This is the accepted version of the manuscript Himaz, R., 2008. Welfare grants and their impact on child health: the case of Sri Lanka. *World Development*, *36*(10), pp.1843-1857
https://doi.org/10.1016/j.worlddev.2008.02.003

Title: Welfare Grants and their Impact on Child Health: The Case of Sri Lanka

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Summary

This paper asks whether an exogenous increase in income in the context of a poverty alleviation program has an impact on child anthropometric outcomes. The study looks at the *Samurdhi* Program in Sri Lanka and uses household data for 1999/2000. Using propensity score matching to account for selectivity bias, the paper finds that *Samurdhi* improves the height for age z-score of a child from a grant receiving family by roughly 0.40 standard deviations with the impact driven mainly by children between six to 36 months of age, compared to if they did not receive the grant. It also improves weight for height z-scores by around 0.45 standard deviations of children aged 36-60 months. These results are important for Sri Lanka where child nutrition is a cause for concern.

Keywords: Welfare Programs, Child Health, Matching Methods, South Asia, Sri Lanka

JEL Classification: H53, I12, I38

Acknowledgements

I wish to thank Sonia Bhalotra, Stefan Dercon, Pramila Krishnan, participants at the seminar 'Child Health in Developing Countries', The Centre For Market And Public Organisation, University of Bristol, 13-14 June 2005 and four anonymous referees for their invaluable comments on previous versions of this paper. The usual disclaimer applies.

1. INTRODUCTION

Can a monthly transfer of cash to a household in the context of a poverty alleviation program reach children and improve their health? Evidence on such experience has been mixed. In the US monetary transfers to poor families are argued to have little impact on child health (Currie(1995), Mayer(1997)). On the contrary in South Africa, an old-age pension scheme that substantially increases income to senior citizens was shown to have a positive impact on girls' anthropometric outcomes if a grandmother receives the grant. The study concludes that a cash transfer can be effective in improving child welfare but the efficiency of a public transfer program depends on the gender of the recipient (Duflo 2000). On a different note some studies argue that income increase does not necessarily translate into an increase in calorie intake (Behrman and Deolalikar 1987), whilst this 'revisionist' claim has been refuted by Subramaniam and Deaton (1996) with an example from rural Maharashtra in India.

However, can smaller transfers that top-up household income in the context of a poverty alleviation exercise and is targeted to the household itself rather than an individual have a positive impact on child health? This paper looks at this issue by considering a poverty alleviation program carried out in Sri Lanka--the *Samurdhi* National Poverty Alleviation Scheme. *Samurdhi* is `holistic' in approach to solving the problem of persistent poverty. Theoretically, it follows a simultaneous three pronged strategy that includes a monthly income transfer to poor households meant to raise nutritional status and welfare, a group savings and credit component that is aimed at reducing the vulnerability of the poor and a low-budget rural infrastructure development program aimed at easing village level bottlenecks in physical capital. The core of the program is the first prong: the income transfer to poor households.

The transfer consumes 80 per cent of the program budget, covers roughly 40 per cent of the population in the year 2000 and is pivotal in sustaining the other arms of the program. The transfer component is also important as it implicitly forces people to remain with the *Samurdhi* and participate in its various social-development and infrastructure programmes[1].

Samurdhi has met with criticism with respect to targeting (with the coexistence of large leakage errors and under-coverage) and as being partly a camouflaged attempt at reducing the problem of youth unemployment by recruiting unemployed youth to feed its colossal administrative structure (World Bank 2000, Gunatilaka et. al 1997). However, did it achieve its aim of improving the nutritional levels and well-being of at least a part of the household--the children?

This paper attempts to answer this question. I estimate the impact of the grant on the anthropometric outcomes of children aged six to 60 months using propensity score matching (PSM) to account for sample selection, with results checked for robustness using different matching algorithms including nearest neighbour, radius calliper and local linear matching. Moreover, the results are checked against an alternative specification to make certain that they are robust. I also discuss briefly the results of a parametric estimation using an endogenous switching regime model (ESRM) to corroborate the findings through PSM. Child well-being is proxied by the standardised anthropometric measure weight-for-height that indicates vulnerability to short-term impacts on nutrition and height-for-age z-scores that reflect accumulated investments to child health, following WHO(1986).

The paper is organized as follows. Section two discusses the *Samurdhi* program in more detail and section three describes the data. Section four discusses PSM, a nonexperimental technique, that estimates treatment effects under the maintained assumption of selection on observables. Section five discusses the results and checks for its robustness. Section six concludes.

2. DESCRIPTION OF THE *SAMURDHI* PROGAM

Samurdhi (meaning 'prosperity') is Sri Lanka's largest social assistance program launched in 1995 and eventually implemented by the government throughout the island. It replaces its immediate predecessor the Janasaviya programme, implemented since 1989. The overall aims of *Samurdhi* are to integrate youth, women and disadvantaged groups into economic and social development activities and to promote social stability and alleviate poverty (*Samurdhi* Act of 1995). In an effort to meet these aims, the program follows a 'holistic' approach and thus various strategies. It differs, therefore, from most of the previous welfare policies of the Sri Lankan government implemented during the 1939-1989 period that included rice rations, food subsidy programs and the provision of food stamps. These programs are no longer operative. It also differs substantially from poverty alleviation programs or welfare schemes that simply transfer cash. *Samurdhi*'s approach comprises an element of 'protecting' the poor and another of 'promoting' them out of poverty. Under the element of protection those in poverty are cushioned with a monthly income transfer. The key aim of the grant is to raise the nutritional status and well-being of recipient households. Apart from this, the 'protection' component also has a so called "social insurance" scheme that covers contingencies (such as death, birth, illness and marriage) by offering an additional one-off payment and various small-scale social development projects targeted at alcoholics, aged destitutes, school drop-outs, etc. The element aiming to promote the poor out of poverty looks to create the institutional support necessary to push people out of poverty through group savings and credit schemes and village-level rural infrastructure development programs.

