Jayaraman, Rajshri

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The impact of school lunches on school enrolment: Evidence from an exogenous policy change in India

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The impact of school lunches on school enrolment: Evidence from an exogenous policy change in India*

Rajshri Jayaraman†‡

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Abstract

Education is thought to be central to economic development. Yet, relatively little is known about how developing countries might advance school participation. In November, 2001 the Indian Supreme Court issued a remarkable interim order directing errant Indian states to offer children in government primary schools a warm school lunch. This paper uses this exogenous policy change to evaluate the impact of school lunches on early primary school enrolment. It finds that the introduction of a school lunch is associated with a 25 per cent increase in class 1 enrolment. There is, however, no evidence to suggest that school lunches bridge the overall gender or caste gaps in enrolment.

*JEL: I2, O22, O12

†PRELIMINARY AND INCOMPLETE. PLEASE DO NOT CIRCULATE. I am grateful to Arun Metha and Naveen Bhatia for kindly sharing their DISE data, and to Alberto Alesina, Sascha Becker, Larry Blume, Benoit Dostie, Jean Drèze, Jyotsna Jalan, Rinku Murgai, Susanne Prantl and Jörg Rocholl for useful comments and discussions.

‡European School of Management and Technology ESMT, Berlin; jayaraman@esmt.org

1 Introduction

Education is thought to be central to economic development. Beneficial in and of itself, it is also viewed as a major contributor to human capital, leading to higher productivity and living standards. Primary education is thought to be associated with especially high returns.[1] Its importance is enshrined in the Millennium Development Goals (MDGs), which call for universal primary education by 2015.

In fact, primary education is far from universal and this MDG remains elusive. UNICEF, the agency responsible for tracking progress on this MDG, estimates a net primary school enrolment rate in developing countries of 84 per cent; this is also estimated to be the Indian average (UNICEF (2008)). The rate drops to 65 per cent in the least developed countries. In view of this, governments across the developing world, India included, have instituted a wide range of policies aimed at improving schooling inputs.

In this paper I examine the effect of one such policy, the provision of a warm school lunch in Indian primary schools, on early primary school enrolment. This analysis is useful for two main reasons. First, India's primary education problem is important from a policy perspective in terms of sheer scale. India is thought to have the largest number of primary school-aged children and the largest number out-of-school primary-school-aged children in the world (UNICEF (2008)). Moreover, school lunches address not only education deficiencies but also nutritional deficiencies and hunger. India's primary school lunch program, which provides lunch to 120 million children every school day, is the largest school meal program in the world (Kingdon (2006)) and is also likely to be one of the world's largest child nutrition programs.

Second, studies examining the effect of schooling policy interventions are typically plagued by endogeneity problems associated with omitted variable bias, which may operate in two directions. If on the one hand parents or communities can influence school inputs, unobserved effects can lead to an overestimate of the impact of school policies on schooling outcomes. On

[1] Psacharopoulos and Patrinos (2002) estimate private returns to primary education of over 25%.

the other hand the problem of "purposive placement", whereby governments target interventions to places with unobserved poor schooling outcomes, may result in an underestimate of the true effect of policy interventions.

These endogeneity problems lie at the heart of the criticism of studies which apply simple OLS to cross-sectional evidence (e.g. Hanushek (1995) and Glewwe (2002)). Economists have recently dealt with this in one of two ways. The first is to resort to randomized evaluation.[2] The second has been to use natural experiments, i.e. exploit natural variation in schooling inputs which are uncorrelated with schooling outcomes.[3]

In this paper I exploit a third strategy: exogenous policy variation. The policy change I examine in this paper – the provision of a warm school lunch in government and government-funded primary schools – was the result of a 2001 Indian Supreme Court directive which was instigated by a drought, and not even motivated by improving schooling outcomes. Moreover, the fact that the directive was binding for some Indian states which had no such program in place, and non-binding for others which had long-established school lunches provides us with exogenous variation across states which can be used to establish the causal effect of school lunches on schooling outcomes.[4]

Using a large panel data census of schools from 7 South Indian districts for 3 academic years from 2001 to 2003, I find that the introduction of a school lunch is associated with a 25 per cent increase in class 1 (i.e. first grade) enrolment. This is comparable in magnitude to the impact attributed to school lunches in a couple of more casual, smaller-scale surveys in India.[5]

[2] Banerjee, Duflo, Cole, and Linden (2007) have recent applications in the Indian context.

[3] See Kremer (2003) for a review of the former, Glewwe (2002) for a review of the latter, and Kremer and Glewwe (2005) for a review of both.

[4] This approach is therefore closely related the natural experiments strategy, but distinct in that the exogenous variation here *directly* concerns the policy variable. In this sense the paper follows Duflo (2001), who examines the effect of a large school building program in Indonesia on educational attainment and wages.

[5] Khera (2002) finds a 23% increase in enrolment following the introduction of school lunches in her 63 Rajasthan schools. Drèze and Goyal (2003) find an 18%, 11%, and 14% increase in enrolment in their Rajasthan, Chattisgarh and Karnataka villages respectively, with samples of 27 schools in each case. It is 5 percentage points *smaller* than the enrolment effect of school lunches based on a randomized evaluation of 25 preschools in Kenya Vermeersch (2003).

There is, however, no evidence in these data to suggest that school lunches have narrowed the overall gender gap in enrolment, or had a higher impact on the enrolment of lower castes.

The paper proceeds as follows. Section 2 provides some background regarding the exogenous nature of the policy variation and the anticipated effect of school lunches on schooling outcomes. Section 3 describes the data. An outline of the empirical strategy in section 4 is followed by some preliminary analysis in section 5. Section 6 presents the estimation results, with robustness checks in section 7. Section 8 concludes.

2 Background

2.1 Supreme Court Directive

In 2001 Rajasthan, a state in Northwest India, suffered from drought. The 2000 Southwest monsoon had failed for the third year running and 31 of 32 districts were officially declared as drought-stricken (Rajalakshmi (2001)). Earlier that year, reports of drought-instigated starvation deaths began to appear in the press.

In April, 2001 the People's Union for Civil Liberties (PUCL), Rajasthan submitted a writ petition to the Supreme Court, pointing out that "while on the one hand the stocks of food grains in the country are more than the capacity of storage facilities, on the other there are reports from various states alleging starvation deaths".[6] The writ urged the court to instruct the Government to release public food stocks, arguing that the right to life under Article 21 of the Indian Constitution included the right to food.[7] The petition has culminated in protracted public interest litigation which is yet to be concluded.[8]

[6]Rajasthan PUCL Writ in Supreme Court on Famine Deaths, PUCL Bulletin, November 2001.

[7]Article 21 of the Constitution of India is entitled "Protection of life and personal liberty" and states (in its entirety), "No person shall be deprived of his life or personal liberty except according to procedure established by law."

