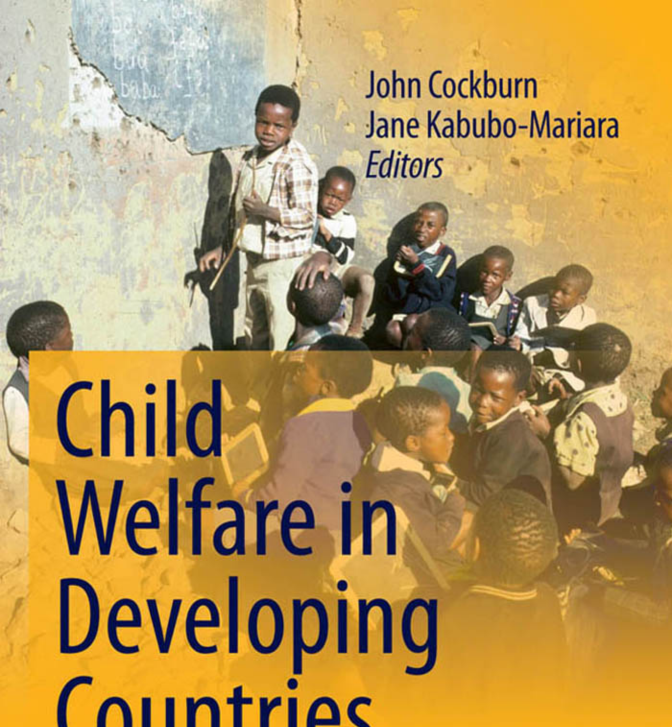

John Cockburn
Jane Kabubo-Mariara
Editors

Child Welfare in Developing Countries

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Child Welfare in Developing Countries: An Introduction

John Cockburn and Jane Kabubo-Mariara

Abstract Child poverty is of urgent concern, yet understudied. This introduction outlines the importance of this issue before providing an outline of the papers included in this book. A first set of papers pushes traditional income-based poverty analysis to focus on the issue of identification and measurement of child poverty in a multidimensional framework. The second set of papers evaluate the impact of selected policy interventions on child welfare in developing countries using a variety of new techniques.

Keywords Children · Welfare · Poverty · Multidimensional · Impact evaluation · Africa, Uruguay

JEL Classification C68, H53, I10, I28, I32

1 Introduction

Child poverty entails fundamental deprivations as a result of which children grow up without access to economic, social, cultural, physical, environmental and/or political resources that are vital to their development and well-being. Most childhood material deprivations may have lifelong irreversible consequences and may contribute to high rates of disability, illness, and death. They also affect the long-term physical growth and development of children, and may lead to high levels of chronic illness and disability in adult life. Some forms of deprivation may also jeopardize future economic growth by reducing the intellectual and physical potential of the entire population.

It is widely recognized that poverty rates are much higher among children than among adults in developed and developing countries alike. In most developing countries, poverty rates remain high in spite of government commitments to providing

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basic services to children. Tackling childhood poverty requires a nuanced anti-poverty strategy based on a real understanding of the relationships between childhood poverty and conditioning factors. Research on the extent, nature, causes, and consequences of child poverty in developing countries is therefore invaluable in efforts to identify the poor among children, design adequate targeting and social protection policies to protect children from the worst consequences of poverty, seek long-term solutions to childhood poverty, and contribute to economic growth.

The papers selected for this volume address crucial issues related to child welfare in developing countries. The key issues in child poverty analysis concern, first, the proper identification of poor children and the extent of their poverty and, second, the design of efficient policies that deliver the greatest possible impact per dollar.

The first set of papers focuses on the issue of identification and measurement of child poverty and does so by adopting a multidimensional approach. Multidimensional poverty comparisons are considered superior to unidimensional measures in two respects. First unidimensional analysis can only lead to a partial understanding of poverty, and often to unfocused or ineffective poverty reduction programs that fail to capture many aspects of deprivation and their interactions. Second, the inclusion of non-monetary measures in multidimensional poverty analysis helps to reveal complexities and ambiguities in the distribution of well-being that income-based poverty analysis cannot capture. Multidimensional poverty analysis has gained popularity since the seminal work of Sen (1985). The popularity of multidimensional over unidimensional poverty comparisons rose further with the establishment of the Millennium Development Goals (MDGs), which focus attention on deprivation in multiple dimensions.

The first paper in this section conducts multidimensional poverty comparisons for Kenya based on a composite poverty indicator and the probability of child survival. The second paper complements the first by making multidimensional poverty orderings of four West African Economic and Monetary Union (WAEMU) countries using a composite poverty indicator. The final chapter of this first section extends the work in the previous two chapters by carrying out statistical multidimensional dominance tests in six WAEMU countries. The analysis is based on child nutritional status and a composite poverty indicator. The three papers concur that first, child poverty is more pronounced in rural than in urban areas; second, there are pronounced regional differentials in child poverty; and third, based on the first two papers, results point to the need to boost health care provisions in order to improve the welfare of children in Africa.

The second set of papers focuses on the evaluation of the impact of selected policy interventions on child welfare in developing countries. In particular, it seeks to isolate changes in the well-being of individuals, households, or other entities that can be attributed to a particular project, program, or policy. These impact evaluations must thus attempt to separate out what would have happened to those receiving an intervention in its absence. To do so, it is important to identify a counterfactual group that is as similar as possible to those receiving the intervention, but which does not benefit from the intervention. By comparing appropriately those who receive the interventions (treatment group) and those who do not (control group), it is possible to establish impact, attributing observed changes in welfare to the intervention, while identifying key factors of success. Impact evaluations are aimed at providing feedback to help improve the design of programs and policies. They also provide greater accountability and a tool for dynamic learning, allowing policymakers to improve ongoing programs and ultimately better allocate funds across programs. Such a causal analysis is essential for understanding the relative role of alternative interventions in reducing poverty.

The papers in this section again adopt a variety of techniques. The first two impact evaluation studies employ propensity score matching to establish, ex-post, a valid control group to assess the impact on child schooling outcomes among beneficiaries of various interventions in Kenya and Ethiopia. The third chapter carries out an ex-ante evaluation of alternative cash transfer programs on child school attendance in Uruguay. The final paper further carries out in-depth macro-modeling and micro-regression analysis to simulate the impacts of the food crisis and various policy responses, including food subsidies and cash transfers, on various dimensions of child poverty in Mali. Though using different approaches, the studies are generally in agreement concerning the positive impact of the cash transfer program on child schooling and labor market outcomes. The studies from Kenya and Uruguay both find that the schooling interventions are progressive. Both the Ethiopian and Uruguayan papers concur that cash transfer programs increase school attendance through an income effect, but find no evidence of a negative substitution effect, which may make child labor more attractive than schooling.

All of these papers were conducted directly or in close collaboration with the Poverty and Economic Policy (PEP) research network. PEP provides financial and scientific support to teams of developing country researchers conducting studies on poverty. Indeed, five of the seven papers are fully authored by researchers who live and work in the countries they study, whereas the other two are partly co-authored by researchers who live or have lived in developing countries. PEP receives funding from the Government of Canada through the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA), and from the Australian Agency for International Development (AusAID).

2 Multidimensional Poverty Analysis

The papers on multidimensional poverty analysis focus on Kenya and several WAEMU countries. The paper by Kabubo-Mariara, Karienyeh, and Mwangi applied the capability approach to poverty measurements to study child survival against a background of worrying trends of infant and child mortality in Kenya since the late 1980s. The objective of their work is threefold. First, they carry out multidimensional poverty and inequality comparisons of child survival ranked by an asset index. Second, they analyze the determinants of childhood mortality. Finally, based on the mortality results, they simulate the impact of relevant policy variables on child survival and assess the implications of these on the achievement of economic recovery strategy and Millennium Development Goals (MDG) targets in Kenya.

The work presented in this chapter marks an important departure from previous studies on poverty in Kenya, which have concentrated on money metric measures of poverty. They remind us that, as postulated by Amartya Sen, the ability to avoid early death is a basic capability and an important indicator of well-being worthy of further study.

The authors show that in Kenya, for the period under study, about 28% of children in rural areas were poor, compared to 19% in urban areas. Further, the relative contribution of rural areas to overall child poverty is found to be 89% while the contribution of urban areas was only 11%. Another interesting message from the chapter is that children from households that did not experience mortality tended to be better off, in terms of the asset index, than children from households that experienced mortality. In particular, children with the lowest probability of survival were from households with the lowest level of assets. Furthermore, the authors find that there is less asset inequality among children facing mortality than among those that did not experience mortality. They conclude that there is a strong need for regional targeting and for anti-poverty policies to improve child survival probabilities.

On the policy front, the authors conduct simulations to show that maternal education significantly lowers the risk of mortality; it is important to reduce teenage births as they are positively correlated with childhood mortality; mortality is highly responsive to wealth, measured by household assets; use of modern contraception has a large significant impact of reducing the risk of mortality; provision of decentralized health care services are important factors for lowering the hazards rates of mortality; there are unexplained macroeconomic variations that reduced the risk of mortality at a diminishing rate between 1978 and 2003. The authors close by calling for policy efforts geared toward improving household well-being, universal primary and secondary education for women, access and utilization of modern contraception, and other health care services. They however caution that in order to substantially improve health care service provision in clusters and districts with very low coverage, issues of access and equity in service provision, information asymmetry, socio-cultural, and other barriers would need to be addressed. They also caution that even with the suggested policy measures, there will still be challenges in the achievement of MDGs in Kenya unless other complementary policies are pursued.

Djoke, Djadou, d'Ameida, and Ruffino conduct a comparative analysis of multidimensional poverty among children under the age of five in four West African Economic and Monetary Union (WAEMU) countries: Côte d'Ivoire, Niger, Guinea-Bissau, and Togo. The study further analyzes inequality in the distribution of the level of child poverty by place of residence and at the national level. The multiple correspondence analysis approach is adopted to construct a composite welfare indicator on which the multidimensional poverty analysis is based. For each country, Multiple Indicator Cluster Surveys (MICS) data are used.

