from other vegetables.

3.4 Estimating cost correlates

We estimate the correlates of per-child cost using a simple pooled OLS method as per the following specification:

$$y_{ct} = \beta_0 + \sum_{k=1}^{K} \beta_k X_{kct} + \alpha_c + \lambda_t + \epsilon_{ct} \quad (4)$$

Where y_{ct} is the annualized cost per child per program, reported in PPP dollars, in country *c* at time *t*; X_{kct} is the *k*-th independent variable in country *c* at time *t*; β_k is the correlation coefficient of interest; α_c is the country fixed effect; λ_t is the survey year fixed effect; and ϵ_{ct} is the error term.

We use alternative specifications of the annualized per-child cost as the dependent variable—both unadjusted and adjusted for dietary diversity based on CoHD or MDD guidelines. The vector of explanatory variables includes a series of program design and operational features that might be correlated with cost efficiency. Specifically, we include variables indicating whether targeting was universal or based on either geographic or individual characteristics, whether the program was implemented by government agencies, where the food ingredients were sourced (local, regional, national, or international), and whether meals were prepared on-site. We control for GDP per capita and both country and year fixed effects.

3.5 Measuring the cost of scaling

The availability of longitudinal data on a sizable number of school meal programs presents a unique opportunity to examine the tradeoff between cost and scale as coverage changes over the medium run. We analyze data on programs that responded to both the wave 1 and wave 3 surveys to capture how their programming evolved over the five years between the two surveys. We defined a Cost of Scaling Index (CSI) to capture how school meal coverage (i.e., number of children receiving meals) changed compared to the change in total program cost. We compute the index for time *t* as follows:

$$CSI_t = \left(\frac{C_t}{C_{t-1}}\right)\left(\frac{N_{t-1}}{N_t}\right) \quad (5)$$

Where *C* is the annual program cost and *N* is the total number of children that have received on-site meals.

- CSI < 1: Cost increases slower than the proportional growth in coverage. This suggests that program expansion is associated with lower marginal costs per additional child—potentially reflecting economies of scale or cost containment as programs grow.

- CSI > 1: Cost increases faster than the proportional growth in coverage, indicating rising marginal costs. This may reflect higher marginal costs from reaching more remote or vulnerable populations or logistical challenges.
- CSI ≈ 1: Cost and coverage increase proportionally, implying constant average cost per child as programs scale.

While the index given in equation (5) captures the baseline scaling-cost dynamics, it does not account for potential changes in meal quality and/or number of days that might occur independent of a change in coverage. Therefore, we compute an alternative, quality and quantity adjusted cost of scaling index as follows:

$$CSI_{adjusted,t} = \left(\frac{C_t / f_{cohd,t}}{C_{t-1} / f_{cohd,t-1}}\right)\left(\frac{N_{t-1}.d_{t-1}}{N_t.d_t}\right) = SEI_t.\left(\frac{f_{cohd,t-1}}{f_{cohd,t}}\right)\left(\frac{d_{t-1}}{d_t}\right) \quad (6)$$

Where C is the annual program cost, N is the total number of children that have received on-site meals, d is the total number of days school meals were provided in the year and f_{cohd} is the share of the cost of healthy diet which is already included in the school meals.

3.6 Limitations

Our analysis is limited by the underlying data. First, wave 2 of the survey was conducted in 2021 and reflects the school year 2020 which was the start of the Covid-19 pandemic when many countries around the world faced sudden school closures (UNICEF, 2021). As a result, programs in wave 2 report significantly fewer meal days and more take-home rations than in-school meals. The annualized cost should still allow for comparison across waves since the cost is standardized per child per day, but some concerns on data validity may still remain. For example, because the pandemic related-school closures were unanticipated, school meal days and number of children fed may have been reduced when fixed program costs were still incurred, or, in another scenario, supplies already bought for and accounted under in-school meals have to be converted to take-home rations.

Second, the adjustment for meal quality discussed in Section 3.3 reflects diversity of food options in the menu but does not account for quantity. In addition, ingredients are not the only line item in a school meals program, but for simplicity, we assume the meal diversity adjustment factor applies to the program cost as a whole.

4. Results

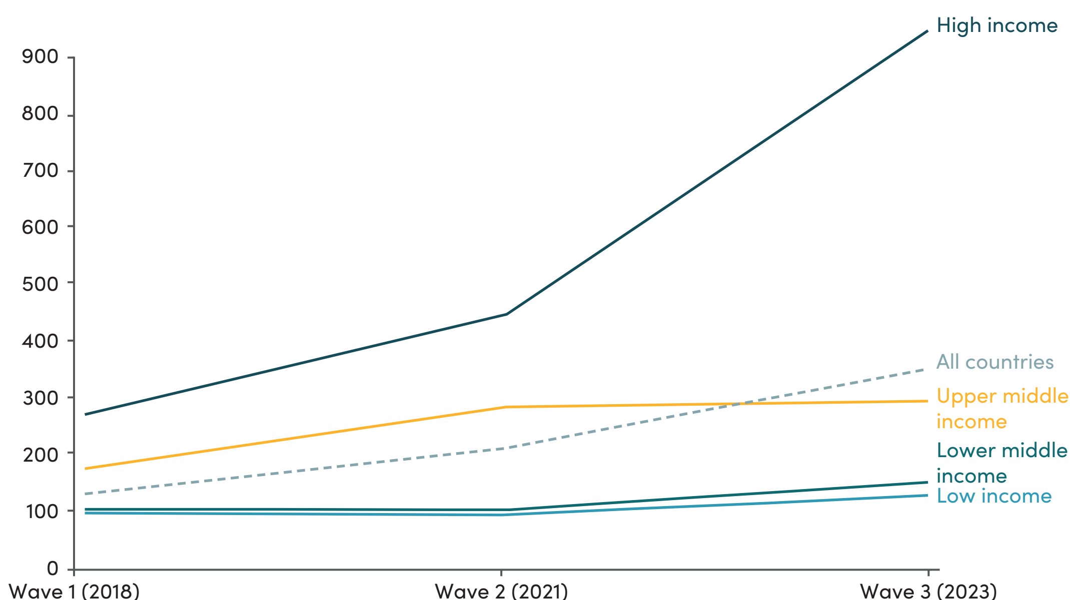
4.1 Cost and quality of meals by country income group

Our sample consists of 264 programs, two-thirds of which are from low-and lower-middle income countries. Programs in higher-income countries spend significantly more per capita than programs implemented in lower-income countries. Across all countries and survey waves (Table 1), the average

annual per-child cost is PPP$250. For low-income countries, the average is PPP$110, increasing slightly to PPP$126 in lower-middle-income countries. In contrast, upper-middle-income countries spend over twice as much (PPP$248), and high-income countries spend roughly six times more (PPP$665) (Table 1).