[8]PUCL vs Union of India and Others, Writ Petition [Civil] 196 of 2001. The Right To Food Campaign has been closely monitoring the developments associated with this case

On November 28 2001, the Supreme Court issued a remarkable "interim order" directing states to introduce cooked mid-day meals, i.e. a warm school lunch, in all government-run and government-aided primary schools.[9] Over the course of the next 5 years, (the deadline for for implementation was January, 2005) the vast majority of Indian states had a midday meal in place. This directive serves the analysis well for two reasons. First, it is difficult to dispute that the primary school policy change it induced was exogenous: The directive was prompted by a drought of unprecedented severity, and it was motivated by nutritional rather than schooling improvement objectives. Second, the directive, although issued to all states, was not binding for 3 states – Tamil Nadu, Gujarat and Kerala had long-established warm school lunch programs, dating back to 1982, 1984, and 1995 respectively. This generates the inter-state variation necessary for identification.[10]

The implementation of the midday meal program is the joint responsibility of central and state governments. The Central Government provides financial assistance which amounts to Rupees 2.21 (or just under 5 cents in 2001) per child per school day. This comprises the cost of food grains, a subsidy to transport this grain from the nearest government grain godown to the primary school, another subsidy towards monitoring and evaluation,

and maintains an extremely informative website at www.righttofoodindia.org.

[9]The basic entitlement outlined by the directive is that "Every child in every government and government-assisted school should be given a prepared midday meal; with a minimum content of 300 calories and 8-12 grams of protein each day of school; for a minimum of 200 days a year."

[10]The only publication of which I am aware that resorts to a similar strategy for a developing country is Chin (2005). She provides a thoughtful evaluation of the impact of the addition of a second teacher to single teacher schools in the 1987 education scheme "Operation Blackboard", by exploiting inter-state variation in single-teacher schools via a differences-in-differences approach. The research design here owes much to her paper: I too use a differences-in-differences approach which exploits inter-state variation to evaluate the impact of a schooling input in India. However, our papers differ in at least 3 important ways. First, whereas teaching inputs comprised only one of several policy instruments in Operation Blackboard, the only primary school input affected by the Supreme Court directive was school lunches. This allow us to present a relatively clean impact evaluation of this particular policy. Second, the fact that we rely on panel data rather than (repeated) cross sectional data arguably arms us with a more powerful set of tools with which to identify any treatment effect. Third, unlike Operation Blackboard which was clearly motivated by educational objectives, the Supreme Court directive constituted an exogenous policy change.

and a cooking cost allowance.[11] The overall responsibility for the directive's implementation lies with state governments, with local government bodies, typically the village government (panchayat), responsible for its day-to-day operations.

2.2 School Lunches

School lunches are thought to be important in promoting primary school outcomes on a number of different dimensions.[12] First, they are thought to boost school enrolment. They act as an implicit subsidy to parents thereby *enabling* some to send their children to school. In addition children, particularly those from poorer families, are more likely to be *willing* to enrol in school as lunches provide welcome respite from hunger and dietary monotony.

Second, they encourage not only enrolment but also attendance. Since they are offered at mid-day and are consumed on the school premises, children have an incentive to actually stay at school for most of the school day. This is in stark contrast to the monthly grain rations offered by most states prior to the institution of warm school lunches under the auspices of the National Programme of Nutritional Support to Primary Education, initiated in 1995. Under this so-called "dry rations" scheme, children commonly enroled in school in order to qualify for grain rations but this did not readily translate into school attendance.

Third, by alleviating classroom hunger, school lunches are thought to improve learning. Quite apart from the direct consumption effect of school lunches, this indirect learning effect is likely to serve as an additional boost to school enrolment and attendance. Finally, school lunches are thought to promote social equity along two dimensions. On the gender dimension, micro-survey evidence from North India suggests that they reduce the gender gap in school participation.[13] This would be consistent with parents having a higher

[11] Guidelines of National Programme of Nutritional Support to Primary Education (2004)

[12] This section draws from micro-survey evidence in PROBE (1999), in whose design I participated, Drèze and Goyal (2003), and Khera (2006).

[13] Khera (2006) provides an overview of these findings.

elasticity of demand for girls' education relative to boys' education. On the caste dimension, since caste commensality (in addition to caste endogamy) is the one of the pillars of the Indian caste structure, the simple act of sitting down and eating together can be a powerful means of breaking down caste barriers.

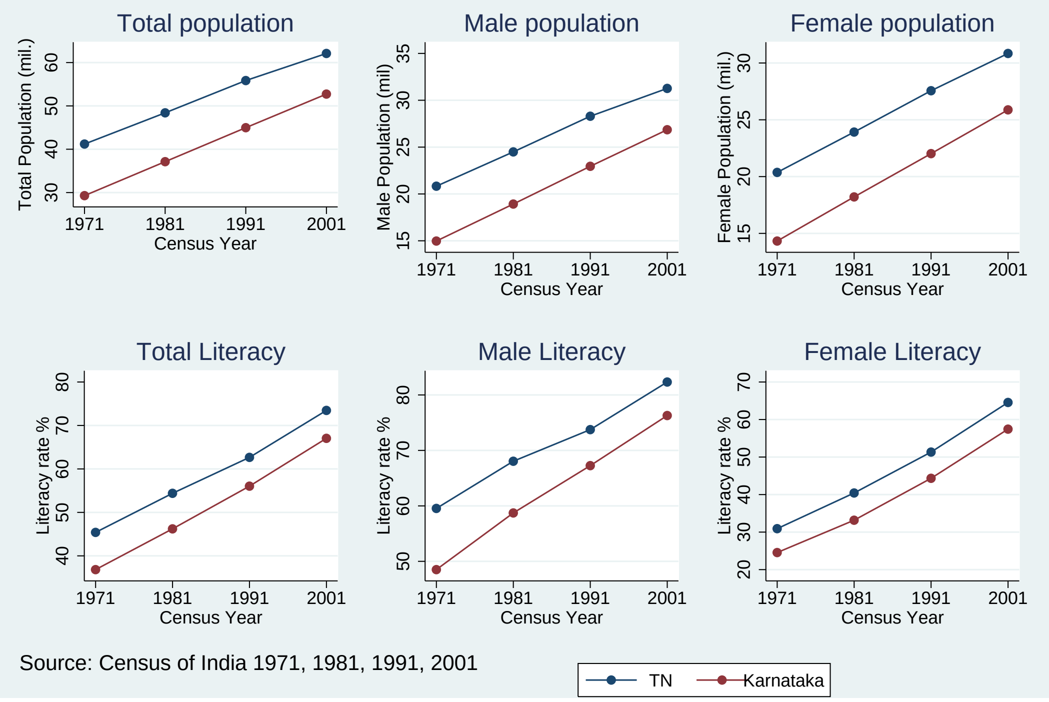
3 Data

The data I exploit in this paper come from the District Information System for Education (DISE) and cover the academic years 2001/2, 2002/3 and 2003/4 (for which I use the shorthand 2001, 2002 and 2003 hereafter). They comprise a census of primary (class 1-5) and lower secondary (class 6-8) schools in 3 Tamil Nadu districts (Dharmapuri, Pudukottai, and Ramanathapuram) and 4 Karnataka districts (Kolar, Bangalore Rural, Chamarajnagar and Mysore) which border Tamil Nadu. The Tamil Nadu districts constitute our control group – school lunches had been in place in these districts since the early 1980s. The Karnataka districts are our control group: the Supreme Court directive was implemented simultaneously in each of these districts in June, 2003.[14]

These data have at least 4 main strengths. First, Tamil Nadu and Karnataka have been reported to provide lunches of comparably good quality, and this is reassuring given that midday meals are not necessarily a homogenous good(Drèze and Goyal (2003)). Second, prior to 1953 when Indian state borders were drawn according to linguistic lines, Tamil Nadu and much of Karnataka were part of the Madras Presidency. Since historic institutions are thought to have a bearing on development we may expect that, having shared common political institutions and educational policies, Tamil Nadu and Karnataka would follow similar development paths. And in Figure 1, which presents population and literacy data from India's decennial censuses,

[14] This is admittedly a perversion of the terms treatment and control, whereby the latter typically involves having *no* policy in place. Notice, however, that a more conventional understanding of treatment and control would be recovered by regarding schools in Karnataka before 2003 as having received treatment (where treatment is having no policy in place) and remaining schools as constituting the control group.