The administrative structure of the *Samurdhi* program extends from a few key national bodies right down to village level development offices. The program created around 40000 new jobs for unemployed youth both as division level managers and development officers by the year 1999/2000.

The monthly income transfer targeted to families in poverty is the most significant aspect of the *Samurdhi*. This is not only because it consumes a bulk of the grant (around 80 per cent of the overall Program budget in 1999), but also because it plays a pivotal role in implicitly forcing people to remain with the *Samurdhi* and participate in its various 'promotional' activities. A household receiving Rs. 500, for example, is expected to contribute four to five man-days of labour to community development projects. Contributing "voluntary" labour is a mandatory requirement for *Samurdhi* beneficiaries and it is not clear whether this has an impact on household labour market activity.

Samurdhi offers beneficiaries monthly coupons to the value of either Rs. 1000, Rs. 500, Rs. 250, Rs. 200 or Rs. 100 based on the number of household members and income levels. The coupons can be exchanged for goods from the local co-operative store. However, the net value is less than the nominal value (only for grants of Rs. 1000 and Rs. 500), since deductions are made at source in lieu of compulsory savings and insurance premia. The average grant received was Rs. 365.10, roughly 25 per cent of the monthly per capita household income of a grant receiving household. It is also roughly a quarter of the poverty line of Rs. 1423 as measured by the Department of Census and Statistics in Sri Lanka for 2002. The grant constitutes 15.6 per cent of the food budget of the poorest quintile and 12.8 per cent of the food budget of the second poorest. It is most commonly exchanged for rice (on average 24 per cent of the household *Samurdhi* budget), sugar (25 per cent), soap (17 per cent) and lentils

(14 per cent). The grant is given to the household--with the 'household head', in 80 per cent of the cases being an adult male, collecting the coupon. There are no discernable differences in the average types of goods bought by gender of the household head.

Technically, beneficiaries are supposed to exit the program when household incomes rise above a given threshold. There is no evidence to say that this has indeed been the case in practice. Also, if a household moves from a particular area their grant-status is cancelled and they are required to re-apply to qualify for the grant once again.

Samurdhi uses the existing co-operative system to deliver its grants. This means that certain weaknesses of the co-operative system spill into the delivery of the grant. Anecdotal evidence suggest beneficiaries dissatisfaction over the uncompetitive prices of goods available, their quality, availability and the staff's refusal almost always to exchange coupon for cash, even though that is technically allowed (Gunatilaka et. al 1997). The survey used in this paper shows that around 20 per cent claim that co-op prices are higher than open market prices while 68 per cent find no difference in prices. As for quality, 85 per cent claim that it is the same as in the open market.

The design of the program lays down means testing as a condition for targeting beneficiaries. It is acknowledged, however, that using income alone as a measure for targeting is difficult because of under-reporting and because poverty has more dimensions to it than can be captured by income. Hence village-level Development Officers who were responsible for nominating suitable beneficiaries were advised to use other characteristics of welfare in conjunction with means testing to identify the poor. These include the type of housing, roofing, walls, the lack of access to a latrine, etc. Beneficiary identification was a one-time affair conducted in 1995 at the commencement of the programme. Once the list of potential beneficiaries was compiled it was displayed in public places and grievances were addressed to the village or division level *Samurdhi* task force. Identification was always at the household level and not the village or community level.

In our sample (more details about the data used will be discussed later), around 40 per cent of the households receive *Samurdhi*. Only around 64 per cent of them come from the two poorest expenditure quintiles. Around 15 per cent are from the two richest quintiles indicative of some amount of mistargeting and leakage[2]. *On the whole, however, the cash transfer component is progressive with a bulk of the recipients being 'poor' as far as desegregations by expenditure quintiles reveal*. Moreover, the benefit incidence seems more equitable by region as well, since the poorest regions do get a higher allocation.

3. EMPIRICAL SPECIFICATION

This paper users propensity score matching to evaluate the impact *Samurdhi* has on child health[3]. Matching methods aims to 'select sufficient observable factors that any two individuals with the same value of these factors will display non-systematic differences in their reaction to the policy reform' (Blundell and Dias 2002:4). In consequence, a child coming from a grant-receiving home can be 'matched' with a child with the exact same observable characteristics but from a grant non-receiving household to isolate the impact of the grant on her health. The counterfactual effect will be measured correctly only if the correct observable characteristics are chosen (Heckman et. al. 1997).

The key identifying assumption for PSM is that the outcomes are independent of program participation, given a set of observables (i.e., conditional independence- Heckman and Robb (1985)) is met. This can be expressed as

$Y_0 \perp D \mid P(X)$ where Y_0 is the outcome of interest in the untreated state, D is a dummy indicating participation in the program, X is a set of observable characteristics and P(X) is the propensity score. Apart from the independence condition, the common support of overlap condition also needs to be satisfied. It rules out the perfect predictability of D given X: $0 < p(D=1|X) < 1$ (overlap). It also ensures that children with the same X values have a positive probability of being both *Samurdhi* recipients and non-recipients (Heckman et. al. 1998).

If both the above conditions hold, the treatment parameter can be identified using a weaker condition of conditional mean dependence: $E(Y_0 \mid D=1, p(X))= E(Y_0 \mid D=0, P(X))$. The effect of the treatment on the treated TT can be calculated as follows:

(1) $TT(X) = E(Y_1 \mid D=1, P(X)) - E(Y_0 \mid D=1, P(X))$

Thus the PSM estimator is the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of participants. In implementing PSM, propensity scores on the covariates using *probit* were estimated. Then, each child was from a *Samurdhi* household (‘treated’ child) was paired with a group of comparable non-*Samurdhi* children. Finally, the counterfactual outcome of the participating child was calculated as a weighted outcome of the neighbours in the comparison group. The baseline results reported, use nearest-neighbour matching, where each participant *i* is matched with a non-participating child j with the closest propensity score. See Essama-Nssah(2006:12-14) for more details. As robustness checks two other matching algorithms are used: caliper and local linear matching. Caliper matching imposes a tolerance level on the maximum propensity score distance of a neighbour. This improves matching quality by avoiding the risk of bad matches that nearest neighbour matching faces, if the closest neighbour is far away. A draw back, however, is that the choice of tolerance level is arbitrary (Smith and Todd 2005). I also use local linear matching that uses weighted averages of all individuals in the control group to construct the counterfactual outcomes. The use of more information means that the variance is lower but on the down side some of the observations used may be bad matches. This means that the proper imposition of the common support condition is important (see Heckman et. al. 1997, 1998).