We also find increased spending over time, but only for programs in higher-income countries (Figure 1). Between 2018 and 2023, per-child costs increased by 66 percent in upper-middle-income countries (from PPP$178 to PPP$296) and more than tripled in high-income countries (from PPP$273 to PPP$945). In comparison, cost increases were modest in low-income (30 percent, from PPP$99) and lower-middle-income countries (40 percent, from PPP$106).

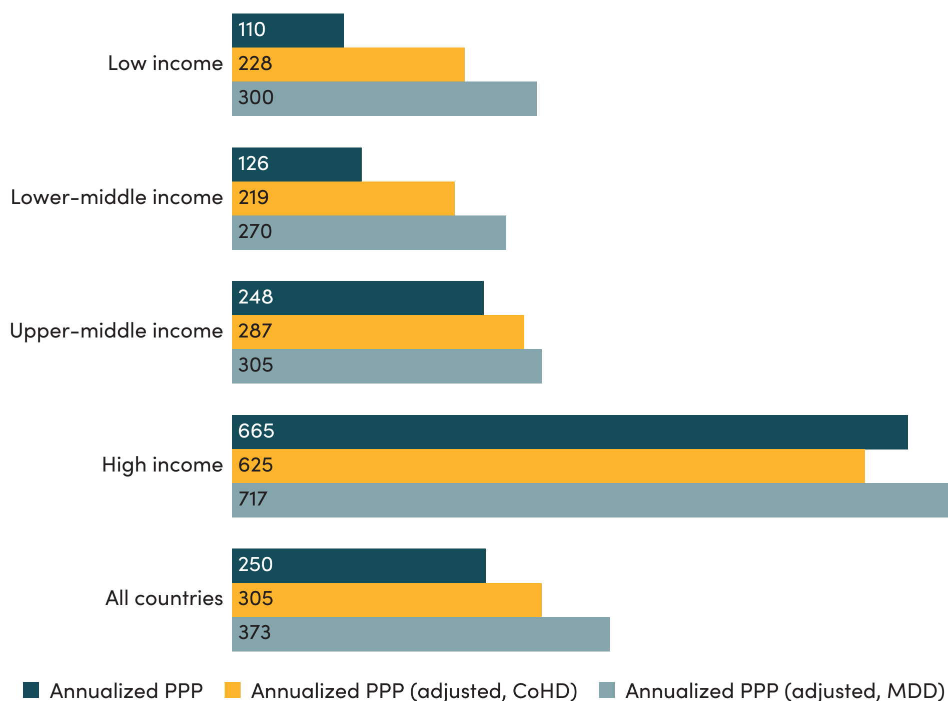
FIGURE 1. Average annualized cost per child across three survey waves, by income group



Programs in lower-income countries are also less likely to provide nutritionally diverse meals. Only four percent of programs in low-income countries and 13 percent of programs in lower-middle income countries provide meals with all the eight food groups defined by Minimum Dietary Diversity index, compared to 40 percent and 70 percent in upper-middle and high-income countries. Using the Cost of Healthy Diet index, only seven percent of the programs in low-income countries report full provision of all recommended food components, compared to 22 percent in lower-middle income countries, 44 percent in upper-middle income countries, and 60 percent in high-income countries. Because disadvantaged children are more likely to experience nutritional shortfalls, the lack of dietary diversity in lower-income programs disproportionately affects those most in need.

To account for differences in meal quality, we adjust per-child costs using the MDD and CoHD guidelines for dietary diversity. After adjusting for the inclusion of all CoHD-recommended food groups, the average cost in low-income countries rises to PPP$228, while the adjusted cost in high-income countries falls to PPP$625 (Table A2, Figures 2 and 3). This suggests that, in low-income countries, the inclusion of all essential food groups would significantly raise costs. By contrast, some programs in high-income countries could potentially lower costs without sacrificing dietary diversity. Overall, as shown in Table A2 and Figures 2 and 3, the cost adjustment required to achieve the quality benchmarks decreases with country income level. Considering the importance of school meals for disadvantaged children, the adjusted cost estimates can be viewed as signaling the additional investment required to ensure that vulnerable children receive nutritionally adequate meals.

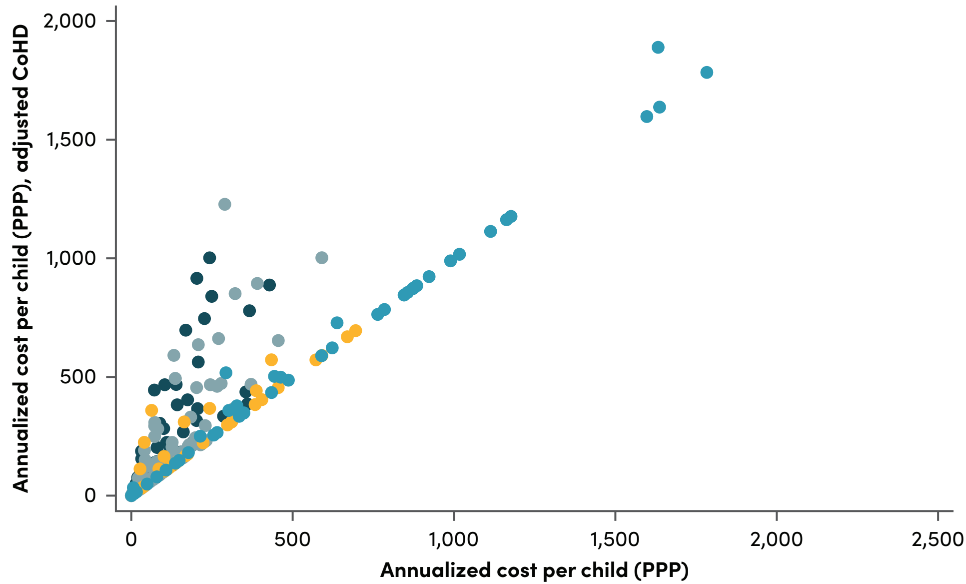
FIGURE 2. Average adjusted and unadjusted annualized cost per child, by income group