Figure 1: Population and Literacy Trends



Source: Census of India 1971, 1981, 1991, 2001

it does indeed seem to be the case that (at least on the basis of these data) the two states have developed in a largely parallel fashion over the last four decades. Third, because they are annual data, we minimize the possibility of confounding policy changes having transpired in between consecutive survey years. Finally, neither Tamil Nadu nor Karnataka were affected by the 2000-2001 drought.[15] This means that treatment and enrolment effects are not picking up drought effects.

The DISE survey was launched in order to monitor progress in education outcomes for those districts covered by the District Primary School Education Programme (DPEP). The school survey questionnaire, which poses detailed questions pertaining to schooling inputs (such as physical infrastructure, funding and teaching staff), are answered at the school level. Data

[15] The 8 states which were drought-afflicted were in North and Central India: Chhatisgarh, Gujarat, Madhya Pradesh, Orissa, Rajasthan, Himachal Pradesh, Maharashtra, and Uttaranchal.

reliability is verified through checks for internal consistency via a standardized software, and at the district level by professionally trained EMIS units.[16]

The school sample used in the main analysis comprises a balanced three-year panel of schools from 2001-2003 located in 4 districts in Karnataka and 3 districts in Tamil Nadu covered by the DPEP. Although the survey contains both private and public schools, I restrict attention to government schools since, although both government and government-aided schools were subject to the Supreme Court directive, Karnataka did not introduce school lunches in government-aided schools until September, 2004.[17]

The main outcome of interest in this paper is class 1 enrolment. The reason for this focus is to minimize noise in the dependent variable. In particular, enrolment in class C for $C \geq 2$ is conditional on having been enroled in class $C - 1$ in 2002; if a child was enroled in school in 2002 when no school meal was offered in Karnataka, any increase in enrolment in that state observed between 2002 and 2003 may well be unreflective of a response to a school meal incentive.

The explanatory variable of interest is a dummy variable called "Lunch". It is equal to 1 for all three years of observation in the case of Tamil Nadu schools in our sample, and equal to 0 in 2001 and 2002 and 1 in 2003 for Karnataka. In India, the academic year commences in June and government schools accept enrolment until September. Since our enrolment data are updated on September 30th of each year and school lunches were introduced in these Karnataka districts in June, 2003, our 2003 enrolment figures can be reasonably expected to pick up any enrolment effects associated with the introduction of school lunches in this year.

Although there was no generalized provision of school lunches prior to 2003 in our Karnataka districts, some government schools have been known to provide lunches under special circumstances. In order to minimize measurement error on the lunch variable, I therefore restricted attention to "unexceptional" primary schools. In particular, I only included schools which

[16]see http://www.dpepmis.org/ for more details.

[17]The government operated schools in our sample comprise both department of education as well as local body schools, with the bulk falling in the latter category. Government-aided schools comprise only 3% of the sample and results are robust to their inclusion.

covered grades 1-5 (and not some fraction thereof), are co-educational, are day-schools (not boarding), were not located in tribal areas, and were taught in either Tamil or Kannada, the local languages in Tamil Nadu and Karnataka, respectively.[18] The full sample comprises a balanced three-year panel of 3148 schools in Karnataka and 2994 schools in Tamil Nadu.

Table 1 provides descriptive statistics pertaining to the average logarithm of class 1 enrolment and total primary school enrolment for this sample, disaggregated by state, year and gender. We use log enrolment for ease of interpretation given that our data pertain to enrolment levels and not enrolment rates. Class 1 average log enrolment for Tamil Nadu and Karnataka in 2001 in row 1 corresponds to an enrolment of 25 and 16 students, respectively. The table shows that in both states, enrolment has been declining over this period. This is consistent with declining fertility rates in these two states and has been observed by others.[19] Class 1 as well as overall school enrolment is higher in Tamil Nadu than in Karnataka and both states demonstrate a gender gap in enrolment.

[Table 1]

4 Empirical Strategy

The basic strategy is to examine how enrolment in Karnataka, following its institution of a school lunch in 2003, changed relative to that in Tamil Nadu, which already had a school lunch in place. This comparison amounts to a difference-in-differences model.[20] The basic equation is:[21]

[18]Local language schools comprised approximately 90% of the total school sample in both states.

[19]e.g. WorldBank (2003). The recent release of the household demographic and health surveys (DHS) also shows this pattern of declining enrolment.

[20]I am grateful to Paul Glewwe for bringing my attention to a contemporaneous paper by Farzana Afridi, which examines the impact of midday meals using a similar difference-in-differences strategy. Using cross-sectional data for a sample of 615 households and 74 primary schools across 14 villages, Afridi (2007) exploits staggered implementation of the midday meal policy within Madhya Pradesh, rather than inter-state variation, to identify its effects on schooling outcomes.

[21]This approach follows Imbens and Wooldridge (2007).

$$y_{it} = \tau L_{it} + \mathbf{x}_{it}\gamma + \lambda_t + \epsilon_{it} \qquad (1)$$

The main variable of interest is L_{it}, the school lunch indicator, which takes on value 1 if school i offers a school lunch during periods $t = 1, 2, 3$ (corresponding to $2001, 2002$ and 2003). In our case, $L_{it} = 1$ in each period for schools in TN; in Karnataka, $L_{it} = 0$ for $t = 1, 2$ and $L_{i3} = 1$. λ_t denotes a (potentially) time-varying intercept and $\mathbf{x}_{it}$ denotes a vector of controls, which in our robustness checks will include a wide range of other schooling inputs; ϵ_{it} is the error term.

Estimating equation (1) using OLS is likely to suffer from omitted variables bias, and this manifested in two ways. One is a standard unobserved school effect. This may be captured as follows:

$$y_{it} = \tau L_{it} + \mathbf{x}_{it}\gamma + c_i + \lambda_t + u_{it} \qquad (2)$$

where c_i reflects school time-invariant unobserved heterogeneity. Equation (2) can be estimated either by first differences or by fixed effects. When the error term is serially correlated – which may be reasonably anticipated in the context of school enrolment – applying the first difference (FD) estimator is more efficient than the fixed effects (FE) estimator. Taking the first difference of equation (2), we obtain:

$$\Delta y_{it} = \tau \Delta L_{it} + \Delta \mathbf{x}_{it}\gamma + \eta_t + \Delta u_{it} \qquad (3)$$

where τ is the differences-in-differences estimate. and $\eta_t = \lambda_t - \lambda_{t-1}$ are time effects. Since the introduction of school lunches in Karnataka arguably constituted an exogenous policy change, the strict exogeneity criteria is satisfied, so OLS applied equation (3) is consistent.