If the match made is of good quality, then the matching procedure would have balanced the distribution of the relevant variables in both the treatment and control groups. To check the quality of the match is important because we condition on the propensity score and not on all covariates. A common approach is the use of a two sample t-test to check that the means of the covariates are not significantly different between the treatment and control groups after matching even though such differences are expected before matching (Rosenbaum and Rubin 1983). Apart from this, Sianesi (2004) suggests the use of the pseudo-R^2. This is computed by re-estimating propensity scores on the matched sample and comparing the pseudo-R^2 before and after matching to indicate how well X explains the participation probability. After matching it should be quite low as there should be no systematic differences in the distribution of covariates between the matched and control groups.

4. DATA

The data for the main empirical analysis come from a one-off cross-section household survey, the Sri Lanka Integrated Survey(SLIS) carried out by the World Bank with the help of the Sri Lanka Business Development Centre from October 1999 to August 2000 throughout Sri Lanka. The survey is the first of its kind and has not yet been replicated within the island. It contains information for 7500 households within 500 communities (with 15 houses randomly selected within a community) and has an accompanying community and price data set. It also contains information about heights and weights of children under five. In an attempt to be representative of the entire island, the survey includes the war-torn North and East of the country. Unfortunately, this data is argued to be not representative of the area, providing information that is contrary to conventional wisdom of the situation in these areas that have been subject to 17 years of civil war (Korf and Silva 2003:7, Narayan and Yoshido 2005:3). This may partly be due to the fact that only the better off and accessible areas of the North and East were surveyed and even then, field work was disrupted by the prevailing conflict conditions with some households being revisited several times, over a period of time in order to complete (if at all) the questionnaire. In any case, the impact of the program on war-torn areas maybe misleading and not strictly comparable with other parts of the country as the government and other institutions face considerable constraints in functioning efficiently under volatile conditions in a conflict zone. Moreover, in conflict areas and times household behaviour may be quite different to when conditions are more favourable. Behavioural differences may have an impact on choices for children (including nutritional investments), on the program, its outcomes and other variables and outcomes. None of the national surveys carried out by the Department of Census and

Statistics or the Central Bank of Sri Lanka included these regions in their surveys ever since the outbreak of civil war in 1983, and it remains impossible to compare the information from the SLIS with another reliable source of data. As such, I exclude data for the North and East from the estimations to follow. Once sample weights are used, this accounts for around 12 per cent of the sample, which is consistent with estimations for the population share in these areas.

Of the 5600 households in the survey (excluding those in the North and East) only 1072 have children between six to 60 months of age and of them only 821 have complete information on child anthropometry as well as the individual and household characteristics considered in this paper. The errors maybe due to faulty measurement, reporting of age, coding or data entry. A comparison of individual and household characteristics for the 251 dropped records and the 821 included ones show that the respective means between the two groups are not significantly different at the five per cent level for any observable characteristic. It is therefore assumed that the portion of the sample that has been excluded is random as far as the observables are concerned. The 853 children in our sample come from 286 communities with the number of children per community ranging from one to eight.

It should be noted here that nearly every child (98 per cent) from households that receive *Samurdhi* has been exposed to the *Samurdhi* program for all of his or her life whereas none of the children in the control group have been exposed to the program for any part of their life. This makes adjustments for program exposure as in Duflo (2000) and Behrman et. al. (2000) unnecessary.

Child well-being is proxied by two anthropometric indicators: weight-for-height--the measure for short-term nutritional fluctuations in health and height-for-age that reflects accumulated investments in child health. Weight for height is a measure of body tissue and fat mass for an individual of a given length. Weight for height z-scores (whz) less than two standard deviations below the mean of zero is taken to indicate 'wasting' that can result from either weight loss or failure to gain weight. Marginally adequate food intakes and bouts of infectious illnesses can rapidly trigger the onset of wasting specially in young children (WHO 1986, 1995)). Note that the paper assumes that a higher weight for height maps into higher welfare. This is because obesity is not a concern in the sample used. The data contains almost no cases where a child's Body Mass Index (calculated as weight in kilograms divided by the square of height in meters) is above 30 points --the measure commonly used to define obesity. Height for age z-scores (haz), on the other hand, reflects accumulated investment in health. A child is considered 'stunted' if his or her haz is below two standard deviations of the mean of zero.

5. RESULTS

Summary statistics are presented in Table 1 for the outcomes variables (i.e., child weight for height z-scores and height for age z-scores) by unmatched (i.e., raw data) and matched samples. The table presents mean values for *Samurdhi* recipients and non-recipients in column 1-2 and 4-5, with a t-test for the equality of means reported in columns 3 and 6. The results based on the raw data show that *Samurdhi* children are significantly worse off in terms of whz in the full sample, the sample for older children aged 36-60 months and for boys and girls seperately. These results are confirmed by the t-tests for the matched sample. In terms of haz, once again *Samurdhi* children are worse off than the others, but this time the results between the unmatched and matched groups are not exactly the same. For the unmatched sample, haz are significantly different for younger children aged six to 36 months and for boys. In the matched sample, significant differences in haz are also seen for the full sample and younger children aged six to 36 months but not for the gender based sub samples.