The authors find that there are two sets of factors that are associated with child well-being in the five WAEMU countries: first, access to vitamin A and iodized salt, breastfeeding, immunization against polio, diphtheria, measles, and yellow fever; second, the occurrence of diseases, such as diarrhea, cough, fever, and breathing difficulties, and lack of immunization or an immunization card. Vaccination was found to be the factor most closely associated with a reduction in the composite welfare indicator, while infant vitamin A supplements and other diseases increased it. Child poverty affects a significant portion of children in WAEMU countries with the countries ranked in increasing order of multidimensional child poverty as Togo, Cote d'Ivoire, Guinea-Bissau, and Niger. The authors found large regional disparities in child poverty across the WAEMU countries. Geographically remote areas were found to experience higher levels of child poverty than less remote areas. In addition, they find that household standard of living is a major factor in explaining the level of multidimensional child poverty.

The study further shows that there are significant inequalities in child welfare and well-being in the WAEMU countries and that children in urban areas are less poor than those in rural areas. Regional disparities in inequality within each country are also noted. Further, differences in vaccination are found to be the most significant factor associated with inequalities in child poverty. The authors stress the need for the government, NGOs, and other stakeholders to lay more emphasis on preventing childhood ailments other than nutritional deficiency and polio. This would have an important effect in reducing child poverty in WAEMU countries. They also stress the need to reduce regional inequalities in child well-being and welfare, which they note would require effective local institutions to support local health service provision for child poverty reduction.

The chapter "Multidimensional Poverty Among West African Children: Testing for Robust Poverty Comparisons" by Batana and Duclos applies a new approach for conducting multidimensional poverty comparisons: statistical multidimensional dominance tests. Dominance tests seek to verify the robustness of poverty rankings between various population subgroups over a range of poverty lines when the exact level of the latter is open to debate. The authors note that stochastic dominance has mostly been analyzed in the framework of unidimensional poverty analysis and that formal statistical tests have not been applied empirically to multidimensional comparisons. In sub-Saharan Africa, where child poverty is highest in the world, there is a death of empirical tests for poverty dominance, especially using data that are readily comparable across countries and time. Batana and Duclos apply the new approach to test the robustness of unidimensional and multidimensional poverty orderings for children in six West African Economic and Monetary Union (WAEMU) countries: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, and Togo.

Two measures of well-being are adopted: nutritional status and assets. The asset index is constructed using two alternative approaches: multiple correspondence analysis and factorial analysis. Furthermore, they carry out statistical inference for multidimensional poverty comparisons using a multivariate extension of an empirical likelihood ratio test proposed for univariate distributions. The authors point out that, as the test statistic used is asymptotically pivotal, they are able to perform bootstrap tests that yield more satisfactory inference than tests that are based solely on analytic asymptotic distributions.

In both unidimensional and multidimensional poverty comparisons, child poverty is robustly more pronounced in rural than in urban areas. The study also establishes statistically significant dominance relationships between almost all (80%) possible pairs of the six countries. Côte d'Ivoire is found to dominate all other countries (i.e. have lower rates of child poverty), followed by Togo, which dominates Benin, Burkina Faso, and Niger. Benin and Mali also dominate (have lower poverty than) Burkina Faso and Niger. Higher-order dominance tests, focusing instead on the poverty gap or severity rather than on the headcount index, rank Mali and Niger respectively dominating Benin in the second order and Burkina Faso in the third order.

Batana and Duclos find considerable heterogeneity in the rural–urban gaps among the different countries, such that country rankings vary considerably depending on whether the focus is solely on urban or rural areas. Burkina Faso, the poorest in rural multidimensional poverty, exhibits lower urban poverty than Niger and Benin. Furthermore, Burkina Faso is only dominated in multidimensional poverty by Côte d'Ivoire. Benin is also inferred to be urban-wise poorer than all other countries. The authors caution us that since the distribution of welfare across socio-economic groups may differ significantly across countries, cross-country comparisons of national poverty can hide important discrepancies within countries. Since uncovering these discrepancies helps understand the context-specific sources of national poverty, they advise that it would be useful and informative to disaggregate multidimensional poverty comparisons within countries before proceeding to country-wise comparisons of welfare.

3 Impact Evaluation Studies

The papers on impact evaluation deal with Kenya, Ethiopia, Uruguay, and Mali. Muyanga, Olwande, Mueni, and Wambugu's study evaluates the impact of a Free Primary Education (FPE) program in Kenya using propensity score matching methods. These methods involve matching participating and non-participating individuals based on observable characteristics such that non-participating individuals can be used to estimate the counterfactual – what would have happened in the absence of the program – for their participating counterparts. They further carry out average benefit incidence analysis to establish the monetary value of the benefits of the FPE program for each household in order to determine whether the program is progressive (pro-poor). The study is based on the premise that this intervention has led to enhanced access to education by children from poor backgrounds. The authors further explore the factors that determine grade progression and secondary school enrolment.

Children from regions with high agricultural potential experienced better education outcomes compared to those from the lowlands. However hunger, famine, and geographic traps in lower-potential regions limit household ability to meet children's schooling and other basic needs, leading to low education outcomes. Other factors significantly limiting both school enrolment and grade progression include chronic illness, high dependency ratios, and orphanhood. Since children can only benefit from FPE if they enroll in schooling, the above factors also influence whether or not children benefit from the program. They remind us that orphans and adopted children are more likely to be out of school and less likely to proceed to and complete secondary schooling.

A key finding of the study is that FPE has significantly improved primary school enrolment. The primary education sensitization campaign that accompanied the FPE program played a significant role in improving primary school enrolment. Increased secondary school enrolment is attributed to increased graduation from primary schools, as a result of the FPE program, as well as several secondary school bursary schemes targeting poor and vulnerable households that were introduced alongside the FPE program. However, the study also finds that grade progression has worsened. This could be a pointer to declining quality of primary education as a result of congestion, lack of teachers, and insufficient primary school infrastructure.

From the benefit incidence analysis, the authors conclude that government spending on FPE program is progressive, with the 20% poorest households capturing more than twice as much of the benefits as their counterparts in the 20% wealthiest households. They argue that even though the program was not targeted, by default poorer households happen to have more children and therefore, the poor are likely to have more children enrolled in primary schools when financial setbacks are alleviated.

Based on the findings, Muyanga and co-authors recommend the improvement of infrastructure and employment of more teachers. They further argue that the low secondary school enrolment rate, especially among the poorer households in the sample, is an indication of a need for more government intervention at the secondary level. The authors also tell us that poorer households have the potential to benefit a lot from the program, but pragmatic interventions are required to deal with other constraints beyond direct schooling costs that keep them from enrolling their children in school. They recommend further research to uncover the key obstacles to primary school enrolment and to facilitate the design and implementation of effective policies and interventions.

Woldehanna's study assesses the impacts of Ethiopia's Productive Safety Net Program (PSNP) and Agricultural Extension Program (AEP) on the allocation of time between work and schooling, as well as on the highest grade completed, among 12-year-old children. The PSNP was developed by the government of Ethiopia, non-government, and donor organizations with the aim of reducing vulnerability of poor households to drought. It involves two sub-programs: a public work program (PWP) and a direct support program (DSP). The author uses data for the older cohort in the 'Young Lives' survey, which was conducted in two rounds in the last quarter of 2002 and 2006. The Young Lives Survey seeks to record changes in child poverty over a 15-year period by tracking cohorts of children over time. The study uses propensity score matching techniques to estimate the impact of the PSNP and AEP on child welfare measured by time allocated to various types of work, schooling, and studying.

Woldehanna finds that direct support from the PSNP was effective in reducing child work in paid and unpaid activities and in increasing grade completion among boys in rural and urban areas. In rural areas, the time spent by boys in unpaid work outside the home and by girls in childcare and household chores declined significantly. For urban areas, the amount of time spent by girls in paid work and by boys in both paid and unpaid work declined substantially. Grade completion rates for boys in urban areas increased marginally. The author concludes that the direct support component of the PSNP has strong impacts on child schooling in Ethiopia.

However, he points out that the public work program part of the PSNP has not been very effective in reducing children's involvement in paid work, highest grade completed, and time children spent on studying at home. He cautions that since the program was only a year old at the time of the survey, it may have been too early to capture its full impact.

A substantial number of households have participated in agricultural extension programs in Ethiopia in order to get expert advice on sustainable land management practices, which have potential to increase farm income and labor use. The income effect is expected to lead to children working less and spending more time in school and studying. However, if households are unable to meet the increased demand for labor, this may lead to just the opposite; increased work participation and reduced schooling and studying. For Ethiopia, Woldehanna shows that the income effect of the agricultural extension program dominates, reducing child paid and unpaid work and increasing hours of schooling time by about 1 h per day.

Amarante, Arim, de Melo, and Vigorito carry out an ex-ante evaluation of *Asignaciones Familiares*, a conditional cash transfer (child allowance) program for children in Uruguay. The main objectives of the program are to increase school attendance at secondary level, given almost universal primary school attendance in Uruguay, and to decrease poverty and extreme poverty. The authors evaluate the effects of the program on secondary school attendance, poverty, inequality, and labor supply. Focusing on children aged 14–17, the authors evaluate the decision of a child either to go to school, to work, or to carry out both activities, and how receipt of the transfer affects these choices.

The study finds that secondary school attendance rates increased by between 6 and 8% as a result of the child allowance program. The increase in school attendance is progressive, with a near doubling of attendance rates among the poorest decile, and that the effect is higher for females than for males. The authors attribute the changes to increased overall household income and a direct incentive from the conditionality of the transfer on the teenager's school attendance. The reform also slightly reduces poverty incidence and income inequality, although it substantially reduces extreme poverty. The program also slightly decreases adult labor supply.

The researchers go on to explore two alternative regimes with the same overall budget. In the first, there is no reduction in the allowance per child according to the number of children in the household and the premium for children attending secondary school is increased. The impact on secondary school attendance is larger. Even stronger impacts on teenage school attendance rates are observed among the poor – more than doubling for the poorest – and the nationwide rate rises a further 2%. Results for adult labor, poverty, extreme poverty, and inequality are not different from the first scenario.

The final scenario provides the same allowance to all children, whether they attend secondary school or not and regardless of the number of children in the household. Its impacts are virtually indistinguishable from those of the current regime. Again, results in regards to adult labor, poverty, extreme poverty, and inequality are similar across scenarios. The authors caution that their study does not attempt to disentangle the effect of the transfer on the teenager and on the siblings and call for further research in modeling these effects.