An additional source of omitted variable bias stems from the possibility that enrolment may be driven by unobserved trends, most notably fertility rates in the school catchment area, or even migration. This is captured by using a "correlated random coefficients" model (Wooldridge (2005)):

$$y_{it} = \tau L_{it} + \mathbf{x}_{it}\gamma + \lambda_t + c_i + g_i t + u_{it} \quad (4)$$

where school-specific trends in responses are captured by g_i. Taking the FD of equation (4) yields:

$$\Delta y_{it} = \tau \Delta L_{it} + \Delta \mathbf{x}_{it}\gamma + \eta_t + g_i + \Delta u_{it} \quad (5)$$

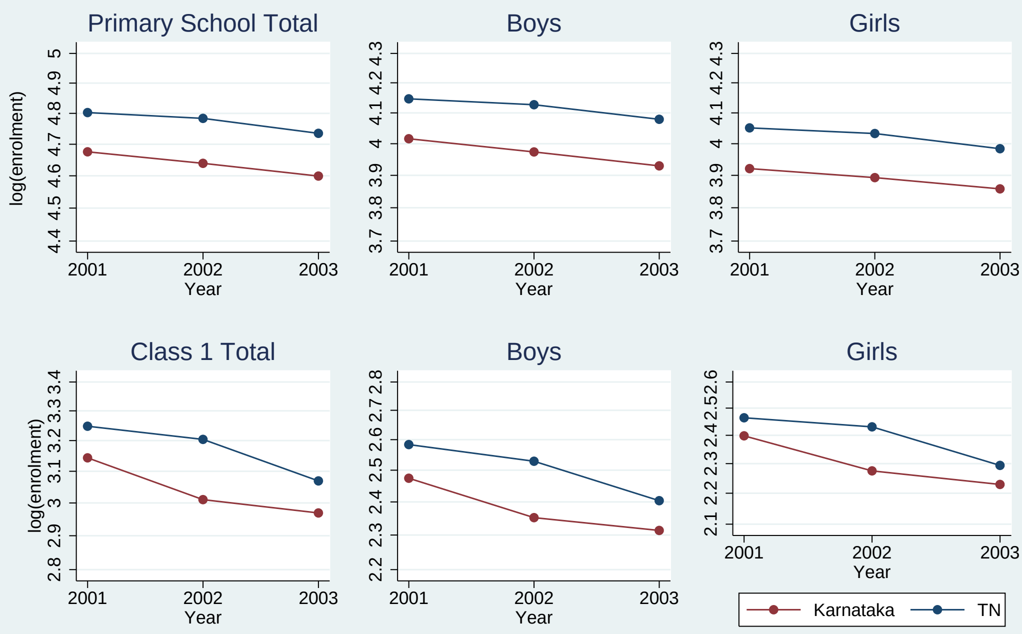
Because we have data for a total of 3 periods, estimating equation (5) using FD or fixed-effects (FE) produces identical estimates.

5 Preliminary Analysis

In addition to the exogeneity of the mid-day program, the validity of the identification strategy in this difference-in-differences approach relies on the so-called "parallel trends" assumption – that outcomes would have followed a parallel evolution in the absence of treatment. This assumption is untestable, and the two years of data prior to the institution of school lunches in Karnataka are unlikely to provide a very accurate picture. Nevertheless, the data as presented in Figure 2 do suggest that primary school enrolment and class 1 enrolment in these Karnataka and Tamil Nadu districts are moving in the same general direction prior to 2003.

Figure 3 presents a rough estimate of the impact of midday meals on class 1 enrolment. Panel 1 describes the evolution of average class 1 log enrolment. As we saw in table 1, in both Tamil Nadu and Karnataka, class 1 enrolment declined over the survey period. In Tamil Nadu, this decline was steeper from 2003-2002 relative to 2002-2001 whereas in Karnataka, this decline became flatter after 2002 with the introduction of school lunches. In other words, the enrolment gap between Tamil Nadu and Karnataka narrowed following the introduction of school lunches. Panel 2 provides an idea of the extent to which this gap was filled. Between 2002 and 2001 the change in enrolment was approximately 0.146 points higher in *Tamil Nadu* than it was Karnataka. After school lunches were introduced in Karnataka, this order was reversed: the change in enrolment between 2003 and 2002 was approximately 0.081

Figure 2: Average log(Enrolment)



Source: Dise 2001, 2002, 2003;Y−axes present school−level averages

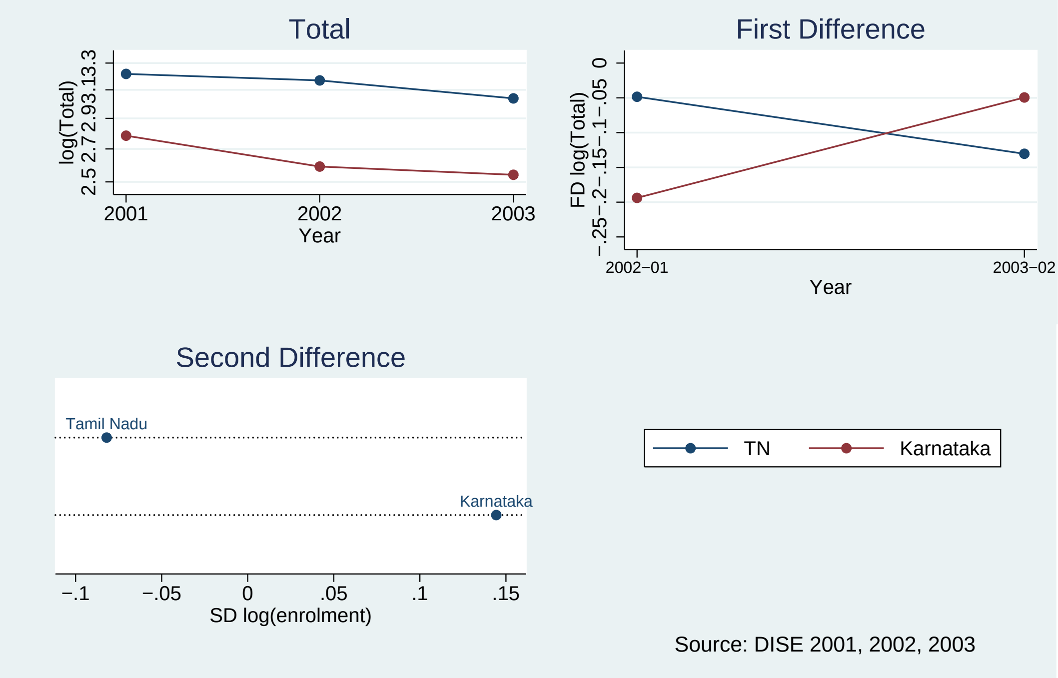
points higher in *Karnataka* than in Tamil Nadu. This graphical analysis suggests that school lunches are associated with just approximately 22.7 per cent increase in enrolment. And this can be seen more clearly by comparing the second differences of class 1 log enrolment between Tamil Nadu and Karnataka, presented in the bottom panel.

6 Basic results

I start by estimating the baseline models specified in equations (3) and (5). Results are presented in table 2. In this and all subsequent regression tables, standard errors are clustered at the school level, and time trends are taken into account.[22] A Wooldridge (2002) test of the null hypothesis of *no* first order auto correlation is marginally rejected (at the 11% level) for total

[22]Results are robust to clustering at the state, state-time, district, block and village levels.

Figure 3: Class 1 Average log(Enrolment)



enrolment and strongly rejected at the 5% level for girls' enrolment.[23] This, along with the exogenous nature of the policy change suggests that the OLS will yield efficient and consistent estimates when applied to equation (3); these FD OLS estimates are presented in the top half of table 2.[24] A Hausman test (whose p-value is presented on the last row of the bottom panel) favors a fixed effects over a random effects specification in the estimation of equation (5) for class 1; these FD FE estimates for the correlated random coefficients model are presented in the bottom half of the table.