Table 2 presents summary statistics for the conditioning variables used by unmatched and matched samples. The main thing to note is that in the unmatched sample, all most all the conditioning variables used are statistically significantly worse-off for the *Samurdhi* group, indicating that they are indeed “poorer” not just in terms of income (excluding *Samurdhi* grant), but also in terms of the other associates to poverty such as access to a latrine, having electricity in the household, having access to safe drinking water, living in poor housing conditions, etc. The *Samurdhi* children also tend to live in rural areas more so than the non-*Samurdhi* children, come from households that are female headed and have parents with significantly lower education levels and household with significantly lower expenditure per capita than their counterparts. Moreover, birth weights for *Samurdhi* children are significantly lower and the number of siblings they have aged zero to five years is higher than that for non-*Samurdhi* children. However, there are no significant differences based on gender of the child, household size or minority ethnic groups apart from Tamil. In the matched sample, as expected, the difference between the treated and control groups are statistically insignificant, satisfying the balancing condition.

Table 3 presents the key results of this paper: the average treatment on the treated effect (ATT) of the *Samurdhi* grant on child whz and haz, using propensity score matching. The results, therefore, reflect the difference between a *Samurdhi* child’s existing health outcome compared to what it would have been, had she not received the grant. For the indicator for child short-term heath, whz, nearest neighbour and calliper matching estimates indicate that the *Samurdhi* improves it by 0.50 standard deviations according to nearest neighbour matching, compared to had they not received the grant, for older pre-schoolers aged 36-60 months. These results are confirmed by other matching algorithms such as caliper and local linear, which show significant improvements of 0.37 and 0.50, respectively.

For haz, the measure for accumulated investments in child health, again the impact is significant with nearest neighbour estimates indicating a positive impact of 0.45, confirmed by the other matching algorithms as well. The result seems to be driven mainly by younger children aged six to 36 months whose haz is positively affected by 0.51 standard deviations due to the *Samurdhi*. Again these results are confirmed by estimations using alternative algorithms.

ATT by gender, does not have a significant impact using any of the algorithms for whz or haz.

Tables 4 and 5 discuss the quality of the match. The probit estimates for the balancing score are presented in Table 4 for the full sample, children aged six to 36 months, 36-60 months, boys and girls. It is clear that most of the variables used are statistically significant, in all five cases. The variables have been selected to reflect the income and non-income based criteria used to select households into the *Samurdhi* program while paying attention to factors that influence child health as suggested in the literature[4].

Table 5 displays results for t-tests for equality of mean between the treatment and control groups before matching and after matching for the samples used under the nearest neighbour, radius calliper and local linear matching algorithms. The t-tests are significant before matching but not after matching using any of the specified algorithms. Thus the sample is balanced after matching. The pseudo-R^2 estimated in all cases is at least above 0.2 before matching but always less than 0.0 after matching, confirming once again that the quality of the match is good[5]. Moreover, the corresponding p-values for the likelihood ratio tests for the joint insignificance of all the regressors before matching rejects this hypothesis in all cases while not rejecting it after matching in all cases. Once again this indicates a good quality match.

As a check of robustness of results, an alternative specification is used to re-estimate them. Once again, all the estimations are first checked to make sure that the quality of the match is high: the t-test approach to check that the means of the covariates of both groups are not significantly different and the test using the pseudo-R^2 all confirm a good quality match. Moreover, common support is imposed. The results of the ATT effect is reported in Table 6. For whz, the results are very similar to that of the baseline specification in terms of significance, with the *Samurdhi* having a significant positive impact specifically those between ages 36-60 months, using nearest neighbour, caliper and local linear algorithms.

The results for height for age are significant for the full sample, only using caliper matching, which gives a coefficient slightly less than that under the previous specification. More encouragingly, however, all three matching algorithms used show that the impact of *Samurdhi* is significant for the 6-36 month group, with coefficients very close to that under specification 1.

Once again, there are no significant ATT effects reported under the samples divided by gender.

As yet another check of robustness, I use a parametric estimation –an endogenous switching regime model (ESRM) estimated using the maximum likelihood method- to cross-check results (unreported but available on request)[6]. The ESRM model allows for possibility that child health may be explained differently by grant receiving and non-receiving households, while accounting for the issue of sample selection. The ESRM results show that *Samurdhi* has a positive impact of 0.5

standard deviations (bootstrapped standard error of 0.29) on haz. This result is quite close to the PSM estimates of the effect of the *Samurdhi* on child long-term health[7].

6. CONCLUSION

The analysis so far shows that a cash transfer in the context of a Poverty Alleviation Scheme can have a positive impact on a child's short-term nutritional status, proxied by weight for height z-scores as well as long-term nutritional status proxied by height for age z-scores. The baseline results used propensity score matching. Various tests for robustness were conducted including using various algorithms such as nearest neighbour, radius calliper and local linear matching. The results indicate that the *Samurdhi* improves the weight for height of a child aged 36 to 60 months by roughly 0.45 standard deviations (calculated as the average of effects estimated using three different matching algorithms and specification 1). It also improves child height for age by 0.4 standard deviations (calculated as the average of the effect estimated using three different algorithms and specification 1), compared to what their health status would have been had they not received the grant. *Samurdhi* has a particularly high impact on the height for age of younger children 6-36 months, showing a positive and significant improvement of over 0.5 standard deviations. The results are robust to differences in specification. They also match results of a parametric estimation using an endogenous switching regime model. An interesting area for future research is to analyse the impact of *Samurdhi* by income group to ascertain whether children from poorer households benefit more than those from richer households.

In summary, *Samurdhi* seems to have been effective in meeting its aim of improving household welfare levels, at least those of children between ages six to 60 months of age. The program seems particularly effective at improving accumulated investments in health for younger children aged six to 36 months as measured by height for age z-scores. It also seems particularly effective at reducing short-term fluctuations in health in older children aged 36-60 months as measured by the weight for height z-score. These results are important for both the fact that they show that receiving the cash transfer can improve child welfare in the context of a poverty alleviation scheme and because of the Sri Lankan context where child nutrition is a cause for concern. The result is also remarkable when juxtaposed with criticisms about the *Samurdhi* such as grant insufficiency and delivery problems.