Bibi, Cockburn, Coulibaly, and Tiberti simulate the impacts of the global food crisis and a number of policy responses with respect to the welfare of children in Mali. They note that the increases in the prices of the principal food items, especially grains, the sizeable share of food in the budget of poor households and the limited ability of the poor to adjust to these price hikes have made the crisis a major challenge. The authors inform us that the impacts on the Malian children are particularly worrisome due to their already precarious situation in terms of nutrition, school participation, child labor, and access to health services. The impacts of the crisis are analyzed in terms of food poverty, nutrition, school participation, child labor, and access to health services of children. The authors also review a number of compensatory policies that the Malian government could consider to respond to the crisis in order to protect the most vulnerable populations, more so children.

Bibi and co-authors show that the food crisis is responsible for a 10% increase in food poverty among children, with a corresponding rise in caloric insufficiency of 8%. In contrast, the impacts on school participation, work and access to health services were predicted to be relatively weak, on the order of 1%.

They simulate a targeted cash transfer program using a proxy means approach that identifies poor children based on a limited number of easily observed socio-demographic characteristics. Even with this relatively sophisticated, but still feasible, targeting method, they find that targeting errors are substantial. About one quarter of poor children would be erroneously excluded as non-poor (under-coverage), while more than a third of non-poor children would be erroneously included as poor (leakage). These identification errors, which increase in proportion with the extremity of poverty, reduce the impact and increase the cost of any public interventions.

Bibi and co-authors however point out that the leakage to the non-poor could nonetheless improve the overall conditions of children in terms of caloric intake, school participation, child labor, and access to health services, none of which are exclusive to poor children. They also note that if targeting is restricted to specific age group (e.g. the youngest for nutritional concerns or school-age children for education concerns), benefits will likely be deflected to some extent to other family members if the cash transfer is shared within the household. This said, it is total household income, regardless of the member targeted, which is assumed to determine decisions relating to child work, education, or access to health services.

The authors also simulate a school feeding program and find it to be a particularly efficient policy for several reasons. First, it targets public funds exclusively on the consumption of highly nutritious foods, while cash transfers can be used by households for other purposes. Second, school feeding programs are likely to have desirable incentive effects on school participation and child labor. The authors nonetheless caution that these programs exclude children who do not attend school, are difficult to target exclusively to poor children, and may lead to a reduction in the child's food rations at home that will reduce the nutritional impact.

The collection of articles presented in this book, authored overwhelmingly by researchers who live and work in the countries they study, use state of the art techniques to make an important contribution to our understanding of child poverty. They provide a critical contribution to the policy debate for stakeholders seeking to alleviate child poverty in a multidimensional context.

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Part I
Multidimensional Child Poverty Analysis

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Multidimensional Poverty, Survival and Inequality Among Kenyan Children

Jane Kabubo-Mariara, Margaret M. Karienyeh, and Francis K. Mwangi

Abstract This chapter analyses multidimensional aspects of child poverty in Kenya. We carry out poverty and inequality comparisons for child survival and also use the parametric survival model to explain childhood mortality using DHS data. The results of poverty comparisons show that: children with the lowest probability of survival are from households with the lowest level of assets; and poverty orderings for child survival by assets are robust to the choice of the poverty line and to the measure of well-being. Inequality analysis suggests that there is less mortality inequality among children facing mortality than children who are better off. The survival model results show that child and maternal characteristics, and household assets are important correlates of childhood mortality. The results further show that health-care services are crucial for child survival. Policy simulations suggest that there is potential for making some progress in reducing mortality, but the ERS and MDG targets cannot be achieved.

Keywords Child survival · Multidimensional poverty · Inequality · Stochastic dominance · Childhood mortality · Asset index · Kenya

JEL Classification J13, I12, I32, I38, D63

1 Introduction

1.1 Background

In Kenya, child mortality rates remain high in spite of the government's commitment to create an enabling environment for the provision of quality health care and reduction of mortality levels. There is clear contrast between recent trends in mortality rates compared with trends in the 1960s and the early 1980s. In the

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immediate post-independence Kenya, child and infant mortality rates declined (Hill et al., 2000). Between 1960 and 1980, Kenya enjoyed impressive and sustained declines in under-five mortality rates of about 2–3% per annum; thereafter, the rate declined to less than 2% between 1980 and 1990. The impressive decline prior to the 1980s is attributable to the relatively stable macroeconomic environment that spurred growth in post-independent Kenya in the 1960s and 1970s. In the early1980s, macroeconomic instability caused by both internal and external factors started to reverse the growth rate of the economy and pose a real threat to many socio-economic aspects of the economy including unemployment and inflation. These were accompanied by deteriorating standards of living and increasing inequality. From 1990, the declining infant and child mortality rates saw a reversal and the rates have since been rising (see Fig. 1).

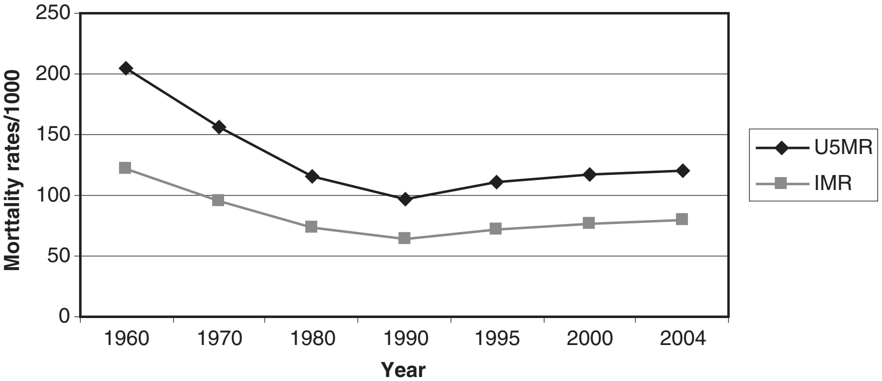

Fig. 1 IMR and U5MR per 1,000 live births in Kenya (1960–2004). (Data source: UNICEF Statistics; http://www.childinfo.org/areas/childmortality/)

The Economic Recovery Strategy (ERS) targets to reduce under-five mortality rates from an estimated 115 in 2003 to 100 in 2006/2008 (Republic of Kenya, 2004), while Kenya subscribes to the Millennium Development Goal (MDG) of reducing by two-thirds the under-five mortality rate between 1990 and 2015 (UNDP et al., 2005). The specific millennium development target for Kenya is to reduce infant mortality rate from 79 to 25 per 1,000 live births and to reduce by two-thirds under-five mortality by 2015. In addition, the goal of the current health sector strategic plan is to reduce health inequalities and reverse the downward trend in health-related outcomes and impact indicators. By addressing the major causes of morbidity and mortality, the plan hopes to contribute toward actualization of some of the MDGs and the reduction of existing disparities in health indices between regions, various population groups, and between the public and private sectors (Ministry of Health, 2005). Given the current rates of infant and child mortality, the country faces a real challenge in the achievement of ERS targets and MDGs.

1.2 Motivation and Contribution of the Study

Traditional welfare studies measure poverty in terms of deprivation of means (incomes), which lead to analysis of incomes and expenditures. However, one of the key non-metric measures of well-being is survival. Sen (1985) argues that poverty should be viewed as a deprivation of ends (capabilities and functionings) that are intrinsically important. Following Sen's definition of well-being, survival (child health) – which is a basic capability and an important indicator of well-being – is worthy of study just like other measures of welfare. Sen's approach suggests that policies should be evaluated not by their ability to satisfy utility or increase income, but to the extent that they enhance the capabilities of individuals and their ability to perform socially acceptable functionings.[1]

Child survival can be used as a social indicator of the quality of life of the poor because it is quite responsive to socio-economic conditions. Previous studies suggest that though infant mortality rates may be directly linked to incomes, the distributional characteristics of infant mortality are almost certainly more sensitive to the welfare of the poor (Younger, 2001). Paxton and Schady (2004) also note that sharp downturns in aggregate income, such as those caused by macroeconomic crises and other factors, might all lead to the deterioration in child health outcomes. The authors argue that much of the correlation between income and health persists even after taking into account differences in education or access to services. However, other studies argue that the children's health status is not necessarily highly correlated with incomes and expenditures, which makes health status an interesting dimension of well-being to study on its own (see Younger, 2001).

Following Sen's approach, this chapter focuses on child survival in Kenya and makes several important contributions to the literature. First, there are increasing empirical studies on poverty and child health determination based on Demographic and Health Survey (DHS) data. There are also a large number of studies that attempt to identify the determinants as well as principal causes of the health gap between the poor and the better off in both developed and developing countries (Wang, 2002). No such study has been done for Kenya using child mortality as the welfare measure. This study presents an attempt to bridge this knowledge gap. Second, evidence from the DHS shows that childhood mortality rates in Kenya differ by region and area of residence. Linking regional differences in mortality to regional differentials in poverty is important for broad regional targeting criteria, especially in the provision of health-care services. We go beyond this to carry out poverty and inequality comparisons of child survival by area of residence and region. Third, analysis of mortality necessitates the study of large populations or the cumulation of the mortality experience of smaller populations over long periods because death is a rare

[1] Functionings are the "beings and doings" of a person, whereas capabilities are the various combinations of functionings that a person can achieve. Capability is thus a set of vectors of functionings reflecting the person's freedom to lead one type of life or another (Sen, 1985). In terms of mortality, capabilities would embrace the ability to live through to mature age whereas the equivalent measure of functioning would be the mortality rates.

event (Mosley and Chen, 1984). In this chapter, combining three DHS datasets offer the advantage of a very large sample compared to individual year analysis. The study also examines the time series of childhood mortality in detail, using women's birth histories to construct mortality rates for many years prior to the survey date. Fourth, this study extends microeconomic analysis to include certain time series elements from secondary sources (Gross National Product, health expenditure, and health facilities) and also estimates trends in mortality rates.

The main objectives of the chapter are (i) to carry out multidimensional poverty and inequality comparisons of child survival. Due to lack of income measures in the data, we use the Sahn and Stifel (2003) asset index to rank children by their level of well-being; (ii) to analyse the determinants of childhood mortality. (iii) Based on the results in (ii), the chapter simulates the impact of relevant policy variables for child survival and assesses the implications of these on the achievement of ERS and MDG targets in Kenya.