[Table 2]

The dependent variable in table 2 is log enrolment – first for class 1, and then for primary school as a whole. In each case, aggregate as well as gender-disaggregated enrolment is presented. Our explanatory variable of

[23] I apply the xtserial command as developed by Drukker (2003).

[24] FE estimation (available upon request) produced the identical point estimates for our differences in differences estimate τ on the lunch variable for total, girls and boys enrolment. I therefore stick to the FD estimator for ease of interpretation.

interest is the school lunch variable. In this and all remaining FD estimation, this variable (and all other right-hand-side variables) are represented in first differences, so in effect this variable is equal to 1 for Karnataka schools in 2003 and 0 elsewhere.

The first row presents coefficient estimates on the impact of school lunch on enrolment using FD OLS. The point estimate is positive and significant across the board for class 1. It suggests that the introduction of a school lunch is associated with an 8.4% increase in total class 1 enrolment in the sample schools.[25] The point estimate is slightly higher for boys than for girls, but this difference is not significant, suggesting that the school lunches have the same impact on boys' and girls' enrolment.

The first row of FD FE estimates in the bottom panel indicate that once unobserved trends are taken into account, the impact of school lunches is about twice as large. The coefficient of 0.226 for class 1 enrolment is consistent with the graphical analysis. Overall, the point estimates suggest that the introduction of a school lunch is associated with an 25% increase in class 1 enrolment. This is slightly lower for boys and slightly higher for girls, but any gender difference in the impact of school lunch is not significant. This is not consist with both micro-survey as well as anecdotal evidence from North India, where enrolment responses from girls have allegedly been substantially higher than that for boys.[26] If elasticity increases as you move up the demand curve, this discrepancy may reflect the fact that the absolute level of girls' enrolment is smaller in North relative to South India.

The large positive effect on class 1 enrolment in the bottom panel of table 2 is not reflected in overall primary school enrolment. The negative point estimate on the lunch variable for primary school enrolment in the FD OLS results in the top panel is insignificant once aggregate trends are taken into account in bottom panel. This confirms our prior that school lunches are

[25] $= exp(0.081) - 1$

[26] Drèze and Kingdon (2001) find, on the basis of their cross-sectional, that midday meals have a strong positive association with girls but not boys educational attainment. In Rajasthan and Chattisgarh, Drèze and Goyal (2003) find that the percentage increase in enrolment is three times as large for girls than boys, and in Madhya Pradesh Afridi (2007) finds a 10 percentage point increase for class 1 girls, with no corresponding increase for boys.

unlikely to increase enrolment beyond class 1 in these data. More generally, schooling costs increase with school class whereas the value of a this lunch subsidy remains constant. A negligible impact of school lunches for overall primary school enrolment relative to class 1 enrolment may therefore reflect the smaller relative value of the school lunches in later school years.[27]

[Table 3]

The DISE data provide enrolment figures disaggregated by up to 7 caste categories. Caste groups vary from region to region in India, and only 2 of these caste categories are reasonably comparable between Karnataka and Tamil Nadu: "scheduled castes" (SC), which constitute the lowest tier in the caste hierarchy, and "other backward castes" (OBC) which rank higher than the scheduled castes, although they typically do not constitute the highest caste group.

Table 3 presents results regarding the effect of school lunch on class 1 enrolment disaggregated by these two caste categories. The first 3 columns present estimates pertaining to OBCs and the last 3 columns present results for SCs. (Note that these two caste groups together form a strict subset of aggregate class 1 enrolment.) The regression specification in the top and bottom panels are identical to that in table 2. The middle panel provides a FE estimation, by way of contrast to the FD estimates in the top panel.

The results in the top and bottom panels pertaining to OBCs in the first 3 columns suggest that the enrolment response in this group is comparable to that of the population at large presented in table 2. The enrolment response to school lunches is over 8% according to the FD OLS estimate and just over 20% according the FD FE estimate, and there is no gender gap in responses.

SC responses are markedly different. Estimates presented in the first row of last 3 columns suggest that school lunches have no impact on enrolment among this caste group. One possible reason for this surprising finding is that FD OLS is not an appropriate model in this case: although a Wooldridge test rejects the null hypothesis of *no* autocorrelation for total as well as boy's class 1 enrolment, we are unable to reject this null in the case of girls. In this case, FE is likely to be more efficient than FD. Such FE estimates, presented

[27] Afridi (2007) has a similar finding and provides the same line of argument.

in the middle panel of table 3, suggest that there is a positive overall SC class 1 enrolment response to school lunches, driven by an increase in girls' SC enrolment. Enrolment among SC girls increases by 8.5% – a number comparable to that of girls in the population at large – but there remains no significant increase in enrolment among SC boys. This result suggests that whereas school lunches do not close the overall gender gap in education, they do close the gender gap in education among the most disadvantaged castes.

The FD FE results in the bottom panel suggest that the picture is not quite as bleak for SC boys as the top two panels suggest: SC boys' enrolment according to these estimates rises by almost 12%. The analogous increase for SC girls, OBC girls and OBC boys is 18.5% and 23% and 19.7%, respectively. This points to a SC-OBC caste gap of 4.5 percentage points for girls and 7.7 percentage points for boys, and a gender gap of 6.5 percentage points (favoring girls) among SCs.

7 Robustness Checks

All governments, at any given point in time, have numerous different policies aimed at promoting schooling outcomes. This presents a problem in the identification of a causal effect of the school lunch program to the extent that there may have been confounding policy changes in Tamil Nadu or Karnataka in 2003.[28] In India, the two main programmes aimed at promoting primary school education are the District Primary Education Programme (DPEP) the Sarva Shiksha Abhiyan (SSA).[29]

The DPEP was conceptualized in the early 1990s in response to India's low literacy rates. Its primary aims were to provide primary school access for all children, reduce dropout rates, increase learning achievements, and reduce gender and caste gaps (DOE (1995)). The costs of the programme are shared by the center and the state; the former provides 85% of the funds

[28] I am grateful to Jyotsna Jalan and Jean Drèze for useful input here.

[29] Although several micro-initiatives were launched by state governments, to the best of my knowledge, no major initiative was launched over the survey period at the district or state-level.

with considerable support from donor agencies.[30] Phase I of the program, launched in 1995, covered 42 districts in 8 states (including Tamil Nadu and Karnataka), and phase II was launched in 1996. In 2003, DPEP was operational in 272 districts in 18 states.

Since DISE was launched precisely to monitor progress under DPEP, all the districts in the sample were covered by DPEP over the entire sample period. To this extent, the observed effect of the introduction of school lunches in Karnataka in 2003 cannot be confounded with any effect associated with cross state-time differences in the *introduction* (or withdrawal) of the DPEP per se.

The SSA, aimed at the 6-14 age group, has the similar aim of achieving universal enrolment, bridging gender and caste gaps, achieving universal retention, and improving education quality.[31] During the survey period (under the Ninth Plan), central and state governments shared costs on an 85:15 basis. To the extent that it was launched in 2001, at the same time in all states, any difference in enrolment outcomes in the treatment group (Karnataka in 2003) cannot be attributed to the introduction of the scheme as a whole.

That being said, our estimates may still be subject to omitted variable bias to the extent that both the SSA and DPEP employ a variety of different policy instruments. These include improvements in schooling infrastructure and teaching aids, provision of school grants, increased monitoring, and increased schooling personnel. Table 4 provides estimates for class 1 enrolment while controlling for a wide range such schooling inputs. To the extent that these inputs are endogenous, all the coefficients in this table will be bias. To the extent that they are not, however, controlling for them will provide an indication of the whether our lunch coefficient estimates suffer from omitted variable bias.