It is unclear as to how much of the improvement in health can be attributed purely to the cash transfer and how much to the various other components of the Program such as the positive externalities through forming small savings groups and increasing household savings, access to credit, advice and awareness on various social development aspects (household nutrition, home gardening, etc.,) lump sum payment at child birth as a part of the social insurance scheme, micro-enterprise schemes that all increase household capabilities, opportunity, mobility and voice. Of course, each of the above prongs of the Program has not benefited all recipients equally and is often difficult to quantify. For instance, only around 5 percent of those who receive the transfer (and have children aged five to 60 months) claim to have participated in the credit program and only 15 per cent have claimed insurance. Moreover, these parts of the Program are rather progressive (unlike the grant itself that is regressive) in that many of the recipients in the poorer quintiles do not receive these benefits as much as those in the richer quintiles. Nonetheless, the empirical analysis could perhaps be refined to account for participation in other aspects of the program and account for externalities of such participation. These are aspects for future research. All such modifications, however, would only help refine the analysis and decompose the positive impact on child health among the various elements of the program. The crux of the conclusions in this paper are most likely to be left robust: *Samurdhi* has a significant positive impact on the short and long-term nutritional status of a child who is most probably from a poor household, whether its driven purely or partially by the cash received.

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[1] In this respect the *Samurdhi* is similar to other conditional cash transfer programs such as the PROGRESA in Mexico, FA in Columbia and PRADF in Honduras. Behrman and Hoddinott(2005) have evaluated the impact of Mexico's PROGRESA on child nutrition to find that it has a significant impact. Under this program mother's receive cash transfers if their school-age children attend school and preventive healthcare visits. Attanasio and Mesnard (2006) evaluates the short-term impact of Columbia's FA program on child-height for age to find that it improves the nutritional status and morbidity of young children. However, some other conditional cash transfer programs such as the PRADF in Honduras had not improved child health (IFPRI 2002) as cited in Attanasio and Mesnard (2006).

[2] Indicative also of mistargeting and leakage is the fact that the *Samurdhi* has been given to roughly 40 per cent of the sample where as poverty itself was estimated to be around 22 per cent in 1995 by World Bank (1995) and around 28.8 per cent in 1995 by the Department of Census and Statistics in DCS (2002). It was around 22.7 per cent in 2002 (DCS 2002).

[3] See Blundell and Dias (2002) and references there in for more details as well as alternative approaches available for program impact evaluation.

[4] See for instance Engel et. al (1999), Mosley and Chen (1994), Schultz (1984) and references there in.

[5] These results (i.e., insignificant t-tests on the difference of means between groups for all variables and favourable pseudo-R^2) are present in all the estimations in this paper, confirming that the balancing condition is satisfied in all cases.

[6] The ESRM specifies two well-being equations for children from households that receive the grant and those that do not, as follows:

(2) $$h_{1ij} = \beta_0 + \beta_1 \tilde{Z}_{ij} + \varepsilon_{1ij} \quad \text{given that} \quad s_j = 1$$

(3) $h_{2ij} = \alpha_0 + \alpha_1 \tilde{Z}_{ij} + \varepsilon_{2ij}$ given that $s_j = 0$

where *h* is the weight for height z-score of child *i* from household *j* and *Z* is a vector of weight for height determining variables and ε are the error terms. The dependent variable is observed in the case of (2) if

(4) $\gamma \tilde{X}_j + u_j > 0$

And in the case of (3) in

(5) $\gamma \tilde{X}_j + u_j \leq 0$

Errors are normally distributed with $\varepsilon_1 \sim N(0,\sigma_1)$ and $\varepsilon_2 \sim N(0,\sigma_2)$ and $u \sim N(0,1)$ with

$$\mathrm{cov}(\varepsilon_1, \varepsilon_2, u) = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix}$$

And $corr(\varepsilon_1 u) = \rho_1$ and $corr(\varepsilon_2 u) = \rho_2$

The systems are identified if X_j contains at least one exogenous variable that influences the selection equations but not the substantial equations. In the empirical analysis two such variables are used: the presence of a disabled or chronically ill member in the household ("disability") and this disability dummy variable interacted with the education level of the child's father. Vector Z contains all the variables in specification 1 of the PSM estimates apart from birth weight (as it may be endogenous) and seven dummies for province of residence. See Maddala (1983) for further details on the model used.

[7] The instruments used in the estimation (presence of a disabled member in the household and this variable interacted with father's education) were checked for relevance and validity in a two stage least squares framework. This model itself is a restricted version of the ESRM model. However, the first stage regression can be used to identify if the instruments used are relevant and valid. The first stage F statistic rejects the null hypothesis that the coefficients on the instruments are jointly zero at the one per cent level, providing evidence of relevance. However, the first stage F-statistic was 4.4. We cannot conclude, therefore, that there is no weak instruments issue. Estimators can perform poorly when instruments are weak (Staiger and Stock 1997; Stock and Yogo 2005). Suffice it to note,

however, that the ATT estimated from the ESRM model were also quite close to that estimated by matching methods and significant, in spite of the fact that the instruments chosen may be weak.