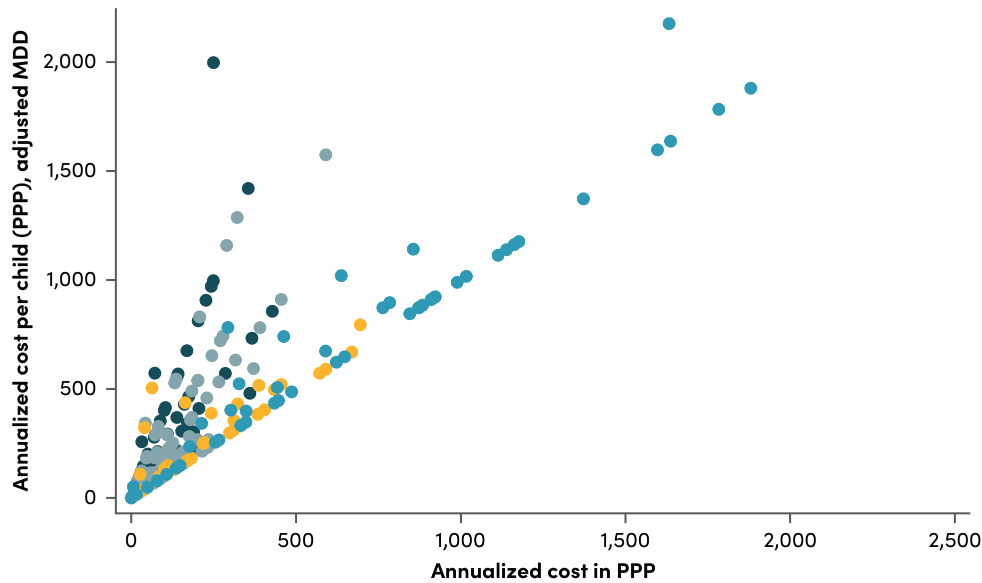
Note: We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

FIGURE 3. Adjusting cost for dietary diversity

Panel A: Cost of a Healthy Diet (CoHD) Adjustment



Panel B: Minimum Dietary Diversity (MDD) Adjustment



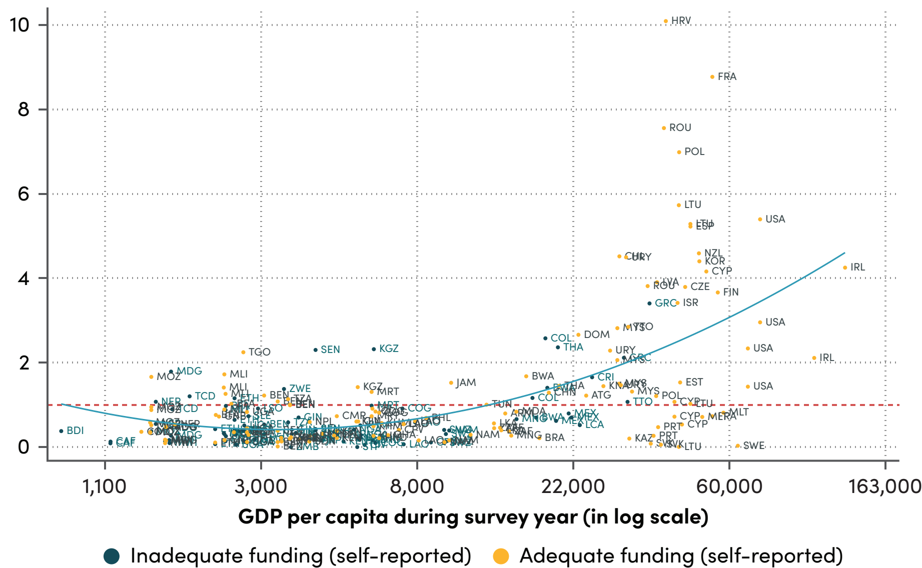
Note: We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

4.2 Funding adequacy

It is difficult to meaningfully assess the cost of school meal programs without also considering funding adequacy. The GCNF survey includes a question on whether "funding was adequate to achieve program targets." Based on this self-reported measurement, half of the programs in low- and lower-middle-income countries report insufficient funding. In contrast, only one-third of programs in upper-middle-income countries and fewer than 2 percent of those in high-income countries report inadequate funding.

We complement the self-reported assessment of budget adequacy with an objective indicator: the ratio of per-child per-day spending to the cost of a healthy lunch, defined as one-third of the nationally estimated Cost of a Healthy Diet (CoHD). This reflects the extent to which actual school meal budgets can meet the nutritional requirements of a single daily meal. We find that 63% of programs fall below this adequacy threshold.[3] Figure 4 plots this objective budget adequacy measure against GDP per capita (log scale), with a horizontal line at y = 1 denoting the minimum requirement to fund a healthy meal. The curve fitted through the data shows that budget adequacy tends to rise with income, but the trend is nonlinear and many low- and middle-income countries fall below the adequacy threshold.

FIGURE 4. Number of healthy meals covered by daily per-child spending for each program



3 It should be noted that this measure is likely to overestimate the cost of a "healthy" school meal because children are unlikely to consume the same quantity of food as the average/typical individual on whom the CoHD calculation is based on.

Programs that cluster near the $y = 1$ line may be viewed as more nutritionally cost-efficient—they spend just enough to meet dietary adequacy benchmarks without incurring large excesses. In contrast, countries significantly above this line spend enough to "buy" multiple healthy meals per day. These high ratios may reflect expanded services, more diverse or generous meals, or bundled delivery and staffing costs. However, they could also indicate cost inefficiencies if not matched by improved nutritional or coverage outcomes.

Figure 4 also reveals a striking misalignment between subjective and objective assessments of adequacy. Many programs perceived as adequately funded (grey dots) lie well below the nutritional threshold, suggesting that respondents may either underestimate the cost of providing a healthy meal or they view nutritional standard as less of a priority. Conversely, a few programs that exceed the adequacy threshold are still marked as underfunded, possibly reflecting broader programmatic ambitions or a larger share of non-food program costs.[4] This misalignment is particularly concerning for disadvantaged populations who rely heavily on school meals as a primary source of nutrition. If programs are perceived as adequately funded despite not meeting basic dietary needs, it may result in persistent undernutrition among the children who depend on them the most.

Beyond income level, funding adequacy is also likely influenced by program scale, as budgets may not always rise proportionally with coverage. Figure 5 presents the marginal effect of program scale (in log) on the number of healthy meals covered by daily per-child budget. The figure shows that program scale is inversely associated with funding adequacy, particularly in low-income settings. In low-income countries, a 10% increase in program coverage is associated with a 1.6 percentage point reduction in the share of a healthy meal covered by per-child spending (which is equivalent to 0.03 standard deviation in number of health meals covered). This negative association weakens in lower-middle income settings and is not statistically significant in upper-middle and high-income countries. This suggests that as programs grow in size, maintaining adequate nutritional budgets becomes increasingly difficult in resource-constrained contexts, potentially due to rising delivery costs or limited fiscal space.

4 Additionally, neither measure of dietary diversity is associated with the self-reported status of funding adequacy (Table A3).

FIGURE 5. Marginal effect of program scale on number of healthy meals covered by daily per-child budget

Note:

1. The vertical lines represent 95% confidence band.
2. The marginal effects are calculated based on estimates from an OLS regression of number of healthy meals covered by daily per-child budget on country income group, program scale (log) and an interaction term. The model controls for country and year fixed effects. Standard errors are clustered at the program level.