Improvements in school infrastructure are captured through 4 variables: the provision of electricity and water, the number of good quality classrooms, and the availability of a toilet facilities. Teaching aids are captured

[30]see World Bank (2003) for a review of the evidence regarding the impact of this program; Jalan and Glinskaya (2003) use a propensity score matching method in their impact evaluation.

[31]see http://ssa.nic.in/

through the number of blackboards and the availability of a bookbank (library). Grants are captured through the amount received in terms of 2 DPEP-funded grants: a school development grant and a teacher grant. The number of visits from the cluster resource center (CRC) and block resource center (BRC) measure increased monitoring. Personnel improvements are captured through the number of sanctioned teachers, parateachers, and non-teaching positions.

[Table 4]

Columns 1 and 2 analyze overall class 1 enrolment (using FD OLS and FD FE, respectively), while columns 3-6 examine caste-disaggregated effects, first for OBCs and then for SCs. The coefficients on the control variables need to be interpreted with caution because of potential endogeneity issues. Nevertheless, those in columns 1-4 suggest that these schooling inputs are associated with increased aggregate as well as OBC enrolment. Electricity (though not water) provision is associated with an approximately 5% higher enrolment; an additional good condition classroom with up to 2% higher enrolment; a common toilet is associated with an additional 3-4% increase and the number of blackboards with just over 1% higher enrolment; teacher grants are associated with a slightly higher enrolment, as are the number of monitoring visits. While parateachers and non-teaching staff have no positive association with overall class 1 enrolment, the number of teachers has a strong positive relationship, with an additional teacher being associated with an approximately 9% higher enrolment.

As columns 5 and 6 indicate, many of these schooling inputs either have no significant association, or a much lower positive association with SC enrolment. Only CRC visits, blackboards, and the number of teachers are associated with higher SC enrolment, and the FD OLS point estimates of the latter two are about half the size of those for aggregate enrolment. Once unobserved trends are accounted for, the only significant control variable is the number of teachers, with an extra teacher being associated with approximately 3-4% higher SC enrolment (compared with 9% for enrolment at large.)

Most importantly in the context of this paper, the result from table 2 regarding the impact of school lunches on enrolment appears to be robust to the inclusion of these controls: The lunch coefficients are, if anything, slightly higher. In columns 1 and 2, respectively, the FD OLS point estimate is 0.0822 compared to 0.081 in table 2, and the FD FE estimate is 0.262 compared to 0.226. The point estimates for OBCs and SCs follow a similar pattern. It is also worth noting that even with the more conservative FD OLS estimates, the only discrete input with a comparable point estimate school lunches is teachers: The results suggest that the impact of school lunches on enrolment is statistically equivalent to the impact of introducing an additional teacher to the school.

The sample I use comprises a balanced panel of government-run primary schools. Hence, the estimates heretofore have essentially ignored the possibility that the observed changes in enrolment may reflect alternative primary school provision, either in the form of newly established public schools – whose construction has been one of the major policy initiatives under both DPEP and SSA – or private schools. If, for instance, there had been a boom in private school provision or public school construction in Tamil Nadu in 2003, the school lunch estimate may be picking up the effect of this on declines in public primary school enrolment for Tamil Nadu relative to Karnataka, rather than the positive effect of lunch provision in Karnataka. I account for this by restricting the sample to the 330 villages in Tamil Nadu and 1658 villages in Karnataka which, over the course of the sample period, had a single village school.

The results, presented in columns 7 and 8 of table 3, indicate that school lunches have had an even larger impact on class 1 enrolment in these single-school villages, with the point estimates using FD OLS and FD FE suggesting a 15.7% and 44.5% increase in enrolment, respectively.

8 Conclusion

In this paper, I used an exogenous policy change to evaluate the impact of school lunches on class 1 enrolment in India. The FD OLS estimates suggest that the provision of a warm school lunch is associated with an approximately

8% increase in class 1 enrolment. When we account for aggregate trends using FD FE, the increase in enrolment associated with school lunches is 25%.

The size of the effect is impressive. Even if we take the conservative 8% estimate at face value and compare it to the point estimates of other potential schooling inputs, then it would seem that introducing a school lunch is associated with a similar increase in enrolment as adding an additional teacher, and teachers are expensive. The average government school teacher in India receives between Rs. 5,000 - 8,000 per month base pay, plus perks (Pritchett and Pande (2006)). Since the average primary school in our sample has about 117 students (the median is even lower at 88 and the Karnataka average is 95), this means that a lunch program at such a school which meets the Supreme Court's minimum directive of providing lunch for 200 days would, at unit price of 2.21 Rupees per student, cost roughly 4,300 Rupees per month – substantially lower than even the lower bound of the average government school teacher salary.[32]

This paper controlled for a wide range of schooling inputs and accounted for unobserved school effects. Nevertheless, the fact that I just engaged in such a back-of-the-envelope calculation highlights one drawback of this study: I have imposed a linear structure on school lunches, while reality has a tendency be non-linear. For example, if school lunches facilitate cognitive acquisition, a richer model may want to account for the possibility that they can be complementary to teaching inputs. Similarly, if enrolment responses are higher at lower levels initial levels of enrolment, the estimates are likely to exaggerate the impact of school lunches to the extent that Karnataka had lower initial enrolment than Tamil Nadu. Although the overall direction of any bias is unclear, the research design does not permit an exploration of such interactions.

In general, the results pertaining to aggregate class 1 enrolment suggest that school lunches may be a useful policy instrument towards attaining the second MDG pertaining to universal primary school attainment. The distributional impact of school lunches suggests, however, that they may be somewhat less effective in attaining the third MDG, which calls for the elim-

[32] [(117 students) X (Rs. 2.21 per student) X (200 days)]/12.

ination of gender disparity in all levels of education by 2015. The estimates suggest that overall class 1 enrolment increases by the same proportion for girls and boys; in other words, school meals are not closing the overall gender gap in Karnataka. This finding is contrary to evidence from North India, and may simply reflect lower demand elasticities corresponding to higher female enrolment in the South. Hence, it cannot be interpreted as evidence that school lunches do not *narrow* the gender gap, but does nevertheless suggest that this policy instrument is are unlikely to *close* (a narrow) gender gap. Where school lunches do appear to be narrowing the gender gap is among scheduled castes. One possible reason for this is that school lunches tend to promote learning. Since lower caste women tend to have higher labor force participation rates than upper caste women the returns to learning, and therefore the incentive for school enrolment, among the former group may be larger than that for the latter. This is encouraging considering that this demographic tends to be characterized by particularly low levels of school participation.

Although the results pertaining to caste need to be treated with due caution – our caste classifications are crude and we cannot control for unobserved heterogeneity below the school level – perhaps the most disheartening result is that school lunches do not appear to be narrowing the caste gap in education, especially among boys. The fact that lower castes are not more responsive to school lunches – at least in these data – suggests that they may face more subtle constraints to school enrolment and underscores the common consensus that reducing caste inequality in education outcomes remains a serious challenge.[33]

Developing a better understanding of the schooling choice problem would help demystify gender and caste differences in responses to schooling inputs, and combining this with a richer model of the schooling production function would help us better grasp precisely which policy instruments (or combination thereof) are most effective in bridging social gaps in enrol-

[33]For example, Deshpande (2000) finds that even in a relatively egalitarian state like Kerala with universal primary school enrolment, caste-based educational disparities persist.

ment. The scope of these extensions are, admittedly, limited by both data constraints and endogeneity concerns. But even within our difference-in-differences framework, with the help of additional data, there is room for further analysis to answer questions pertaining to the role of school lunches in promoting learning, nutritional and health outcomes, and retention. This is left to future research.