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Table 1. Summary statistics for outcome variables by unmatched and matched samples

Outcome variables	Unmatched sample			Matched Sample		
	Samurdhi recipients **(1)**	*Samurdhi* non-recipients **(2)**	t-ratio (p-value) testing for equality in means in (1) and (2)	*Samurdhi* recipients (4)	*Samurdhi* non-recipients (5)	t-ratio (p-value) testing for equality in means in (4) and (5)
Children aged 6-60 months						
Weight-for-height z-score (whz)	-0.94 (0.10)	-0.68 (0.11)	-1.83(0.06)*	-0.92 (0.10)	-0.72 (0.09)	-1.42(0.15)
Height for age z-score (haz)	-1.55 (0.09)	-1.38 (0.12)	-0.98(0.32)	-1.53 (0.13)	-1.05 (0.12)	-2.66(0.00)**
Children aged 6-36 months						
Weight-for-height z-score (whz)	-0.71 (0.12)	-0.58 (0.09)	-0.80(0.21)	-0.73 (0.13)	-0.56 (0.09)	-0.86(0.39)
Height for age z-score (haz)	-1.58 (0.15)	-1.23 (0.11)	-1.87(0.06)*	-1.50 (0.17)	-1.00 (0.19)	-2.08(0.03)*
Children aged 36-60 months						
Weight-for-height z-score (whz)	-1.28 (0.11)	-0.78 (0.10)	-3.18(0.00)**	-1.38 (0.11)	-0.58 (0.16)	-3.95(0.00)**
Height for age z-score (haz)	1.57 (0.13)	1.56 (0.11)	-0.04 (0.96)	-1.43 (0.15)	-1.56	0.27 (0.78)
Boys 6-60 months						
Weight-for-height z-score (whz)	-1.10 (0.10)	-0.79 (0.09)	-2.11 (0.03)**	-1.06(0.11)	-0.76(0.12)	-1.73(0.08)*
Height for age z-score (haz)	-1.73 (0.14)	-1.35 (0.10)	-2.11 (0.03)**	-1.68 (0.14)	-1.79 (0.14)	0.58 (0.29)
Girls 6-60 months						
Weight-for-height z-score (whz)	-0.83 (0.13)	-0.53 (0.10)	**-1.76 (0.00)***	-0.87 (0.13)	-0.53 (0.10)	**-2.00(0.04)***
Height for age z-score (haz)	-1.39 (0.15)	-1.38 (0.12)	-0.05 (0.95)	-1.38 (0.16)	-1.38 (0.12)	-0.01 (0.99)

Note: Figures in columns 1, 2, 4 and 5 are means, with standard errors in parenthesis. * significant at the 10 per cent level, ** significant at 5 per cent or higher. The 'matched sample' outcomes for the various categories (i.e., children aged 6-60 months, children aged 6-36 months, children aged 36-60 months, boys and girls) are calculated by using the corresponding matched samples that pass the balancing test (using specification 1 explained in the text) and fall into the region of common support, defined as the maximum of mins and the minimum of maxs.
Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).

Table 2. Summary statistics for conditioning variables by unmatched and matched samples

	Raw Sample			**Matched sample**		
ConditioningVariable	*Samurdhi* recipients (1)	*Samurdhi* non-recipients (2)	t-ratio (p-value) testing for equality in means in (1) and (2)	*Samurdhi* recipients (4)	*Samurdhi* non-recipients (5)	t-ratio (p-value) testing for equality in means in (4) and (5)
Specification 1:						
sex (male)	0.52	0.51	0.22(0.87)	0.54	0.55	-0.09(0.94)
age 6-12 months	0.10	0.12	-0.91(0.36)			
age 12-18 months	0.09	0.13	**-1.73(0.08)***	0.09	0.09	-0.00(1.00)
age 18-24 months	0.11	0.07	1.62 (0.10)	0.11	0.12	-0.37 (0.70)
age 24-30 months	0.09	0.14	**-2.03(0.04)***	0.08	0.10	0.94(0.34)
age 30-36 months	0.13	0.09	**1.85(0.06)***	0.13	0.11	0.84 (0.40)
age 36-42 months	0.11	0.13	-0.64(0.52)	0.12	0.11	0.37 (0.70)
age 42-48 months	0.11	0.10	0.33 (0.74)	0.10	0.11	-0.38 (0.70)
age 48-60 months	0.22	0.18	**1.66(0.09)***	0.22	0.21	0.48 (0.62)
Birth_weight (kg)	2.79	2.90	**-3.21(0.00)****	2.79	2.79	-0.10(0.92)
Expenditure per household member(Rupees)	1165.43 (554.40)	2030.1 (1487.62)	**-10.07(0.00)****	1169.5 (612.93)	1198.3 (1499.2)	-0.68(0.49)
Number of children aged 0-5 years	1.30	1.35	-1.15(0.24)	1.30	1.29	0.46(0.64)
Number of children aged 6-14 years	0.91	0.72	**2.86(0.00)****	0.91	0.95	-0.41(0.68)
Household size	5.51 (1.86)	5.39 (1.83)	0.94(0.34)	5.52 (1.82)	5.33 (1.82)	1.23(0.22)
Mother's education (years)	8.7 (0.19)	10.1 (0.1)	**-7.12(0.00)****	8.7 (0.19)	8.9 (0.1)	-0.74(0.46)
Father's education (years)	8.1 (0.20)	9.7 (0.13)	**-8.09(0.00)****	8.2 (0.20)	8.2 (0.13)	0.03(0.975)
Tamil ethnicity	0.02	0.12	**-5.28(0.00)****	0.02	0.02	0.54(0.58)
Water from unprotected source	0.39	0.20	**-6.31(0.00)****	0.39	0.42	-0.73(0.46)
No bathroom	0.17	0.08	**3.74(0.00)***	0.18	0.21	-1.56(0.16)
Poor housing	0.49	0.34	**-5.09(0.00)****	0.49	0.49	0.16(0.87)
Have electricity	0.49	0.73	**-7.47(0.00)****	0.50	0.48	-0.40(0.68)
Distance to primary health care services (km)	0.60 (0.49)	0.46 (0.49)	**3.41(0.00)****	0.58 (0.49)	0.53 (0.48)	0.69 (0.49)
Specification 2: Additional conditional variables introduced						
Rural residence	0.83	0.62	**6.64 (0.00)****	0.83	0.82	0.32 (0.75)
Household head (female)	0.18	0.13	**1.68 (0.09)***	0.18	0.22	1.39 (0.16)
Other minority	0.06	0.09	-1.49(0.13)	0.06	0.08	-1.38(0.16)
Number of observations	326	527		294	510	

Note: For the binary variables, the associated numbers in columns 1, 2,4 and 5 correspond to proportions. For continuous variables, numbers are means, with standard errors in parenthesis. * significant at the 10 per cent level, ** significant at 5 per cent or higher. The 'matched sample' means reported in this table are for the full sample of children aged 6-60 months after imposing common support, defined as the maximum of mins and the minimum of maxs.
Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).