4.3 Cost correlates

We regressed both unadjusted and diet-adjusted annualized per-child costs on a range of program characteristics, including targeting approach, implementation modality, and procurement practices. All models control for the log of GDP per capita, as well as year and country fixed effects.

We find that individual targeting—as opposed to geographic or universal provision—is associated with significantly lower costs, ranging from PPP$223 to PPP$300 depending on the dietary diversity adjustment applied ($p < 0.05$, see Table 2). Heterogeneity analysis shows that this cost advantage is driven primarily by programs in upper-middle and high-income countries (Table 3), and that the relationship holds under less sensitive meal adjustment specifications (Appendix Table A4). In contrast, targeting modality is not significantly associated with costs in low- and lower-middle-income countries. This finding aligns with programmatic realities: higher-income countries often have greater administrative capacity to implement targeted interventions efficiently and generally experience lower rates of food insecurity. In lower-income settings, however, the administrative burden of individual targeting may be prohibitively high. Moreover, flatter income distributions in these contexts mean that food insecurity is widespread, making universal or geographically targeted approaches no less efficient.

TABLE 2. Correlations between annualized cost and operational characteristics of school meal programs

Variables	(1) Annualized Cost per Child (PPP)	(2) Annualized Cost per Child (PPP, adjusted CoHD)	(3) Annualized Cost per Child (PPP, adjusted MDD)	(4) Annualized Cost per Child (PPP)	(5) Annualized Cost per Child (PPP, adjusted CoHD)	(6) Annualized Cost per Child (PPP, adjusted MDD)	(7) Annualized Cost per Child (PPP)	(8) Annualized Cost per Child (PPP, adjusted CoHD)
Targeting: geographic	–22.75	–37.35	–25.58					
	(30.28)	(52.12)	(61.60)					
Targeting: individual	–132.4*	–204.8**	–176.4*					
	(70.84)	(98.05)	(105.9)					
Is government implemented				–82.39	–145.7	–125.8		
				(50.19)	(90.93)	(92.93)		
Food sourced: local							–47.68	–156.5**
							(54.53)	(62.03)
Food sourced: regional							–23.56	10.50
							(36.29)	(65.67)
Food sourced: national							–49.66	–62.12
							(54.90)	(64.74)
Food sourced: international							63.29	45.37
							(48.08)	(59.36)
Meals prepared: on-site								
GDP per capita during survey year (log)	660.9**	984.2*	1,155**	640.5*	1,181*	1,302**	517.6*	835.2
	(290.8)	(502.9)	(520.1)	(345.2)	(690.0)	(620.1)	(266.3)	(574.8)
Constant	–5,899*	–9,488*	–11,183*	–5,719	–11,325	–12,834*	–4,514	–7,875
	(3,166)	(5,081)	(5,684)	(3,786)	(6,927)	(6,779)	(2,932)	(5,799)
Observations	261	234	255	229	204	225	248	222
R-squared	0.820	0.640	0.676	0.787	0.623	0.662	0.821	0.654
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES

TABLE 2. (Continued)

Variables	(9) Annualized Cost per Child (PPP, adjusted MDD)	(10) Annualized Cost per Child (PPP)	(11) Annualized Cost per Child (PPP, adjusted CoHD)	(12) Annualized Cost per Child (PPP, adjusted MDD)	(13) Annualized Cost per Child (PPP)	(14) Annualized Cost per Child (PPP, adjusted CoHD)	(15) Annualized Cost per Child (PPP, adjusted MDD)
Targeting: geographic					–26.81	–32.50	–18.59
					(42.83)	(68.52)	(69.32)
Targeting: individual					–223.2*	–300.5**	–277.4*
					(116.1)	(144.7)	(152.2)
Is government implemented					–73.52	–114.9	–87.60
					(49.47)	(83.59)	(89.96)
Food sourced: local	–216.0**				–33.45	–148.8*	–228.3**
	(84.51)				(77.51)	(84.40)	(99.21)
Food sourced: regional	30.98				–37.17	1.677	32.00
	(75.34)				(45.60)	(91.79)	(100.4)
Food sourced: national	–69.78				–43.98	–59.62	–89.01
	(66.11)				(69.71)	(79.49)	(81.27)
Food sourced: international	12.42				96.95	90.56	37.46
	(71.23)				(76.33)	(88.43)	(102.9)
Meals prepared: on-site		160.8	239.1	248.7*	133.2	229.5	230.0
		(121.9)	(145.5)	(147.9)	(121.9)	(153.4)	(173.8)
GDP per capita during survey year (log)	882.3*	485.4*	861.5*	1,004**	646.6	1,165	1,183**
	(497.1)	(272.3)	(505.9)	(485.3)	(399.9)	(711.6)	(597.3)
Constant	–8,399	–4,258	–8,240	–9,944*	–5,795	–11,141	–11,577*
	(5,460)	(2,973)	(5,111)	(5,323)	(4,330)	(7,142)	(6,474)
Observations	243	261	234	255	214	190	211
R-squared	0.703	0.818	0.629	0.673	0.821	0.708	0.734
Country fixed effects	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parenthesis. Standard errors are clustered at the program level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves. Robustness test on sensitivity of results according to adjustment is available on Appendix Table A4.

TABLE 3. Correlations between cost per child and operational characteristics: heterogeneity with respect to resource adequacy

Variables	Inadequately Funded or Unable to Meet Targets			Adequately Funded and Meeting Targets		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annualized Cost per Child (PPP)	Annualized Cost per Child (PPP, adjusted CoHD)	Annualized Cost per Child (PPP, adjusted MDD)	Annualized Cost per Child (PPP)	Annualized Cost per Child (PPP, adjusted CoHD)	Annualized Cost per Child (PPP, adjusted MDD)
Targeting: geographic	−37.84	27.36	9.389	13.14	−51.66	−72.21
	(58.82)	(75.59)	(91.59)	(114.7)	(233.3)	(203.7)
Targeting: individual	−12.02	−36.51	−18.09	−148.1	−242.8	−244.3
	(99.39)	(163.2)	(215.3)	(179.7)	(245.5)	(265.9)
Is government implemented	−46.83	−195.0	−164.1	23.85	72.40	50.64
	(75.99)	(130.1)	(146.5)	(63.35)	(145.5)	(129.3)
Food sourced: local	113.9	−45.75	−109.9	−28.14	−158.4	−209.3
	(134.4)	(126.5)	(152.1)	(80.61)	(184.9)	(163.2)
Food sourced: regional	−41.70	−90.39	−81.46	72.69	199.6	173.1
	(80.55)	(98.10)	(122.3)	(118.5)	(212.8)	(204.7)
Food sourced: national	54.13	−26.62	−4.949	−71.58	−184.8	−150.0
	(79.00)	(76.30)	(84.30)	(85.27)	(168.4)	(120.5)
Food sourced: international	52.24	−98.34	−157.3	41.41	175.7	197.6
	(117.5)	(113.7)	(133.9)	(73.17)	(114.4)	(119.3)
Meals prepared: on-site	52.60	−90.85	−85.31	156.1	441.5**	526.4**
	(141.0)	(142.5)	(146.9)	(122.5)	(219.7)	(207.9)
GDP per capita during survey year (log)	903.1	2,539**	1,775	106.8	−571.3	280.7
	(922.5)	(1,093)	(1,115)	(548.3)	(1,550)	(988.7)
Constant	−8,532	−19,732**	−16,325	−58.24	6,250	−2,252
	(8,721)	(8,716)	(10,695)	(6,081)	(15,836)	(10,906)
Observations	111	98	108	103	92	103
R-squared	0.842	0.847	0.817	0.962	0.911	0.926
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parenthesis. Standard errors are clustered at the program level. *** p < 0.01, ** p < 0.05, * p < 0.1. We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