The rest of the chapter is organized as follows. Section two presents a brief description of the data types and sources. Section three presents the methodology. Section four presents the results and is divided into four sub-sections: the first sub-section presents sample statistics, the second sub-section presents multidimensional poverty and inequality comparisons, the third sub-section presents survival (Weibull) model results for under-five mortality, and the last sub-section presents results of policy simulations for achievement of ERS and MDGs targets. Section five concludes.

2 The Data

To achieve the objectives of the study, we used three rounds of DHS data for the period 1993–2003. The DHS are nationally representative samples of women aged 15–49 and their children. The three surveys, while relatively comparable, differ in a number of ways. The 1993 KDHS collected information on 7,540 women aged 15–49, and 6,115 children aged less than 60 months from 7,950 households in the months of February to August 1993. The 1998 KDHS collected information on 7,881 women aged 15–49, and 5,672 children aged less than 60 months from 8,380 households in the months of February to July 1998. The 2003 KDHS covered 8,195 women aged 15–49 and 5,949 children aged less than 60 months from 8,561 households in the months of April to August, 2003. All surveys covered both rural and urban populations. The surveys collected information relating to demographic and socio-economic characteristics for all respondents and more extensive data on pre-school children.

The Demographic and Health Surveys utilized a two-stage sample design. The first stage involved selecting sample points (clusters) from a national master sample maintained by the Central Bureau of Statistics (CBS): the fourth National Sample survey and Evaluation Programme (NASSEP) IV. The 1993 and 1998 KDHS selected 536 clusters, of which 444 were rural and 92 urban, from seven out of the eight provinces in Kenya. The 1993 survey collected data from 34 districts, while the 1998 survey collected from 33 districts. In 2003, a total of 400 clusters, 129 urban and 271 rural, were selected, drawn from all 8 provinces and 69 districts. For 2003, 65 of the districts were taken from the 7 provinces sampled in the earlier surveys, but the sample is equally representative due to creation of new districts from previously surveyed districts. From the selected clusters, the desired sample of households was selected using systematic sampling methods.

In this chapter, we pooled together the three DHS survey datasets and used women's birth histories to create a long time series of data for cohorts of 5-year-old children born between 1978 and 2003. This yielded a sample of 48,772 children, 36, 34, and 29% in 1993, 1998, and 2003, respectively. The data was complemented with secondary macro-level data on Gross National Product (GNP) per capita, health expenditure, and regional distribution of health facilities for the year of a child's birth. The secondary data on the above variables was collected for each year of a child's birth (from 1978) and merged with the generated time series data by year of birth.

3 Methodology

3.1 Poverty and Inequality Comparisons

According to Sen (1985), poverty should be seen in relation to the lack of basic needs or basic capabilities. This means that poverty is a multidimensional phenomenon and should therefore be measured by considering multiple indicators of well-being. Emerging literature that theoretically and empirically analyzes poverty as a multidimensional issue uses dominance approaches in a uni-dimensional context, following Atkinson (1987) and Foster and Shorrocks (1988). The key advantage of a multidimensional dominance approach to poverty comparisons is that it is capable of generating poverty orderings that are robust to the choice of the poverty index over broad classes of indices (Duclos and Araar, 2006). The orderings are also poverty line robust in that they are valid for the choice of any poverty frontier over broad ranges (Duclos et al., 2006a). Unlike other works on multidimensional poverty comparisons, the approach developed by Duclos et al. (2006a), takes into account sampling variability with the poverty comparisons therefore being statistical, using consistent, distribution-free estimators of the sampling distributions of the statistics of each poverty comparison. Our approach is to measure well-being in two dimensions: asset index and probability of child survival, following the approach developed by Duclos et al. (2006a). In our case, a child is considered poor if she comes from a household whose asset index is below an asset poverty line or if her probability of survival falls below a mortality poverty line. If a child is poor in only one of these indicators of well-being, then she is poor in a union definition, but if she is poor in both indicators, then she is poor by an intersection definition.[2]

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[2] See Duclos et al. (2006a, b) for a detailed discussion of intersection and union definitions of poverty. The framework presented in this section borrows heavily from Duclos et al. (2006a, b) and Araar (2006).

3.1.1 Analytical Framework for Multidimensional Poverty Comparisons

Assume that we have two measures of well-being: assets (x) and child survival (y). Assuming differentiability, we can show that each of the indicators can contribute to overall well-being. This well-being can be denoted as:

$$\lambda(x, y) : \Re^2 \to \Re \left| \frac{\partial\lambda(x, y)}{\partial x} \geq 0, \quad \frac{\partial\lambda(x, y)}{\partial y} \geq 0. \right. \tag{1}$$

Following Duclos et al. (2006a), we can assume that an unknown poverty frontier separates the poor children from the rich children, defined implicitly by a locus of the form $\lambda(x, y) = 0$ and is analogous to the usual downward sloping indifference curves. The set of the poor children can then be given as:

$$\Lambda(\lambda) = \{(x, y)\, | \lambda(x, y) \leq 0\}\,. \tag{2}$$

To define the multidimensional poverty indices precisely, let the distribution of x and y be denoted by $F(x, y)$. Focusing on classes of additive multidimensional poverty indices, an additive poverty index that combines the asset index and child survival can be defined as $P(\lambda)$ where:

$$P(\lambda) = \int_{\Lambda(\lambda)} \prod(x, y;\ \lambda)\mathrm{d}F(x, y). \tag{3}$$

Where $\pi(x, y; \lambda)$ is the contribution to poverty of an individual with well-being indicators x and y such that

$$\prod(x, y;\ \lambda) \begin{cases} \geq 0 & \text{if} \lambda(x, y) \leq 0 \\ = 0 & \text{otherwise} \end{cases}. \tag{4}$$

In Eq. (4), Π is the weight that the poverty measure attaches to a child inside the poverty frontier. By the poverty focus axiom, $\Pi = 0$ for a child outside the poverty frontier. The multidimensional headcount is obtained when $\Pi = 1$ (Duclos et al., 2006a).

Modifying the usual FGT poverty index (Foster et al., 1984), a bi-dimensional stochastic dominance surface can be defined as

$$P^{\alpha_x, \alpha_y}(z_x, z_y) = \int_0^{z_y} \int_0^{z_x} (z_x - x)^{\alpha_x}(z_y - y)^{\alpha_y}\mathrm{d}F(x, y) \tag{5}$$

for integers $\alpha_x \geq 0$ and $\alpha_y \geq 0$. We generate the dominance surface by varying the poverty lines z_x and z_y over an appropriately chosen domain. The poverty comparisons that can be made from (5) are valid for broad classes of poverty functions other than the FGT. Further, the surface will be influenced by the covariance between assets and the probability of child survival, because the integrand is multiplicative.

From Eq. (5), we can derive a class of bi-dimensional poverty indices which are first order in both assets and probability of child survival, and possess the important characteristics of being additively separable, non-decreasing in each dimension, anonymous, and continuous at the poverty lines. Another characteristic is that assets and probability of child survival must be substitutes and not complements.[3]

3.1.2 Analytical Framework for Inequality Dominance

In addition to the multidimensional poverty comparisons, we measure inequality in assets using the absolute rather than the usual Gini index because the asset index assumes negative values for the poorer groups. The absolute Gini index can be defined as

$$AI = I \times \mu, \tag{6}$$

where I is the usual relative Gini coefficient and μ is the average of assets.

The absolute Gini can be defined in terms of the magnitude of relative deprivation; that is, the difference between the desired situation and the actual situation of a child (Araar, 2006). The relative deprivation of child i compared to child j can be defined as follows:

$$\delta_{i,j} = (y_j - y_i)_+ = \begin{cases} y_j - y_i & \text{if } y_i < y_j \\ 0 & \text{otherwise} \end{cases}, \tag{7}$$

where y_i is the assets for child i. The expected deprivation of child i equals to:

$$\overline{\delta_i} = \frac{\sum_{j=1}^{N} (y_j - y_i)_+}{N}, \tag{8}$$

where N is the total number of children under 5 years. The AI can be written in the following form:

$$AI = \sum_{i=1}^{N} \frac{\overline{\delta_i}}{N} = \overline{\delta}. \tag{9}$$

The functional form of the Absolute Gini coefficient presented in Eq. (9) shows that this coefficient is average of the expected relative deprivation. This AI possesses all the important inequality axioms and most importantly, all axioms are consistent and continue to be so when the mean is negative or equal to zero (see Araar, 2006 for a detailed discussion of the axioms of the absolute Gini index).

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[3] See Duclos et al. (2006a) for important features and conditions of bi-dimensional dominance surface.

The contribution of each child to total inequality depends on her expected relative deprivation. When child k belongs to group g, her average relative deprivation can be written as:

$$\bar{\delta}_k = \phi_g \bar{\delta}_{k,g} + \stackrel{\approx}{\delta}_{k,g}, \tag{10}$$

$$\bar{\delta}_{k,g} = \sum_{\substack{j=1 \\ j \notin g}}^{N-Kg} \frac{(y_k - y_j)_+}{N}, \tag{11}$$

where ϕ_g is the population of children's share of group g, Kg is the number of children that belong to the group g, $\bar{\delta}_{k,g}$ is the expected relative deprivation of child k at the level of group g and $\stackrel{\approx}{\delta}_{k,g}$ is the expected relative deprivation of child k at the level of its complement group. Araar (2006) has shown that by using Eqs. (10) and (11), the decomposition of the Gini index takes the form:

$$AI = \sum_{g=1}^{G} \phi^2 AI_g + AI(\mu_g) + R, \tag{12}$$

where R is a residual or a group asset overlap.

Analogous to the absolute Gini index, we use the absolute Lorenz curve to test for inequality dominance. Araar (2006) has shown that the absolute inequality in distribution A dominates that of B if and only if:

$$AL_A(p) < AL_B(p) \forall p \in [0, 1], \tag{13}$$

where AL_D is the absolute Lorenz curve for the distribution D, such that

$$\begin{aligned} AL_D(p) &= \int_0^p (y_D(q) - \mu_D)\,\mathrm{d}q \\ &= GL_D(p) - p\mu_D, \end{aligned} \tag{14}$$

where GL_D is the generalized Lorenz curve for the distribution D. Using the above analogy, the absolute concentration curve can also be derived from the usual concentration curve to measure progressivity in child survival.