Table 3: The Average Treatment on the Treated effect (ATT) of the *Samurdhi* grant on child health using propensity score matching

	Full Sample (children aged 6-60 months) (1)	Sample of children aged 0-36 months (2)	Sample of children aged 36-60 months (3)	Boys aged 6-60 months (4)	Girls aged 6-60 months (5)
Outcome: weight for height z-score					
Nearest neighbour	-0.03 (0.17)	0.39 (1.20)	**-0.50 (1.64)***	-0.29 (1.14)	-0.14 (0.50)
Caliper matching (radius=0.008)	-0.06 (0.39)	0.25 (0.94)	**-0.38 (1.64)***	-0.19 (0.80)	-0.17 (0.62)
Local linear (band width=0.009)	-0.03 (0.16)	0.23 (0.85)	**-0.50 (1.70)***	-0.21 (0.72)	-0.11 (0.39)
Outcome: height for age z-score					
Nearest neighbour	**-0.45 (1.92)***	-0.52 (1.60)	-0.51 (1.46)	-0.17 (0.53)	-0.10 (0.28)
Caliper matching (radius=0.008)	**-0.36 (1.64)***	**-0.57 (1.85)***	-0.31 (0.82)	-0.32 (1.61)	-0.18 (0.56)
Local linear (band width=0.009)	**-0.45 (1.83)***	**-0.58 (1.84)***	-0.39 (1.15)	-0.21 (0.56)	-0.23 (0.64)
Balancing property satisfied	YES	YES	YES	YES	YES
Common support imposed	YES	YES	YES	YES	YES
% treated observations outside region of common support	1.95	2.1	2.5	5.0	5.4
Observations					
Treated	295	158	134	168	122
Control	510	297	213	266	244

Note: Specification for estimations in column (1)-(3) ("specification 1") comprises sex, child age cohort (between 12 to 18 months, 18 to 24 months, 24 to 30 months, 30 to 36 months, 36 to 42 months, 42 to 48 months or 48 to 60 months, birth weight, household expenditure per capita, number of children under 6, number of children between 6- 12 years of age, household size, mother's education level, father's education level, whether water consumed comes from an unprotected or open source, poor housing condition, no private latrine within compound, no electricity, Tamil ethnicity, living in the rural sector and distance to nearest primary health care centre. The specification for estimation in column (4) includes all the variables in specification 1 as well as expenditure interacted with poor housing and expenditure interacted with electricity to satisfy the balancing condition. The specification for estimation in column (5) includes all the variables in specification 1 as well as the square and cube of household size and square of mother's education in order to satisfy the balancing condition. Balancing property satisfied for all samples with differences in means of matched observables not significantly different from 0 at least at the 10 per cent level. Common support is defined as the maximum of the mins and the minimum of the maxs. . Nearest neighbour estimator computed with replacement. Local linear matching for estimations in column 2 and 3 use a band width of 0.03. Standard errors for the average treatment on the treated effect are computed using bootstrap with 50 replications. Resultant z-scores are reported in parenthesis, with * significant at the 10% level and ** significant at the 5% level.
Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).

Table 4: Probit estimates for balancing score

	Full sample	Children aged between 6-36 months	Children aged between 36-60 months	Boys aged 6-60 months	Girls aged 6-60 months
Sex	0.03 (0.29)	-0.06 (0.43)	0.12 (0.77)		
Age12to18	0.11 (0.53)	0.10 (0.48)		0.24 (0.76)	0.03 (0.12)
Age18to24	0.46 (2.11)**	0.48 (2.11)**		0.46 (1.50)	0.54 (1.62)
Age24to30	-0.14 (0.66)	-0.11 (0.51)		0.01 (0.04)	0.24 (0.77)
Age30to36	0.45 (2.11)**	0.46 (2.10)**		0.44 (1.46)	0.61 (1.88)*
Age36to42	0.18 (0.88)		-1.33 (1.84)*	0.27 (0.92)	0.10 (0.35)
Age42to48	0.26 (1.20)		-1.25 (1.71)*	0.17 (0.55)	0.44 (1.39)
Age48to60	0.48 (2.52)**		-1.02 (1.42)	0.82 (2.91)**	0.17 (0.65)
Lnexp	-0.00 (7.19)**	-0.00(6.09)**	-0.00(4.13)***	-0.00(3.59)**	-0.00 (5.22)**
Number of children under 5	-0.25 (2.34)**	-0.28 (1.93)*	-0.24 (1.44)	-0.30 (2.01)**	-0.25 (1.54)
Number of children aged 6-14	-0.03 (0.43)	-0.00 (0.03)	-0.03 (0.37)	-0.00 (0.04)	-0.06 (0.60)
Household size	0.05 (1.50)	0.04 (0.94)	0.05 (0.90)	0.10 (2.31)**	0.98 (1.57)
Square of household size					-0.13 (1.58)
Cube of household size					0.00 (1.55)
Mother's education	-0.03(1.40)	-0.05 (1.59)	-0.01 (0.20)	-0.04 (1.38)	0.40 (2.75)**
Square of mother's education					-0.02 (0.93)
Father's education	-0.05(2.36)**	-0.03 (0.96)	-0.07 (2.34)**	-0.04 (1.24)	-0.06 (1.78)*
Unprotected water	0.27 (2.34)**	0.31 (2.05)**	0.21 (1.24)	0.22 (1.39)	0.31 (1.86)**
No latrine	0.29 (1.88)*	0.28 (1.36)	0.31 (1.28)	0.29 (1.41)	0.37 (1.46)
Poor housing	0.21 (1.81)*	0.08 (0.47)	0.37 (2.22)**	0.34 (2.13)**	0.07 (0.43)
Have electricity	-0.17 (1.52)	-0.18 (1.12)	-0.16 (0.89)	-0.30 (1.83)*	-0.08 (0.45)
Rural	0.25 (1.91)*	0.07 (0.43)	0.42 (2.18)**	0.39 (2.15)**	0.05 (0.24)
Tamil ethnicity	-1.35 (5.68)**	-1.33 (4.09)**	-1.33 (4.01)**	-1.36 (4.24)**	-1.45 (3.87)**
Birth weight	0.22 (2.06)**	-0.30 (2.00)**	-0.115 (0.69)	-0.26 (1.72)*	-0.16 (0.93)
Distance to primary health centre	0.15 (1.33)	0.09 (0.60)	0.29 (1.70)*		
Expenditure*poor housing				0.00 (1.41)	
Expenditure*electricity				0.00 (1.61)	
constant	1.70 (3.41)**	2.36 (3.51)**	2.46 (1.64)*	1.26 (1.75)*	-1.47 (0.88)