We also find that local procurement is associated with lower costs, but only when adjusting for dietary diversity (PPP$150 to PPP$228, $p < 0.05$). Local sourcing may facilitate access to a broader range of perishable foods—such as seasonal fruits, vegetables, and meats—that are otherwise costly to store and transport. This correlation holds across both lower- and higher-income countries (Table 4). However, in models using MDD-based diversity adjustment, the results

appear sensitive to alternative measures where diversity has a smaller impact on program cost adjustment (Appendix Table A4). It is worth noting that programs that are not sourcing food locally are often situated in more food-insecure contexts, suggesting that part of the observed correlation may reflect broader differences in food prices and availability.

TABLE 4. Correlations between cost per child and operational characteristics: heterogeneity with respect to income group

Variables	Low and Lower-Middle Income Countries			Upper-Middle and High-Income Countries		
	(1)	(2)	(3)	(4)	(5)	(6)
	Annualized Cost per Child (PPP)	Annualized Cost per Child (PPP, adjusted CoHD)	Annualized Cost per Child (PPP, adjusted MDD)	Annualized Cost per Child (PPP)	Annualized Cost per Child (PPP, adjusted CoHD)	Annualized Cost per Child (PPP, adjusted MDD)
Targeting: geographic	−3.988	−19.60	−12.21	−96.33	178.5	308.7
	(21.68)	(55.01)	(55.66)	(349.6)	(293.2)	(320.0)
Targeting: individual	−21.41	−118.1	−61.82	−492.7**	−607.0***	−670.6***
	(50.91)	(106.2)	(117.0)	(187.0)	(170.5)	(171.0)
Is government implemented	−43.98	−97.59	−67.91	−274.9	−591.2	−611.5
	(27.42)	(73.20)	(81.11)	(769.7)	(594.6)	(618.3)
Food sourced: local	−42.44	−127.9*	−222.8**	−249.7	−578.0**	−639.4**
	(32.08)	(66.76)	(92.24)	(405.4)	(261.5)	(316.9)
Food sourced: regional	3.949	60.24	83.09	−68.06	95.27	189.9
	(31.96)	(91.90)	(101.1)	(314.2)	(374.4)	(422.5)
Food sourced: national	−22.52	−20.55	−55.64	−46.73	−171.8	−205.4
	(24.38)	(56.30)	(69.40)	(234.2)	(222.2)	(196.5)
Food sourced: international	−5.576	28.09	−47.02	642.1	396.6	429.1
	(32.57)	(78.94)	(94.28)	(509.4)	(318.9)	(346.8)
Meals prepared: on-site	49.87	102.4	127.2	272.9	450.6	438.2
	(48.94)	(76.64)	(113.3)	(418.7)	(323.0)	(316.0)
GDP per capita during survey year (log)	242.4	198.2	513.5	1,274	2,005**	1,896***
	(196.2)	(633.8)	(609.8)	(972.5)	(986.9)	(517.5)
Constant	−1,808	−1,181	−3,615	−13,012	−19,126*	−19,337***
	(1,590)	(5,210)	(4,966)	(11,346)	(10,044)	(5,608)
Observations	134	124	134	80	66	77
R-squared	0.531	0.529	0.534	0.866	0.903	0.921
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parenthesis. Standard errors are clustered at the program level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

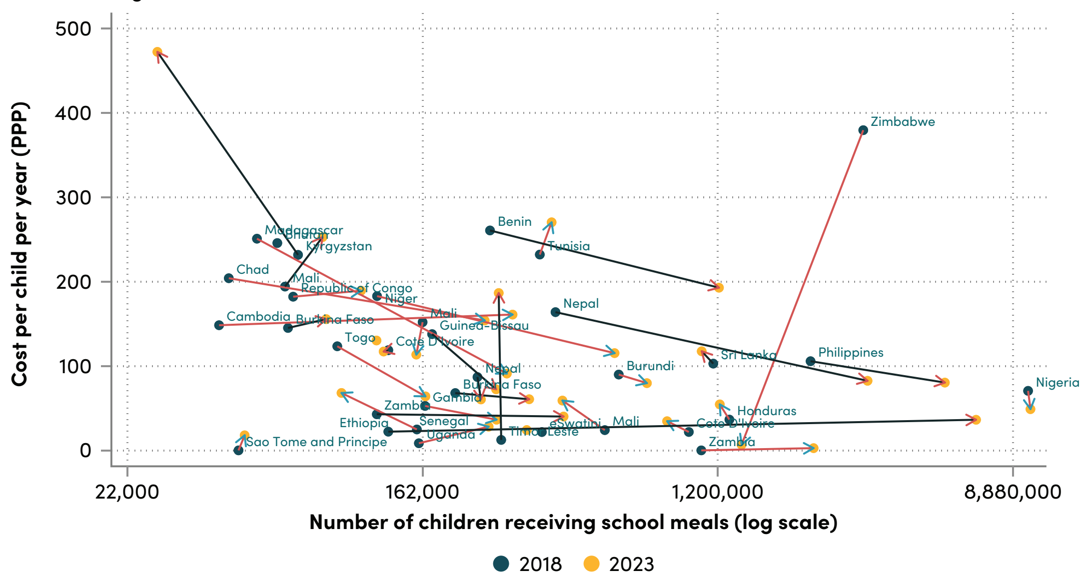
Finally, for programs that are adequately funded, preparing meals in school premises instead of in off-site kitchens is linked to higher costs (Table 3; PPP$ 442 to PPP$ 526, $p < 0.05$). This is likely because off-site meal preparation tends to happen in centralized kitchens. Centralized kitchens may offer economies of scale in terms of labor costs, facilities such as produce storage, and kitchen equipment. We are unable to verify this in the data, but another potential explanation is that programs that prepare meals on-site may also target other objectives such as generating employment for local women and youth. This translates to higher cost per meal, albeit with a potentially wider range of benefit to community.