3.2 Determinants of Childhood Mortality

The analytical framework for child survival adopted in this chapter follows the household production model (Becker, 1965; Strauss and Thomas, 1995). The basic idea of the model is that households allocate time and goods to produce commodities some of which are sold on the market, some consumed at home, and some for which no market exists at all. The households face preferences that can be characterized by the utility function U, which depends on consumption of a vector of commodities,

X, and leisure, L.

$$U = U(X, L). \tag{15}$$

The production function for the consumption good depends on a vector of household input supplies. The household chooses the optimal consumption bundle, given this production function and a budget constraint. The budget constraint states that given market prices and wages, total consumption (including the value of time spent in leisure activities) cannot exceed full income.

The household model can be modified to model human capital outcomes including child health by relaxing the assumption of perfect substitutability between home-produced and market goods (Strauss and Thomas, 1995). Child health can be thought of as being generated by a biological production function in which a number of input allocations such as nutrient intake and general care result from household decisions. Households therefore choose to maximize chances of child survival given the resources and information constraints they face. In the context of mortality, these constraints are referred to as proximate determinants of child survival (Mosley and Chen, 1984).

The proximate determinants framework (Mosley and Chen, 1984) is based on several premises: First, in an optimal setting, 97% of infants may be expected to survive through the first 5 years of life; second, reduction in the probability of survival is due to social, economic, biological, and environmental forces; third, socio-economic determinants must operate through basic proximate determinants that in turn influence the risk of disease and the outcome of disease processes. Other premises relate to the relationship between morbidity and mortality (medical science methodologies), which is beyond the scope of this chapter. Given these premises, the key to model specification is the identification of a set of proximate determinants or intermediate variables that directly influence the risk of childhood mortality. All social and economic determinants must operate through these variables to affect child survival (Mosley and Chen, 1984).

To model child survival, Eq. (15) can be modified to include supply of child health (child survival) and the corresponding budget constraint modified to include inputs into a child health production function. The resulting constrained utility function can then be solved for the optimal quantities of child health supplied to the market.

Following Mosley and Chen (1984) and Schultz (1984) and starting with the household production function, we can integrate the underlying production process with household choices to derive a reduced-form[4] child health production function with the following relationships:

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[4] Schultz (1984) has shown that the best approach would be to estimate both the demand equations for health inputs and the production function linking health inputs to child survival by simultaneous structural equation methods. This however requires that there are accurate data on prices, wages, programs, and environmental conditions, which can be used as exogenous instruments. In the absence of appropriate instruments, the reduced-form equation for child survival may be estimated without imposing a great deal of structure on the problem, as is commonly done in the literature.

$$MR = \beta_0 + \beta_1 X_i + \beta_2 \mathrm{H}_i + \beta_3 \mathrm{C}_i + \beta_4 \mathrm{Z}_i + \varepsilon_i, \tag{16}$$

where *MR* is a 0/1 indicator of whether a child died before a given birthday; *X* is a vector of a child's health endowments, the component of child health due to either genetics or environmental conditions cannot be influenced by family behavior, but is partially known to it, called health heterogeneity (Schultz, 1984); H is a vector of a household's economic endowments and preferences; C is a vector of community-level characteristics that include regional, price, and program variables. Z is a vector of macro-level variables; and ε_i is a stochastic disturbance term.

3.2.1 Dependent Variable

In this study, mortality rates are estimated for up to 15 years prior to the survey and so cover all births between 1978 and 2002. This has two advantages: (1) mortality can be regarded as a measure of health outcomes for the period between the survey date and 15 years prior to the survey. (2) The measurement errors in mortality rates due to misreporting can be reduced to some extent when using the most recent maternal history data (Wang, 2002). Most studies calculate infant mortality rates (IMR) by taking all the children born in a given period, counting the number of deaths that occur after 1 year, then dividing the deaths by the number of children born. While this method is straightforward, it has one important limitation: it cannot provide an estimate of the IMR for the 1-year-period immediately prior to the survey. Children born within a year before the survey will be censored in the sense that they will not have yet lived a year, and thus do not run all the risks of death before reaching their first birthday. The IMRs based on these children will therefore be biased downwards. While this may not seem too important a limitation for IMRs, it is quite important for child or under-five mortality rates. To solve this problem, under-five and child mortality rates for a given time period are usually calculated using synthetic cohorts of infants at risk. This method allows the researcher to calculate mortality rates for dates close to the survey date.

The DHS collect data on women's entire birth histories (all children born and about their survival). By using these birth histories, it is possible to construct mortality rates for many years prior to the survey date. However, the expected negative correlation between mortality and mother's age is likely to introduce a bias to calculations of mortality rates for periods far from the date of the survey.[5] To avoid

[5] The survey interviews women between the ages of 15 and 49 today, so the information it has on births and deaths (say 15 years ago) is for women who were 0–34 years old at that time, and the estimated mortality rates for the earlier period would be biased upward because the sample of mothers is younger. At the same time, there are some mothers who were less than 15 but no information was collected on them. So an estimate of current mortality will be biased downward. Another possible bias arises from the fact that some women would have died in the years between the date for which a mortality rate is to be estimated and the survey date, as there is no information about them in the survey. If these women's infants were more likely to die than other infants then the mortality rates estimated for years prior to the survey will be biased downward (see Mosley and Chen, 1984; Ssewanyana and Younger, 2005). One problem of analyzing retrospective birth histories is the quality of information: misplacement of dates of birth is always possible, and so is

any possible biases (Glick et al., 2006). To take care of such biases, we base the mortality analysis on 5-year cohorts of children born up to 15 years prior to each survey date to mothers aged 15–34, calculated as the number of children from that cohort who died before age five, then divided by the total number of children in the cohort.

To correct for inherent censoring in mortality rates, we use one of the standard hazard or survival modeling techniques, namely the Weibull parametric survival-time model.[6] The censoring problem arises from the fact that if a child is dead or is of a given age, we have full information, but when a child is still alive and is less than 60 months, we do not have information whether the child will die or not. Hazard and survival (relative risk) models help to avoid any downward bias in estimation of mortality rates – they allow us to model the probability of a child dying at age x_{tplus1} (say 60 months) conditional on being age x_{t}(say 59 months). This is very important because erroneous measures and estimation of mortality would lead to wrong policy implications.[7]

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misreporting of death as well as omissions of birth reporting of children who die very early in life. These problems are however more likely to bias neonatal and infant mortality, but not under-five mortality (Hobcraft et al., 1984). We investigate for possible biases in the data using education and mother's heights by women's birth cohort, but uncover no evidence of any of these problems (this is presented in a separate appendix and is available from the authors or from PEP).

[6] Survival analysis is a technique for analyzing time to event or failure data. It helps to model the risk of failure or the probability of experiencing failure (hazard) at time t_{+1} given that the subject is at risk at time t. The higher the hazard, the shorter the survival. In the case of mortality, the survival time of a child is a continuous non-negative random variable T with a cumulative distribution function $F(t)$, and probability density function $f(t)$. The survivor function is defined as $S(t) \equiv 1 - F(t)$, the probability of being alive at time t.

If we let the cumulative density function for the failure function to be $\Pr(T \leq t) = F(t)$, then the survivor function can be estimated as:

$$S(t) \equiv \Pr(T > t) = 1 - F(t). \tag{17}$$

The Weibull model is parameterized as both a proportional hazard and accelerated failure-time model. It is suitable for modeling data with monotone hazard rates that either increase or decrease exponentially with time. The proportional hazard model for Weibull regression is specified as:

$$\theta(t:X) = \alpha t^{\alpha-1} \exp(\beta' X) = \alpha t^{\alpha-1} \lambda, \tag{18}$$

where $\lambda \equiv \exp(\beta' X)$, α is the shape parameter to be estimated from the data and exp(.) is the exponential function. The hazard rate either rises monotonically with time ($\alpha > 1$), falls monotonically with time ($\alpha < 1$), or is constant ($\alpha = 1$). The last case is the special case of the Weibull model known as the exponential model. For a given value of α, larger values of λ imply a larger hazard rate at each survival time. Like other probabilities, the survivor function lies between zero and one, and is a strictly decreasing function of t. The survivor function is equal to one at the start of the spell ($t = 0$) and is zero at infinity: $0 \leq S(t) \leq 1$. The density function is non-negative but may be greater than 1 in value, i.e., $F(t) \geq 0$.

[7] To save on space, this analysis is based on under-five mortality only. The advantage of using under-five mortality is that duration models allow us to explore the determinants of probability of a child dying before the fifth birthday without losing any information. Yet, because most deaths occur before the first birthday (neonatal and infant mortality), this analysis allows us to make inferences about the correlates of infant mortality as well. For this reason, we use the term childhood mortality or child survival in the discussion of all results.

3.2.2 Explanatory Variables

Following Mosley and Chen (1984) and other relevant literature, a number of proximate determinants of childhood mortality can be identified. These include child, maternal, household, and regional characteristics embedded in socio-economic and environmental forces. However, it is important to bear in mind that in view of the assumptions of Mosley and Chen (1984), Kenya is a sub-optimal case, with infant mortality rates well above 60%.

3.2.3 Child Characteristics

The study investigates the impact of individual characteristics including gender of the child, first-born children, birth order, and children of multiple births, which are expected to have higher mortality probabilities, controlling for other factors. Though some studies have shown that male infants are more physiologically vulnerable than female infants, empirical studies have shown that this may be reversed where there are strong sex-of-child preferences (Muhuri and Preston, 1991).

3.2.4 Mother's Characteristics

This chapter investigates the impact of several maternal characteristics. Maternal education and age are expected to increase the likelihood of child survival through altering the household preference function and also through increasing the mother's skills in health-care practices related to conception, nutrition, hygiene, preventive care, and disease treatment (Mosley and Chen, 1984). Some studies also argue that maternal education could affect child survival in two different ways: as an indicator of social economic status, and also by directly influencing mother's behavior (Muhuri and Preston, 1991). Schultz (1984) outlines four ways in which mother's education may improve child health: (1) Education may affect productivity of health inputs that determine child health because better educated mothers may obtain greater benefits from a given use of health services; (2) education may affect the perceptions about the best allocation of health inputs; (3) education may increase total family resources, either due to labor market participation or due to assortative mating; and (4) education may residually affect preferences for child health and family size, given total resources, prices, and technology. Other studies support the role of maternal education in reducing childhood mortality (Hobcraft et al., 1984; Filmer and Pritchett, 1997; Ware, 1984). The chapter focuses on the impact of primary and post-primary education.