Table 1: Average log(Enrolment)

	Tamil Nadu			Karnataka		
	2001	2002	2003	2001	2002	2003
Class 1	3.217	3.169	3.039	2.785	2.591	2.542
	(0.694)	(0.693)	(0.714)	(0.703)	(0.710)	(0.724)
Class 1 Boys	2.548	2.489	2.360	2.045	1.851	1.808
	(0.761)	(0.760)	(0.786)	(0.797)	(0.805)	(0.817)
Class 1 Girls	2.424	2.384	2.245	2.050	1.848	1.786
	(0.773)	(0.781)	(0.801)	(0.787)	(0.794)	(0.808)
Primary School	4.764	4.742	4.698	4.336	4.285	4.200
	(0.669)	(0.652)	(0.655)	(0.659)	(0.664)	(0.700)
Primary School Boys	4.109	4.087	4.045	3.638	3.585	3.498
	(0.682)	(0.666)	(0.670)	(0.682)	(0.685)	(0.724)
Primary School Girls	4.011	3.991	3.945	3.630	3.578	3.489
	(0.688)	(0.675)	(0.677)	(0.677)	(0.683)	(0.727)
Observations	2994	2994	2994	3148	3148	3148

This table presents log(enrolment), averaged across schools within a given state . and academic year. Rows (1)-(3) present average log(enrolment) for Class 1 and rows (4)-(6)present average log(enrolment) for primary school (i.e. classes 1-5). Columns (1)-(3) present averages for 3 Tamil Nadu and columns (4)-(6), for 4 Karnataka districts. Total as well as gender-disaggregated figures are presented in each case. Source: DISE 2001, 2002,2003; Standard errors in parentheses

Table 2: Basic Results

Dependent Variable	**Class 1 log(enrolment)**			**Primary School log(enrolment)**		
	Total	Boys	Girls	Total	Boys	Girls
First-Difference OLS						
Lunch	0.0810***	0.0856***	0.0769***	-0.0414***	-0.0455***	-0.0438***
	(0.0158)	(0.0196)	(0.0194)	(0.0129)	(0.0136)	(0.0136)
2003	-0.007	-0.002	-0.016	-0.007	-0.004	-0.009*
	(0.0107)	(0.0145)	(0.0151)	(0.005)	(0.005)	(0.005)
Constant	-0.123***	-0.128***	-0.123***	-0.0371***	-0.0379***	-0.0364***
	(0.005)	(0.008)	(0.008)	(0.003	(0.003)	(0.003)
Observations	12284	12284	12284	12284	12284	12284
Adj. R-squared	0.004	0.003	0.002	0.002	0.002	0.003
Wooldridge Test p-value	0.113	0.188	0.0587	0.007	0.002	0.007
First-Difference Fixed Effects						
Lunch	0.226***	0.220***	0.238***	-0.0120	-0.0160	-0.0128
	(0.022)	(0.029)	(0.029)	(0.015)	(0.019)	(0.016)
2003	-0.0820***	-0.0709***	-0.0985***	-0.0216***	-0.0192***	-0.0248***
	(0.013)	(0.017)	(0.018)	(0.006)	(0.006)	(0.007)
Constant	-0.123***	-0.128***	-0.123***	-0.0371***	-0.0379***	-0.0364***
	(0.006)	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)
Observations	12284	12284	12284	12284	12284	12284
Number of Schools	6142	6142	6142	6142	6142	6142
Adj. R-squared	0.018	0.011	0.011	0.002	0.002	0.002
Hausman test p-value	0.000	0.000	0.000	0.033	0.048	0.038

This table presents the impact of school lunches on class 1 enrolment (columns (1)-(3)), and primary school enrolment (columns (4)-(6)), disaggregated by gender.
This impact for Class 1, is measured by the coefficient on the “Lunch” variable equal to 1 in 2003 in Karnataka and 0 otherwise). 2003 is a dummy variable equal to 1 for that year.
Each column in the top and the bottom panels represents a different regression.
Standard errors, corrected for clustering at the school level, are reported in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$

Table 3: Caste differences in class 1 enrolment

Dependent Variable	**Class 1 log(enrolment)**					
	OBC			**SC**		
	Total	Boys	Girls	Total	Boys	Girls
First-Difference OLS						
Lunch	0.0828***	0.0884***	0.0827***	0.0333	0.0137	0.0525
	(0.0203)	(0.0249)	(0.0250)	(0.0255)	(0.0328)	(0.0327)
Observations	9323	9323	9323	5189	5189	5189
Adj. R-squared	0.003	0.002	0.001	0.003	0.001	0.002
Wooldridge test p-value	0.0896	0.0639	0.0671	0.0365	0.0569	0.379
Fixed Effects						
Lunch	0.101***	0.107***	0.0983***	0.0595**	0.0341	0.0817***
	(0.0197)	(0.0241)	(0.0242)	(0.0245)	(0.0313)	(0.0314)
Observations	15414	15414	15414	9888	9888	9888
Number of schools	5807	5807	5807	4334	4334	4334
Adj. R-squared	0.0597	0.0383	0.0386	0.0351	0.0260	0.0209
Hausman test p-value	0.000	0.000	0.000	0.000	0.000	0.009
First-Difference Fixed Effects						
Lunch	0.189***	0.180***	0.209***	0.142***	0.112**	0.177***
	(0.0300)	(0.0389)	(0.0397)	(0.0406)	(0.0545)	(0.0554)
Observations	9323	9323	9323	5189	5189	5189
Number of schools	5065	5065	5065	3026	3026	3026
Adj. R-squared	0.011	0.006	0.007	0.006	0.002	0.005
Hausman test p-value	0.000	0.002	0.000	0.001	0.0271	0.006

This table presents the impact of school lunches on Class 1 enrolment, disaggregated by caste. This impact is measured by the coefficient on the "Lunch" variable (equal to 1 in 2003 in Karnataka and 0 otherwise). OBC in columns (1)-(3) refers to "Other Backward Castes", which are considered a higher caste category than "Scheduled Castes" (SC) in columns (4)-(6). FD and FE specifications include a constant and dummy for 2003 FE specification includes, in addition, a 2002 time dummy and a Karnataka*2001 dummy Standard errors, corrected for clustering at the school level, are reported in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$

References

Afridi, F. (2007). The impact of school meals on school participation: Evidence from rural India. Mimeo, Syracuse University.

Banerjee, A., E. Duflo, S. Cole, and L. Linden (2007). Remedying education: Evidence from two randomized experiments in India. *Quarterly Journal of Economics 122*(3), 1235–1264.

Chin, A. (2005). Can redistributing teachers across schools raise educational attainment? evidence from operation blackboard in India. *Journal of Development Economics 78*, 384–405.

Deshpande, A. (2000). Does caste still define disparity? a look at inequality in Kerala, India. *American Economic Review, Papers and Proceedings 90*(2), 322–325.

DOE (1995). *Department of Education DPEP Guidelines.* New Delhi: NCERT.

Drèze, J. and A. Goyal (2003). Future of mid-day meals. *Economic and Political Weekly November 1*, 4673–4683.