4.4 Scaling and cost dynamics

We analyze a sample of 48 school meal programs with survey responses available from both wave 1 and wave 3. The five-year interval between these survey waves enables us to examine medium-term trends in program coverage and cost. Figure 6 illustrates the dynamics of program scale-up and per-child cost by income group. Approximately 70 percent of programs in low- and lower-middle-income countries expanded their coverage, with a median increase of 57,000 pupils. In comparison, 64 percent of programs in upper-middle- and high-income countries expanded, but with a more modest median increase of 7,297 pupils.

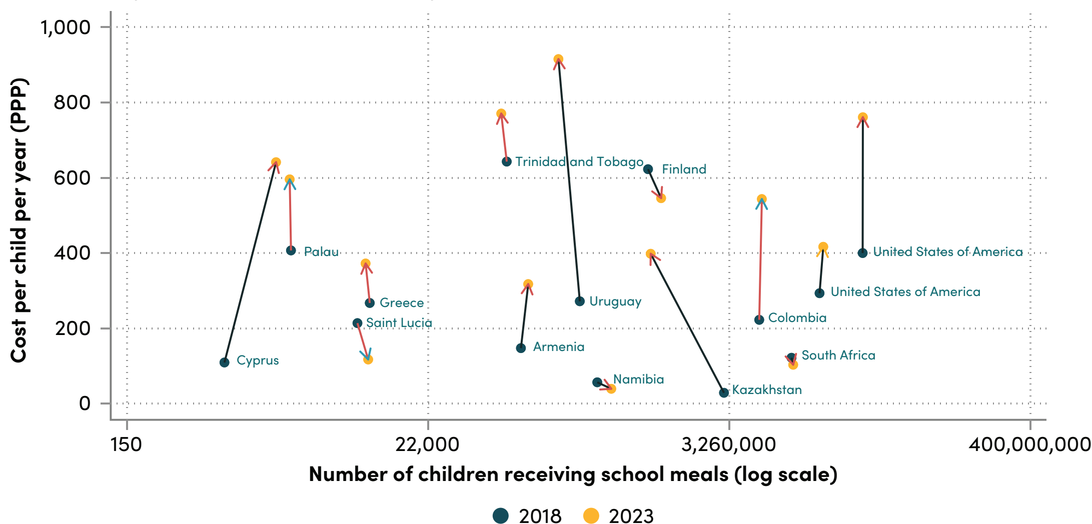
FIGURE 6. Cost-scale dynamics over 5 years for long-term programs[5]

Panel A: Programs in low- and lower-middle income countries



5 The suspiciously precipitous fall in per-child cost for the program in Zimbabwe is partly caused by a dramatic adjustment in the PPP conversion factor. The comparably unusual jump in per-child cost in the program in Kyrgyzstan is caused by a steep decline in number of children receiving meals.

FIGURE 6. (Continued)



Note: Black connecting lines designate programs with "adequate funding" as per officials responding to the survey whereas red connecting lines designate "inadequate funding". These are programs that have data in both Wave 1 (2018) and Wave 3 (2023).

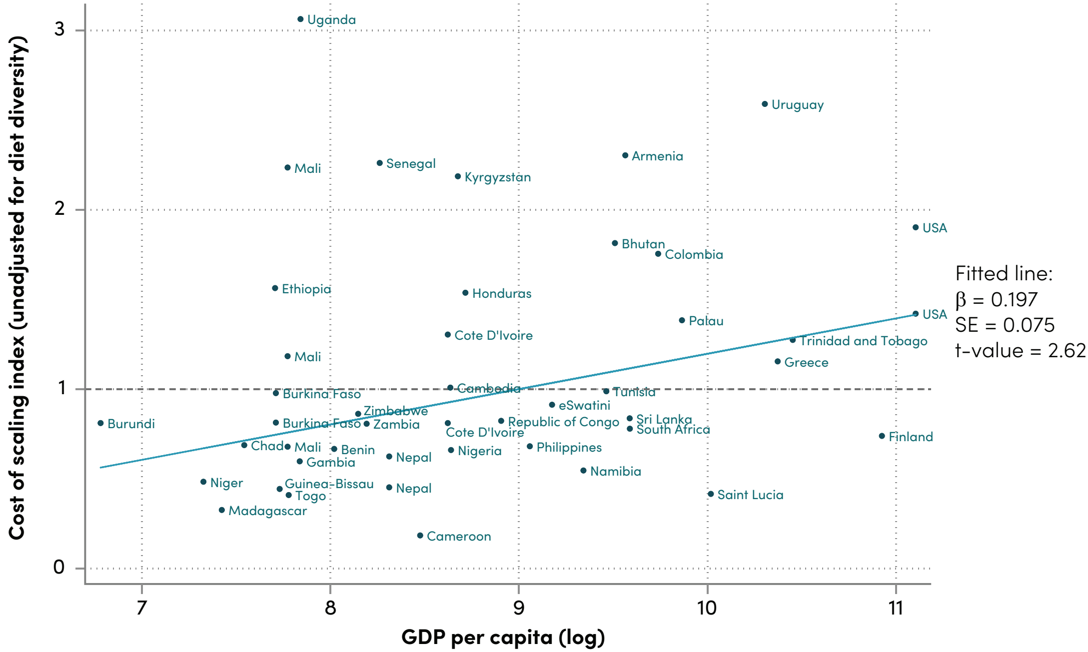
On the cost side, only half of the programs in low- and lower-middle-income countries experienced an increase in per-child cost, with a median rise of PPP$0.40. By contrast, 71 percent of programs in upper-middle- and high-income countries saw cost increases, with a median rise of PPP$148. This suggests that programs in lower-income settings were more likely to scale more inexpensively—that is, expanding coverage more rapidly than costs increased (Panel A), relative to their counterparts in higher-income countries (Panel B).

For example, between 2018 and 2023, a program in Nepal grew its coverage eightfold—from 400,000 to 3.3 million children—while total program costs rose fourfold, from PPP$65 million to PPP$273 million. This implies coverage grew twice as fast as cost. Similarly, in Benin, program coverage grew by a factor of 4.7, while costs increased by a factor of 3.5, resulting in 35 percent faster growth in coverage than in cost. In contrast, Uruguay's program saw costs rise from PPP$74.4 million to PPP$176 million (a 137 percent increase), even as coverage declined by 30 percent from 270,000 to 190,000 children.