Height of the mother is included to capture both the genetic effects and the effects resulting from family background and characteristics not captured by maternal education.

3.2.5 Household Characteristics

Several household characteristics are included in the mortality model. Household resources/income[8] is generally a powerful determinant of child health through, among other ways, providing access to housing, fuel/energy/hygiene, transportation, and information (Mosley and Chen, 1984). In the absence of income data in the DHS, an asset index (which takes into account household endowment of most of these income factors) is included as an indirect measure of the impact of resources/income.[9] Previous studies have shown that the index is an important measure of wealth just like expenditures or incomes, whether instrumented

Table 1 Weights (scores) for assets from principal components analysis

Variable	Weights
Radio	0.84989
Television	0.95624
Fridge	0.96384
Bike	0.81707
Motor transport	0.11424
Electricity	0.96041
Piped water	0.07354
Surface water	−0.08413
Flush toilet	0.1808
No toilet	−0.11849
Traditional floor	−0.31733
Heads years of education	0.14671
Respondents years of education	0.1614

[8] In this chapter, the asset index is used as a proxy for household resources or income. These two are measures of household welfare and may therefore be seen as indicators of household wealth and well-being. For this reason, some of these terms may be used interchangeably in the chapter depending on the context.

[9] The asset index can be defined as: $A_i = \sum_k \tau_k \alpha_{ik}$, where A_i is the asset index for household i, the α_{ik}'s are the k individual assets recorded in the survey for that household, and the τ_k's are the weights. Most studies use the standardized first principal component of the variance–covariance matrix of the observed household assets as weights, allowing the data to determine the relative importance of each asset based on its correlation with the other assets, following Filmer and Pritchett (2000). This study uses the factor analysis approach to derive the index, following Sahn and Stifel (2000, 2003). This approach is similar to principal components but has certain statistical advantages and assumes that the one common factor that best explains the variance in the ownership of a set of assets is the measure of economic well-being (Sahn and Stifel, 2000). The assets that are included in the analysis are ownership of a radio, TV, refrigerator, bicycle, a motorcycle, a car, the household's source of drinking water (piped or surface water relative to well water); the household's toilet facilities (flush or no facilities relative to latrine facilities); the household's floor material (low quality relative to higher quality); and the years of education of the household head (and of respondent if not the head) to account for household's stock of human capital. The scoring coefficients from the factor analysis are applied to each household to estimate its asset index and will rank the households on a –1 to 1 scale. To avoid arbitrary assignment of weights to the variables, we rely on the factor loadings results for weights (see Table 1 for weights so generated).

or not, in explaining health outcomes (Sahn and Stifel, 2003, Ssewanyana and Younger, 2005).

Other household characteristics include the number of adult women in a household, as a proxy for availability of childcare. We omit household size and number of children because of possible endogeneity with mortality, i.e., higher mortality will make households smaller. Access to water, sanitation, and electricity are also included. These variables can be seen as measures of the environmental/sanitation quality of the residence of the child and are therefore expected to be important correlates of child mortality. A dirty environment is associated with some childhood diseases (such as diarrhea and upper respiratory system diseases), which are the main causes of child mortality in developing countries.

3.2.6 Cluster, District, and Regional Characteristics

Market prices affect household demand behavior and consequently the provision for child health. Price data is not always collected in household survey data but one set of proxies include availability of private and public services, where access is often a major part of price variation. Community characteristics are useful in estimating demand relationships because they generally can be assumed to be exogenous from the household's point of view (Schultz, 1984). In this chapter, we generate a vector of community-level (cluster and district) variables to proxy prices.[10] At the cluster level, we focus on the share of women who used modern contraceptive methods and mothers' knowledge of oral rehydration therapy, focusing on the latest birth and for births within the last 5 years.

The district-level (district year averages) shares include: the share of children who were fully immunized; the share of women who received professional prenatal and birth care (doctor, midwife, or nurse); and the share of pregnant women who received tetanus toxoid vaccine, for which district averages are used. These variables can be interpreted as proxying for availability of health care in a district for which we have no direct measure.

At the regional/provincial level, we include health institutions per capita with the expectation that health care is inversely correlated with mortality. The health facilities available at the regional level include number of hospitals, health centers and dispensaries, and number of beds and cots per a given 100,000 population. Regional dummies are also included to capture the political economy and ecological setting (Mosley and Chen, 1984) in the absence of measures of these variables in the data.

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[10] Cluster- and district-level shares are used instead of the individual responses to adjust for design effects in the survey and also to control for endogeneity of individual level data on service use. Endogeneity of these variables spring from the fact that they depend on household characteristics among other factors and may also be jointly determined with other factors that affect mortality. For some variables, it is convenient to use cluster averages because of decentralization of service delivery (e.g., family planning clinics) but for other variables, delivery is less decentralized (e.g., medical professionals) and so these variables are measured at the district level.

The place of residence (rural/urban) may capture living conditions, but may also be correlated with the public health-care provisions (Hobcraft et al., 1984; Trussell and Hammerslough, 1983).

3.2.7 National Characteristics

At the national level, the gross national income (GNP) is included as a measure of national well-being, while the share of health expenditure to GNP is included as a measure of government's efforts toward reducing mortality (Filmer and Pritchett, 1997; Wang, 2002). These variables are measured at the year of birth of the child and are therefore highly aggregated. We also include a time trend to check for correlations between unexplained progressions in child mortality over time that may be present once the microeconomic variables are controlled for. One would expect these variables to have a mortality-reducing impact.

4 Results

4.1 Descriptive Statistics

The sample characteristics by survey year are presented in Table 2. Most of the characteristics vary, albeit marginally across surveys. Looking at household characteristics, it is apparent that demographic indicators, namely household size, number of children, and number of women aged 15–49 years were much higher in 1993 compared to 1998 and 2003. For instance, the mean household size was 7 persons in 1993, but fell to 6 persons in 2003, probably reflecting a demographic transition over the 10-year-period. Though the mean asset index changed significantly from 1993 to 1998/2003, the per capita index changed very marginally (by only 0.01 points). All other household characteristics remained basically the same. There was no systematic pattern in the differences in household access to different sources of water and type of toilet. In other words, the data suggests no improvement or deterioration in sanitation across the survey years.

Child characteristics also remained fairly the same across the survey years. Maternal characteristics also remained comparatively similar across the survey with the exception of mothers who completed both primary and secondary education, where the proportions changed considerably between 1993 and 2003. The cluster share variables show more variations across survey years than household, child, and mother characteristics. The variation however seems to be more of differences between the 1993 survey and the other two surveys.

Table 3 shows the district/year averages and suggests that general vaccination of children, prenatal care, and vaccination of mothers against tetanus declined over time. There was a significant decline in the district share of children receiving all vaccinations.

Table 4 suggests modest improvement in national income, budgetary allocations to health care, and growth in health institutions per 100,000 persons, except for hospitals that reported a decline in 2003.

Table 2 Descriptive statistics by survey year

	1993		1998		2003	
Variable	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Household characteristics						
Household size	7.15	3.17	6.31	2.52	6.15	2.46
No. of children in a household	1.63	1.16	1.37	1.08	1.43	1.03
No. of women 15–49 in household	1.53	0.93	1.43	0.75	1.42	0.74
Log asset index	0.47	0.29	0.54	0.32	0.55	0.36
Public tap	0.11	0.31	0.09	0.28	0.09	0.29
Piped water in residence	0.14	0.35	0.16	0.37	0.15	0.36
Other water	0.04	0.20	0.02	0.15	0.09	0.28
Well water	0.23	0.42	0.22	0.41	0.19	0.39
Flush toilet	0.07	0.25	0.07	0.26	0.07	0.26
Other toilet	0.20	0.40	0.19	0.39	0.22	0.42
Child characteristics						
Gender of child dummy: 1 = male	0.49	0.50	0.51	0.50	0.51	0.50
Birth order	3.95	2.64	3.66	2.45	3.50	2.39
Child is first birth	0.20	0.40	0.22	0.42	0.24	0.43
Child is of multiple birth	0.03	0.17	0.03	0.17	0.03	0.18
Child is a first-born twin	0.002	0.04	0.002	0.04	0.003	0.05
Mothers characteristics						
Mother has some primary education	0.23	0.42	0.20	0.40	0.18	0.38
Mother is primary graduate	0.32	0.47	0.40	0.49	0.44	0.50
Mother has some secondary education	0.09	0.28	0.09	0.29	0.09	0.29
Mother has secondary education or higher	0.09	0.29	0.13	0.34	0.13	0.33
Mother's age at child's birth	25.85	6.41	25.66	6.20	25.79	6.24
Mother's age/first-born interaction	3.86	7.89	4.44	8.41	4.80	8.72
Mother's height in cm	158.97	9.89	159.99	6.58	159.74	6.41
Cluster average, use of modern contraception	0.29	0.19	0.31	0.19	0.29	0.16
Cluster average, rehydration knowledge (birth past 5 years)	0.81	0.14	0.74	0.15	0.74	0.13
Cluster average, rehydration knowledge last birth)	0.59	0.16	0.74	0.15	0.74	0.13
Sample size	17,783		16,645		14,344	

Table 3 District average health-care services by survey year

Variable	1993 Mean	1993 Standard deviation	1998 Mean	1998 Standard deviation	2003 Mean	2003 Standard deviation
Child received any vaccinations	0.93	0.09	0.93	0.10	0.93	0.10
Child received all vaccinations	0.64	0.24	0.55	0.27	0.49	0.26
Birth care by doctor	0.06	0.07	0.07	0.08	0.08	0.09
Birth care by any professional	0.44	0.21	0.44	0.21	0.44	0.22
Prenatal care by doctor	0.11	0.10	0.13	0.13	0.13	0.13
Prenatal care by any professional	0.92	0.09	0.90	0.09	0.89	0.10
Mother received tetanus toxoid	0.90	0.08	0.90	0.08	0.89	0.10
Sample size	6,651		10,550		13,491	

Table 4 Per capita macro- and regional-variables by survey year

Variable	1993 Mean	1993 Standard deviation	1998 Mean	1998 Standard deviation	2003 Mean	2003 Standard deviation
Log GNP per capita	8.58	0.43	9.14	0.56	9.82	0.58
Log health expenditure per capita	4.60	0.37	5.12	0.54	5.65	0.50
Number of hospitals/100,000	1.81	1.88	1.87	1.73	1.69	0.55
Number of health centres/ 100,000	1.96	1.14	2.13	1.03	2.18	0.85
Number of dispensaries/ 100,000	9.50	8.28	11.11	7.86	10.35	4.33
Number of hospital beds and cots/100,000	160.21	91.47	179.90	97.43	195.18	74.27
Sample size	17,783		16,645		14,344	

Table 5 suggests fluctuations in the regional distribution of the actual sample covered in the three survey rounds. These fluctuations reflect adjustments to ensure that the sample is proportional to the size of the population in each region.