Note: T-statistics in parenthesis , with * significant at the 10% level and ** significant at the 5% level or above.

Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).

Table 5: Quality of the match: t-tests for equality of means before and after matching (for full sample of children aged 6-60 months)

	t-value of test before matching	t-value of test after nearest neighbour matching	t-value of test after caliper matching	t-value of test after local linear regression matching
Sex	0.22	0.09	-0.10	0.09
Age12to18	-1.73	0.00	0.26	-0.13
Age18to24	1.62	-0.37	0.21	1.18
Age24to30	-2.03	-0.94	0.28	1.60
Age30to36	1.85	0.84	0.10	1.45
Age36to42	-0.64	0.37	-.0.31	-0.47
Age42to48	0.33	-0.38	-1.12	-1.39
Age48to60	1.66	0.48	0.66	-0.55
Expenditure	-10.07	-0.68	-0.70	-1.38
Number of children under 5	-1.17	0.46	0.28	0.07
Number of children aged 6-14	2.93	-0.41	-0.87	0.40
Household size	0.94	1.23	0.86	1.09
Mother's education	-7.12	-0.74	0.45	-1.41
Father's education	-8.09	0.03	1.01	0.33
Unprotected water	6.32	-0.73	-0.49	-1.62
No latrine	3.74	-1.56	-1.05	-1.47
Poor housing	5.09	0.96	-1.07	0.55
Have electricity	-7.47	0.40	0.63	0.70
Rural	6.64	0.32	0.19	-0.65
Tamil	-5.28	0.54	-0.47	0.54
Birth weight	-3.40	0.10	-0.49	0.43
Distance to public health services	3.41	0.37	0.40	0.37
n	821	295	795	805

Note: Test results provided only for full sample of children.
Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).

Table 6: The Average Treatment on the Treated effect (ATT) of the *Samurdhi* grant on child health using propensity score matching with alternative specification

	Full Sample (children aged 6-60 months) (1)	Sample of children aged 0-36 months (2)	Sample of children aged 36-60 months (3)	Boys aged 6-60 months (4)	Girls aged 6-60 months (5)
Outcome: weight-for-height z-score					
Nearest neighbour	-0.04 (0.20)	0.12 (0.40)	**-0.68 (2.19)*** **	-0.21 (0.64)	-0.39 (1.34)
Caliper matching (radius=0.01)	-0.07 (0.40)	0.17 (1.12)	**-0.53 (2.24)*** **	-0.27 (1.35)	-0.47 (0.74)
Local linear (band width=0.006)	-0.04 (0.23)	0.03 (0.10)	**-0.54 (1.82)** **	-0.25 (0.95)	-0.13 (0.54)
Outcome: height-for-age z-score					
Nearest neighbour	-0.33 (1.35)	**-0.56 (1.69)* **	-0.55 (1.36)	-0.13 (1.39)	-0.33 (1.16)
Caliper matching (radius=0.01)	**-0.21 (1.80)* **	**-0.35 (1.76)* **	-0.07 (0.50)	-0.24 (0.80)	-0.32 (1.12)
Local linear (band width=0.006)	-0.35 (1.42)	**-0.56 (1.64)* **	-0.44 (1.44)	-0.01 (0.02)	-0.16 (0.42)
Balancing property satisfied	YES	YES	YES	YES	YES
Common support imposed	YES	YES	YES	YES	YES
% treated observations outside region of common support	0.37	0.43	1.4	2.7	1.0
Observations					
Treated	308	166	138	156	139
Control	510	297	213	266	244

Note: The estimation results reported in this table have a specification less parsimonious than that of baseline results reported in Table 2. All new variables included in the specification have a significance of at least 10 per cent in the probit estimates. Specification for estimations in column (1) comprise sex, child age cohort (between 12 to 18 months, 18 to 24 months, 24 to 30 months, 30 to 36 months, 36 to 42 months, 42 to 48 months or 48 to 60 months, birth weight, log of household expenditure per capita, number of children under 6 and between 6- 12 years of age as a proportion of household size, log of household size, mother's education level, whether water consumed comes from an unprotected or open source, poor housing condition, no private latrine within compound, no electricity, Tamil ethnicity, living in the rural or urban sector and whether the household head is female. The specification for estimations in columns (2) and (3) include all of the above as well as whether the household belongs to a minority ethnic group (other than Tamil) in order to satisfy the balancing condition. Columns (4) and (5) include all the variables included in the estimation in column 1 together with whether the household belongs to a minority ethnic group (other than Tamil) and the square of household size, in order to satisfy the balancing condition. Balancing property satisfied with differences in means of matched observables not significantly different from 0 at at least the 10 per cent level. Common support is defined as the maximum of the mins and the minimum of the maxs. Nearest neighbour estimator computed with replacement. T-statistic in parenthesis, * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.
Source: Own calculations using Sri Lanka Integrated Survey 1999/2000 (excluding North and East).