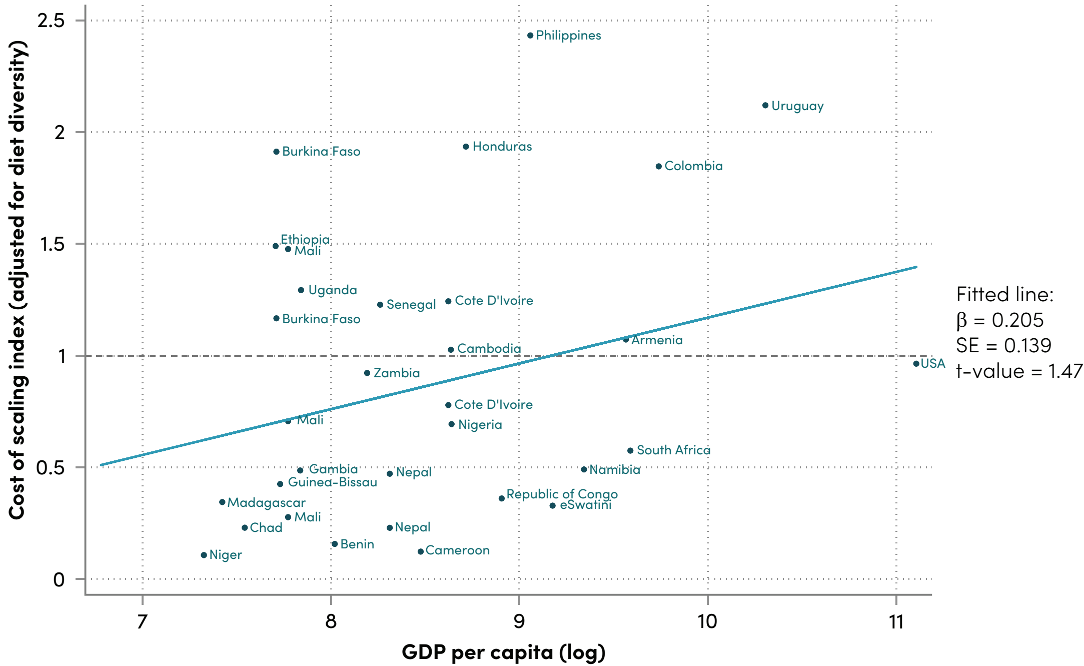
To systematically compare scaling performance across programs, we construct a Cost of Scaling Index (CSI), detailed in Section 3.5. A CSI < 1 indicates economies of scale where coverage is rising faster or declining slower than costs, CSI > 1 indicates diseconomies of scale, and CSI = 1 implies cost-neutral scaling. The median CSI across programs is 0.94, suggesting that the presence of economies of scale in the typical program. A robust regression of CSI on the log of GDP per capita reveals a statistically significant positive relationship—economies of scale tend to improve as income level decreases (Figure 7, Panel A).

FIGURE 7. Cost of scaling and country income (with and without adjustment for diet diversity)

Panel A: Unadjusted for changes in diet diversity and number of meal days



Panel B: Adjusted for changes in diet diversity and number of meal days



Note: Each observation represents a specific program although the labels show country name. There are sometimes multiple school meal programs from a single country represented in the graphs. Correlation coefficients are based on robust regression, correcting for the effect of influential outliers.

As noted in earlier sections, lower-income countries tend to provide meals with lower dietary diversity, and funding adequacy is negatively correlated with scale in these contexts. This raises important equity considerations: disadvantaged children, who are more likely to rely on school meals as a key source of nutrition, may benefit from increased coverage but still miss out on essential nutrients if diets remain limited. We account for this by adjusting the CSI for meal diversity, as described in Section 3.5. The adjusted CSI remains low, with a median of 0.92, suggesting that economies of scale do not generally come at the expense of dietary quality. While the negative association between country income and adjusted CSI persists, it is somewhat weaker in statistical significance (Figure 7, Panel B). These results suggest that scaling up in low-income countries can be cost-efficient, but ensuring nutritional adequacy—especially for the most vulnerable—requires more than just reaching more children; it requires targeted investment in the quality of meals delivered.

5. Conclusion

This paper offers new evidence on the funding structures, cost patterns, and economies of scale of school meal programs across more than 100 countries, using three waves of the Global Child Nutrition Foundation's comprehensive survey. By constructing standardized and dietary-diversity-adjusted cost metrics, we provide a nuanced view of how costs vary across country income groups, implementation modalities, and over time.

We find that per-child costs are significantly lower in low- and lower-middle-income countries, but this sometimes reflects inadequate funding rather than greater efficiency. When accounting for the nutritional diversity of meals, the cost gap between country income groups narrows considerably. Local food sourcing is associated with more cost-efficient delivery after adjusting for meal quality, while on-site preparation is linked to higher costs, particularly in better-resourced programs. We also find that individual targeting reduces costs, but only in higher-income settings with the administrative capacity to implement such approaches effectively. Perhaps most notably, our analysis of scaling dynamics shows that programs in low- and lower-middle-income countries tend to expand coverage faster than their costs increase, suggesting greater economies of scale despite more constrained resources. However, some of this scalability may come at the expense of meal quality.

These findings speak directly to ongoing policy debates about how to sustainably scale school meal programs in resource-constrained settings. While global momentum behind school feeding has grown, questions of affordability and scalability remain central—especially as governments weigh the trade-offs between expanding coverage, maintaining nutritional quality, and ensuring long-term fiscal sustainability. Our results suggest that lower-income countries demonstrate promising models of cost-efficient scale-up, albeit with limited dietary diversity. However, funding constraints may be compromising program performance through insufficient meal quantities and irregular provision, as in the case of Ghana's national school feeding program (Bedasso et al., 2023). All in all,

our findings highlight a core equity tension: while coverage expansion is commendable, especially in reaching underserved populations, real gains for disadvantaged children will depend on whether that expansion is matched by investments in the nutritional quality of meals. This raises critical questions about how to finance both the expansion and enhancement of school meals in a way that aligns with human capital development goals. Future research should focus on generating rigorous evidence on the effectiveness and sustainability of alternative delivery models and financing strategies.

6. References

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7. Appendix

TABLE A1. Meal diversity index based on FAO's Cost of Health Diet and MDD guidelines for food diversity