Table 6 shows different estimated mortality rates by region and survey year. The overall estimates (urban, rural, and all regions) suggest that there are no systematic differences in variations in different mortality rates across the survey years. Neonatal and infant mortality rates fluctuated across the 3 years. All mortality rates in Nairobi showed a similar trend. Child mortality rates increased marginally over the years but under-five rates rose significantly. Regional differences in mortality rates indicate that Nyanza, Western, and Coast provinces fared worst in almost all estimated mortality rates. Central province and Rift Valley province reported the lowest mortality rates.

In Table 7, we present a tabulation of mortality rates by gender and survey year. The statistics show that boys were at a higher risk of mortalities than girls throughout the decade. Mortality rates for boys show a consistent upward trend, but rates for girls fluctuated. Table 8 shows estimated mortality rates by child poverty status.

Table 5 Regional distribution of sample (%) by survey year

Region	1993	1998	2003
Nairobi	4	6	6
Central	13	10	12
Coast	9	7	9
Eastern	20	16	16
Nyanza	17	23	18
Western	15	13	13
Rift valley	22	25	27
Rural	88	84	82
Urban	12	16	18
Sample size	17,783	16,645	14,344

Table 6 Estimated mortality rates (per 1,000 live births) by age group, region, and survey round

Region	Neonatal mortality[a]	Infant mortality	Child mortality	U5 mortality
1993				
Nairobi	28	44	28	71
Central	17	34	10	44
Coast	35	80	35	115
Eastern	31	54	15	69
Nyanza	40	116	50	166
Rift Valley	26	48	13	61
Western	27	61	38	98
Urban	23	50	21	71
Rural	30	65	26	91
All regions	29	63	26	89
1998				
Nairobi	20	38	16	54
Central	18	28	4	32
Coast	32	70	22	92
Eastern	25	52	17	69
Nyanza	36	121	52	173
Rift Valley	28	46	15	61
Western	25	70	47	118
Urban	21	47	24	71
Rural	29	71	28	99
All regions	28	67	28	95
2003				
Nairobi	28	60	21	81
Central	24	39	8	47
Coast	42	75	30	105
Eastern	32	53	23	77
Nyanza	31	131	57	188
Rift valley	34	59	13	72
Western	25	74	47	121
Urban	24	56	24	79
Rural	33	75	29	104
All regions	31	72	28	100

[a]Neonatal mortality refers to death within the first month of birth, infant mortality refers to death within the first 12 months of birth, child mortality refers to death between 12 and 60 months and under-five mortality refers to death within 60 months (5 years) of births.

Table 7 Estimated mortality rates (per 1,000 live births) by gender of child and DHS survey round

	1993		1998		2003		All years	
Variable	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Neonatal mortality	32	27	33	23	36	26	34	25
Infant mortality	67	59	72	62	79	64	73	62
Child mortality	26	25	26	30	29	28	27	28
U5 mortality	93	85	98	92	108	91	100	89
Sample size	8, 819	8, 964	8, 380	8, 265	7, 252	7, 092	24, 451	24, 321

Table 8 Estimated mortality rates by poverty status and DHS survey round

	1993		1998		2003	
	Poor[a]	Non-poor	Poor	Non-poor	Poor	Non-poor
Neonatal mortality	37(36)	28(28)	36(36)	28(28)	42(42)	29(29)
Infant mortality	92(89)	60(59)	107(105)	62(62)	88(92)	66(65)
Child mortality	41(40)	25(25)	41(40)	26(26)	29(29)	27(27)
U5 mortality	133(129)	85(84)	148(145)	88(87)	117(121)	92(91)

[a]Poverty line set at 40% of the asset index, figures in parenthesis are for poverty line set at 60% of the index.

The poverty status is derived using relative poverty lines, where a child is classified as poor if she/he falls below 40% (or 60%) of the asset index, otherwise she/he is non-poor. The results show that poor children are more likely to face mortality than the less poor. This result is robust for all poverty lines. The results further show that the largest differences in infant and U5 mortality risks between the poor and non-poor were observed in 1998. The largest differences in neonatal mortality risks between the poor and non-poor were observed in 2003.

4.2 Multidimensional Poverty Comparisons

Descriptive statistics presented and discussed in the previous section show that different regions in Kenya fared differently with respect to child survival. Nyanza province experienced the highest levels of mortality across the years while Central province and Nairobi had the lowest mortality rates. In this section, we test for differences in welfare of children across regions and the country, taking into account the household assets. To do so, we first decompose poverty in assets across the regions and areas of residence (rural and urban), then test for the dominance of poverty. In addition, we test for inequality in assets and progressivity of the probability of child survival.[11]

[11] The probability of child survival is defined as 1 minus the number of children that faced mortality weighted by the total number of children aged 0 to 60 months born to a household. We could as well use the predicted probabilities of survival from a childhood mortality regression, with the only difference being that the latter smoothens out the expected probability of survival. Both approaches gave us comparable results. Recall from the methodology that childhood mortality is measured through under-five mortality.

4.2.1 Poverty Decompositions and First-Order Dominance Testing

In this section we look at the contribution of location to our two dimensions of well-being through decomposition of poverty. We first report results of the decomposition of FGT index by rural and urban areas in Table 9, where well-being is represented by the probability of child survival. The results for rural and urban areas suggest that only 28% of children in rural areas are poor compared to 19% in urban areas. The table further shows that the relative contribution of rural areas to child poverty is 89% while the contribution of urban areas is only 11%.

In Table 10 we perform the same decomposition by region. The results suggest that Nyanza province contributed the most to childhood mortality with an FGT index of 0.467 and a relative contribution of 33%. This was followed by Western and Rift valley provinces, which contributed about 18% to total poverty. Nairobi is least poor with a head count index of 15% and a relative contribution of only 3%.

The results presented in Tables 9 and 10 point at the link between the probability of child survival and household assets. First-order dominance tests for poverty in

Table 9 Decomposition of the FGT index by rural and urban groups

Group	FGT index	Population share	Absolute contribution	Relative contribution
1: Rural	0.281	0.843	0.237	0.889
	0.008	0.009	0.008	0.010
2: Urban	0.188	0.157	0.030	0.111
	0.012	0.009	0.002	0.010
Population	0.267	1.000	0.267	1.000
	0.007	0.000	0.007	0.000

Note: FGT indices for probability of child survival.
Poverty line = 98.

Table 10 Decomposition of the FGT index by region

Group	FGT index	Population share	Absolute contribution	Relative contribution
1: Nairobi	0.154	0.055	0.008	0.032
	0.019	0.005	0.001	0.005
2: Central	0.107	0.106	0.011	0.043
	0.012	0.008	0.002	0.006
3: Coast	0.312	0.084	0.026	0.099
	0.021	0.007	0.003	0.011
4: Eastern	0.209	0.177	0.037	0.139
	0.014	0.012	0.004	0.014
5: Nyanza	0.467	0.187	0.087	0.327
	0.022	0.012	0.007	0.022
6: Rift	0.192	0.249	0.048	0.179
	0.010	0.013	0.004	0.014
7: Western	0.344	0.141	0.048	0.182
	0.017	0.009	0.004	0.014
Population	0.267	1.000	0.267	1.000
	0.007	0.000	0.007	0.000

Note: FGT indices for probability of child survival.
Poverty line = 98.

assets across the regions and by area of residence (rural vs. urban) suggest patterns that mimic the results presented in these tables. We present first-order dominance tests for asset poverty by region, by rural and urban areas, and by childhood mortality (whether the child is from a household that experienced death of a child or not).

Figure 2 shows that Nairobi dominates all other regions, but there is no dominance between the other regions. When we focus on the first-half of the distribution (about 50% of the poverty line), Central province is less poor than all other regions except Nairobi and the poorest children seem to be located at the Coast region.

Figure 3 shows the FGT curves for rural and urban areas. These curves show that the urban areas dominate the rural areas in poverty.[12]

Figure 4 presents FGT curves by childhood mortality. Children from households that did not experience death dominate children from households that experienced childhood mortality in poverty.

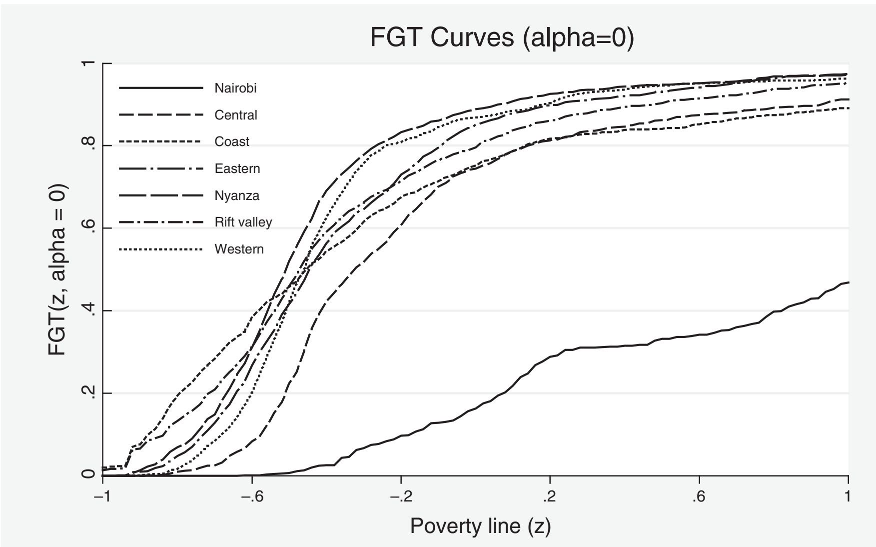

Fig. 2 FGT curves by region

[12] Recall that dominance in poverty refers to the distribution that is better in well-being. There are two steps in testing for the statistical robustness of stochastic dominance (see Araar, 2007). The first step is to draw the difference between FGT curves. This is a necessary but not a sufficient test because it can only tell us whether there is stochastic dominance or not. The second step is to test whether the upper bound of the difference between poverty orderings is anywhere below zero at a desired confidence interval. If both conditions/tests are satisfied, the stochastic dominance is statistically robust. If the first is satisfied and the second is not, there is stochastic dominance but the difference is not statistically significant. Our results show that the stochastic dominance of urban over rural areas is statistically robust. There is stochastic dominance of Central over all other provinces except Nairobi and Coast provinces, but this dominance is not statistically robust.