Drèze, J. and G. G. Kingdon (2001). School participation in rural india. *Review of Development Economics 5*(1), 1–33.

Drukker, D. M. (2003). Testing for serial correlation in linear panel-data models. *The Stata Journal 3*(2), 168–177.

Duflo, E. (2001). Schooling and labor market consequences of school construction in Indonesia: Evidence from an unusual policy experiment. *American Economic Review 91*(4), 795–813.

Glewwe, P. (2002). School and skills in developing countries: Education policies and socioeconomic outcomes. *Journal of Economic Literature 40*(2), 436–482.

Hanushek, E. (1995). Interpreting recent research on schoooling in developing countries. *World Bank Research Observer 10*(2), 227–246.

Imbens, G. and J. Wooldridge (2007). Differences in differences estimation. NBER Summer School Lecture Notes 10.

Jalan, J. and E. Glinskaya (2003). Improving primary school education in India: An impact assessment of DPEP-Phase I. Mimeo.

Khera, R. (2002). Mid-day meals in Rajasthan. *The Hindu November 13*.

Khera, R. (2006). Mid-day meals in primary schools: Achievements and challenges. *Economic and Political Weekly November 18*, 4742–4750.

Kingdon, G. G. (2006). The progress of school education in India. *Global Poverty Research Group GPRG-WPS-017*.

Kremer, M. (2003). Randomized evaluations of educational programs in developing countries: Some lessons. *American Economic Review, Papers and Proceedings 93*(2), 102–106.

Kremer, M. and P. Glewwe (2005). Schools, teachers and education outcomes in developing countries. Second dradt chapter for *Handbook on the Economics of Education*.

Pritchett, L. and V. Pande (2006). Making primary education work for India's rural poor: A proposal for effective decentralization. *Social Development Papers, South Asia Series 95*(June).

PROBE (1999). *Public Report on Basic Education*. New Delhi: Oxford University Press.

Psacharopoulos, G. and H. A. Patrinos (September, 2002). Returns to investment in education: A further update. World BANK Policy Research Working Paper 2881.

Rajalakshmi, T. (2001). Rajasthan's thirst. *Frontline 18*(6).

UNICEF (2008). *State of the World's Children*. New York: UNICEF.

Vermeersch, C. (2003). School meals, educational achievement and school competition: Evidence from a randomized evaluation. Mimeo, Oxford University.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Setion and Panel Data*. Cambridge, MA: MIT Press.

Wooldridge, J. M. (2005). Fixed effects and related estimators for correlated random-coefficient and treatment-effect panel data models. *Review of Economics and Statistics 87*(2), 385–390.

WorldBank (2003). A review of eucational progress and reform in the district primary education program (Phases I and II). Human Development Sector, South Asia Region.

Table 4: Robustness Checks

Dependent Variable	**Class 1 log(enrolment)**							
Estimation	FD OLS	FD FE	FD OLS	FD FE	FD OLS	FD FE	FD OLS	FD FE
Caste	All	All	OBC	OBC	SC	SC	All	All
Sample	Full	Full	Full	Full	Full	Full	Single	Single
Lunch	0.0822***	0.262***	0.0844***	0.228***	0.0325	0.150***	0.146***	0.386***
	(0.0152)	(0.0229)	(0.0198)	(0.0309)	(0.0260)	(0.0432)	(0.0289)	(0.0452)
Electricity	0.0440***	0.0578***	0.0467**	0.0693***	0.0208	0.0457	0.0370	0.0281
	(0.0153)	(0.0195)	(0.0188)	(0.0265)	(0.0242)	(0.0364)	(0.0252)	(0.0327)
Water	0.0115	-0.006	0.007	-0.014	-0.001	-0.036	0.035*	0.027
	(0.0110)	(0.0149)	(0.0134)	(0.0190)	(0.0185)	(0.0269)	(0.0187)	(0.0258)
Good condition classrms.	0.0186***	0.0162***	0.0174***	0.0164***	0.00668	0.00641	0.0253***	0.0176**
	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.007)	(0.008)	(0.009)
Toilet	0.0378***	0.0316**	0.0185	0.00577	0.0168	0.0127	0.0639***	0.0621**
	(0.0123)	(0.0153)	(0.0134)	(0.0178)	(0.0193)	(0.0281)	(0.0243)	(0.0311)
No. blackboards	0.0122***	0.0108***	0.0122***	0.0130***	0.008**	0.006	0.0180***	0.0134**
	(0.003)	(0.00320)	(0.00254)	(0.00380)	(0.00310)	(0.00436)	(0.00502)	(0.00532)
Bookbank	-0.00296	-0.00194	0.0127	0.0176	0.0112	0.0147	-0.00936	-0.0123
	(0.0106)	(0.0136)	(0.0126)	(0.0162)	(0.0193)	(0.0271)	(0.0225)	(0.0289)
Sch. Devt Grant/100	-0.000	0.000	0.000	0.000	-0.001**	-0.000	0.000	0.001
	(0.000)	(0.000)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Teacher Grant/100	0.002***	0.002***	0.00139***	0.002**	0.001	0.001	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
No. CRC visits	0.004*	0.005*	0.001	0.002	0.008**	0.008	0.006*	0.008*
	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)	(0.004)
No. BRC visits	0.002	0.004*	0.001	0.004	-0.002	-0.005	0.003	0.004
	(0.0017)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
No. teachers	0.0914***	0.0855***	0.0653***	0.0624***	0.0405***	0.0334***	0.0711***	0.0771***
	(0.0176)	(0.0143)	(0.0156)	(0.0123)	(0.0123)	(0.0113)	(0.0258)	(0.0223)
No. Parateachers	-0.010	-0.003	-0.022**	-0.022**	-0.013	-0.008	0.076*	0.088
	(0.010)	(0.013)	(0.009)	(0.010)	(0.040)	(0.060)	(0.045)	(0.064)
No. non-teaching positions	-0.013	-0.013	-0.020	-0.014	0.015	0.050	-0.012	0.00357
	(0.012)	(0.015)	(0.014)	(0.016)	(0.030)	(0.046)	(0.031)	(0.044)
2003	-0.002	-0.092***	-0.020	-0.086***	0.047**	-0.041	-0.017	-0.213***
	(0.012)	(0.014)	(0.013)	(0.015)	(0.021)	(0.028)	(0.027)	(0.038)
Constant	-0.138***	-0.138***	-0.121***	-0.116***	-0.119***	-0.109***	-0.189***	-0.190***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.011)	(0.011)	(0.011)	(0.012)
Observations	11506	11506	8788	8788	4871	4871	3651	3651
Adj. R-squared	0.134	0.119	0.0735	0.0746	0.0309	0.0252	0.157	0.152

This table presents the impact of school lunches on Class 1 enrolment, controlling for other schooling inputs This impact is measured by the coefficient on the "Lunch" variable (equal to 1 in 2003 in Karnataka and 0 otherwise). Each of the columns pertain to a different regression. FD OLS applies OLS to first-differenced explanatory and dependent variables. FD FE applies fixed effects to the first differences. "Caste" refers to to the castes covered in the regression sample. OBC is "Other Backward Castes" and SC is "Scheduled Castes". "Sample" refers to the school sample, where "Full" refers to all government-run schools, and "Single" pertains to those government-run schools which were the single school in the village over the sample period 2001-2003 Standard errors, corrected for clustering at the school level, are reported in parentheses.
$***p < 0.01, **p < 0.05, *p < 0.1$