		Wave 1	Wave 2	Wave 3
	CoHD Food Groups			
1	animal source foods	4 Dairy products	4 Dairy products	7 Dairy
		5 Eggs	5 Eggs	6 Eggs
		6 Meat	6 Meat	8 Poultry and game meat
		7 Poultry	7 Poultry	9 Red meat
		8 Fish	8 Fish	10 Processed meat
				11 Fish and shellfish
2	fruits	11 Fruits	11 Fruits	14 Fruits
3	legumes, nuts and seeds	3 Legumes, nuts	3 Legumes, nuts	4 Legumes
				5 Nuts and seeds
4	oils and fat	12 Oil	12 Oil	18 Deep-fried foods
				20 Liquid oils
				21 Semi-solid and solid fats (e.g., butter)
5	starchy staples	1 Grains/cereals	1 Grains/cereals	1 Whole grains
		2 Roots/tubers	2 Roots/tubers	2 Refined/milled grains
				3 Blended grain-based products
				13 White roots and tubers
6	vegetables	9 Green vegetables	9 Green vegetables	15 Dark green leafy vegetables
		10 Other vegetables	10 Other vegetables	17 Other vegetables
				12 Deep orange vegetables and tubers
				16 Cruciferous vegetables
		13 Salt	13 Salt	19 Sweets and ice cream
		14 Sugar	14 Sugar	22 Salt
		15 Other	15 Other	23 Other
		16 Other - specify	16 Other - specify	
	MDD Food Groups			
1	grains, white roots and tubers, and plantains	1 Grains/cereals	1 Grains/cereals	1 Whole grains
		2 Roots/tubers	2 Roots/tubers	2 Refined/milled grains
				3 Blended grain-based products
				13 White roots and tubers
2	pulses (beans, peas and lentils)	3 Legumes, nuts	3 Legumes, nuts	4 Legumes
3	nuts and seeds*			5 Nuts and seeds
4	milk and milk products	4 Dairy products	4 Dairy products	7 Dairy
5	meat, poultry and fish	6 Meat	6 Meat	8 Poultry and game meat
		7 Poultry	7 Poultry	9 Red meat
		8 Fish	8 Fish	10 Processed meat
				11 Fish and shellfish
6	eggs	5 Eggs	5 Eggs	6 Eggs

TABLE A1. (Continued)

	MDD Food Groups	Wave 1	Wave 2	Wave 3
7	dark green leafy vegetables	9 Green vegetables	9 Green vegetables	15 Dark green leafy vegetables
8	other vitamin A-rich fruits and vegetables*			12 Deep orange vegetables and tubers
				16 Cruciferous vegetables
9	other vegetables	10 Other vegetables	10 Other vegetables	17 Other vegetables
10	other fruits	11 Fruits	11 Fruits	14 Fruits
	Not included	12 Oil	12 Oil	18 Deep-fried foods
		13 Salt	13 Salt	19 Sweets and ice cream
		14 Sugar	14 Sugar	20 Liquid oils
		15 Other	15 Other	21 Semi-solid and solid fats (e.g., butter)
		16 Other - specify	16 Other - specify	22 Salt
				23 Other

Note: Food groups with * are not included in the index because they were not covered by earlier waves. We incorporated group 5 from wave 3 to MDD group 2 and groups 12 and 16 in wave 3 to MDD group 9 to maintain consistency across waves.

TABLE A2. Annualized cost per child with and without adjustment for dietary diversity

	Annualized Cost per Child (PPP)	Annualized Cost per Child (PPP, meal diversity adjusted by CoHD)	Annualized Cost per Child (PPP, meal diversity adjusted by MDD)
Low income	110.0	228.3	300.3
	(92.1)	(241.1)	(337.9)
	N = 80	N = 72	N = 80
Lower middle income	126.2	218.9	269.9
	(107.1)	(234.1)	(286.9)
	N = 93	N = 88	N = 92
Upper middle income	247.8	287.3	305.4
	(183.4)	(187.8)	(193.7)
	N = 36	N = 32	N = 35
High income	665.0	624.5	717.4
	(556.3)	(497.3)	(523.1)
	N = 55	N = 43	N = 51
All countries	250.1	305.3	372.6
	(349.3)	(332.4)	(389.9)
	N = 264	N = 235	N = 258

Note: Standard deviations are in parenthesis. We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

TABLE A3. Meal diversity by funding status

Variables	(1) Diversity index (CoHD)	(2) Diversity index (MDD)
Was the funding adequate to achieve program targets?	−0.0559	−0.122
	(0.157)	(0.127)
GDP per capita during survey year (log)	−0.590	−0.145
	(0.525)	(0.432)
Constant	6.231	1.883
	(4.999)	(4.153)
Observations	107	117
R-squared	0.824	0.864
Country fixed effects	YES	YES
Year fixed effects	YES	YES

Note: Robust standard errors in parenthesis. Standard errors are clustered at the program level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. We use two methods to account for meal diversity as described in Section 3.3: (1) the Cost of a Healthy Diet (CoHD) database which reports how much it would cost to provide a balanced meal per day in each country, and; (2) a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves.

TABLE A4. Robustness of findings based on how we adjust for meal diversity

Variables	(1) Annualized Cost per Child (PPP)	(2) Annualized Cost per Child (PPP, adjusted1)	(3) Annualized Cost per Child (PPP, adjusted2)	(4) Annualized Cost per Child (PPP, adjusted3)
Targeting: geographic	−26.81	−19.66	−18.85	−18.59
	(42.83)	(44.46)	(47.47)	(69.32)
Targeting: individual	−223.2*	−250.7*	−257.3*	−277.4*
	(116.1)	(127.7)	(132.3)	(152.2)
Is government implemented	−73.52	−75.06	−78.82	−87.60
	(49.47)	(52.66)	(56.97)	(89.96)
Food sourced: local	−33.45	−83.52	−103.8	−228.3**
	(77.51)	(64.75)	(67.96)	(99.21)
Food sourced: regional	−37.17	−44.38	−32.80	32.00
	(45.60)	(50.43)	(56.06)	(100.4)
Food sourced: national	−43.98	−59.20	−65.42	−89.01
	(69.71)	(62.37)	(64.12)	(81.27)
Food sourced: international	96.95	56.47	56.45	37.46
	(76.33)	(56.15)	(62.36)	(102.9)
Meals prepared: on-site	133.2	207.9	212.9	230.0
	(121.9)	(157.3)	(159.4)	(173.8)
GDP per capita during survey year (log)	646.6	845.1*	891.5*	1,183**
	(399.9)	(453.6)	(469.4)	(597.3)
Constant	−5,795	−7,979	−8,474*	−11,577*
	(4,330)	(4,918)	(5,086)	(6,474)
Observations	214	211	211	211
R-squared	0.821	0.831	0.820	0.734
Country fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES

Note: Robust standard errors in parenthesis. Standard errors are clustered at the program level. *** p < 0.01, ** p < 0.05, * p < 0.1. Column 1 reports correlates against the unadjusted annualized cost. As a measure of food diversity, we use a 10-food-group guideline adopted by the UN to measure Minimum Dietary Diversity for the SGDs reconstructed to 8 food groups common among the three survey waves (discussed in more detail in Section 3.3). In this adjustment, a program with only one food group in their menu would need to multiply their budget by a factor of 8 to provide all 8 food groups. Results using this measure is reported in column 4. We test the robustness of our findings by testing a less sensitive measure of diversity such that, for the program with one food-group, the multiplication factor is 4 (therefore, half as sensitive as the full adjustment) which is reported in Column (3), and a final measure where the multiplication factor is 2 (therefore, one-fourth as sensitive as the full adjustment) which is reported in Column (4). Thus, going from columns 1–4, we show the original annualized cost and an increasingly sensitive measure of diversity.