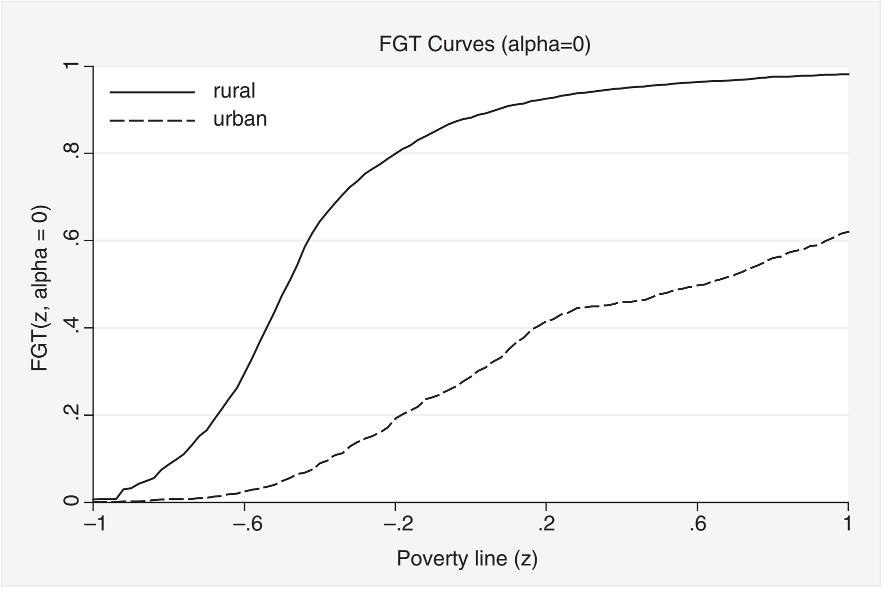

Fig. 3 FGT curves by rural and urban areas

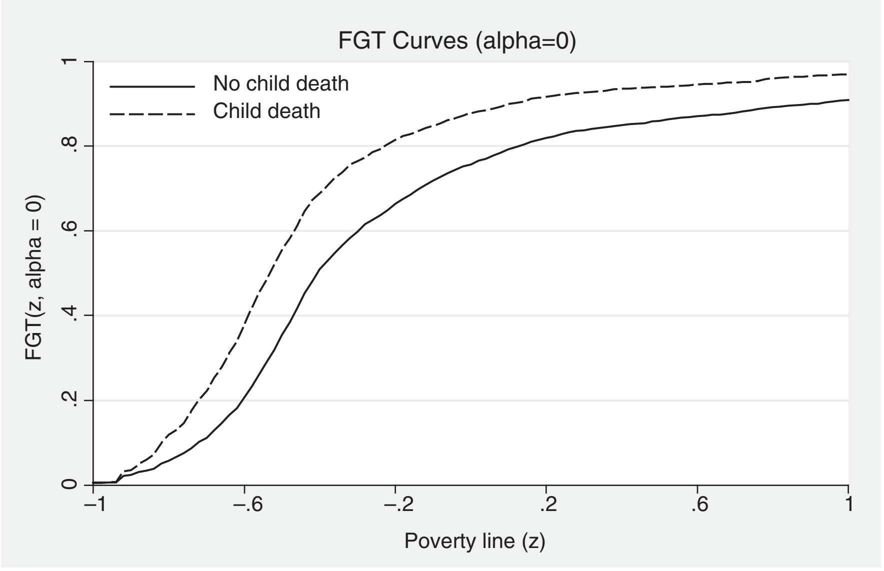

Fig. 4 FGT curves by child mortality groups

4.2.2 Bivariate Dominance

Bivariate poverty dominance allows us to check for the dominance on poverty when the standard of living is composed from two well-being indicators. In our case, we assume that well-being for the child is composed from two indices. These are the asset index (a synthetic index of a set of well-being indicators) and the probability of child survival. One can report here that this probability is positively correlated with the asset index, as shown in Fig. 5. In the figure, we show that most of the children come from households whose assets lie between 0 and −1. Most important, the surface diagram shows that children with the lowest probability of survival (say 98%) are from households with the lowest level of assets. This is clear from the diagram because the ridge of the hill is angled out from the origin.

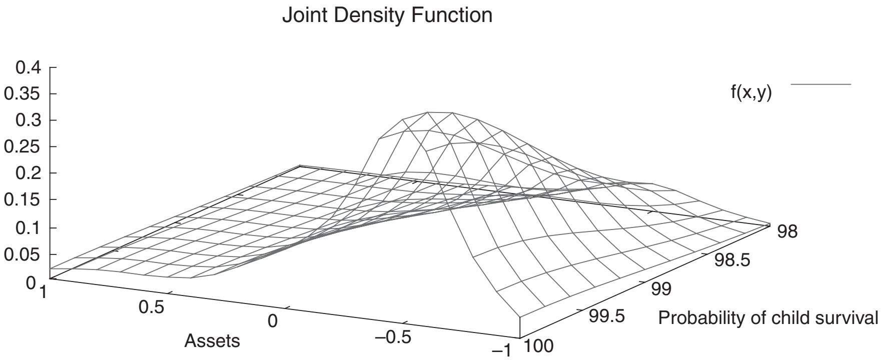

Fig. 5 Joint density function of child probability survival and assets: pooled data

Figure 6 shows the density curves for asset index by mortality. Density curves are purely descriptive tools, intended to show the distribution of well-being. The curves suggest that at very low levels of assets, poor households are more likely to experience child death than at higher levels of assets.

4.2.3 Bi-dimensional Dominance

This chapter also tests for the bi-dimensional dominance in the difference in poverty between urban and rural areas. To test for sensitivity of poverty ranking to the sensitivity of poverty lines, we first evaluate the dominance of poverty at different poverty lines. Starting with a minimum of −0.6 and a maximum of 0.6 (Fig. 7), the results show that in general, urban areas dominate rural areas in poverty because the upper bound surface is in general below the zero level. When we change the poverty lines to say −0.8 to 0.8 (or a narrower range), the upper bound remains consistently below zero, showing that the poverty orderings are robust to the choice of poverty line. Taking the extreme poverty lines (−1 and 1), also show that urban areas still dominate rural areas in poverty (Fig. 8). By using the minimum and maximum of all possible poverty lines, the analysis presented in Fig. 6b tests for both bi-dimensional poverty

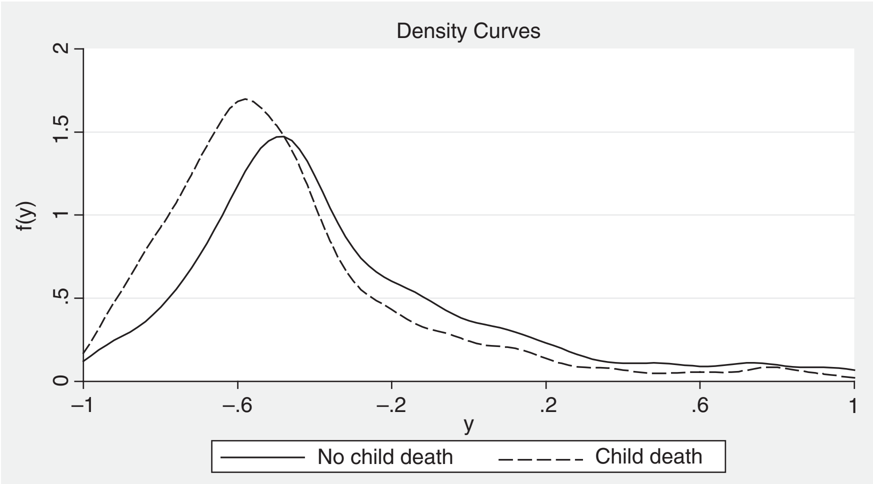

Fig. 6 Density curves for child mortality

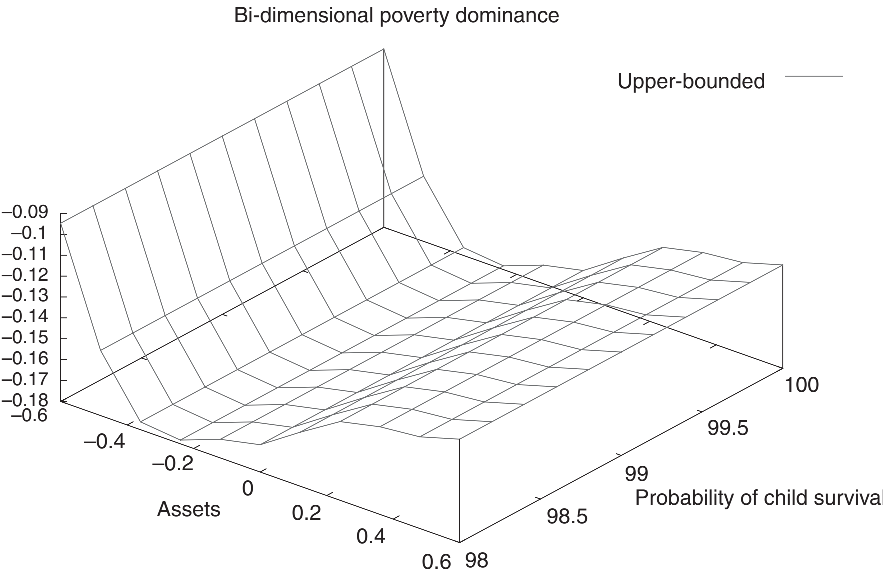

Fig. 7 Bi-dimensional dominance on poverty difference between urban and rural areas – poverty line (−0.6, 0.6)

dominance and also for the sensitivity of poverty orderings to poverty lines. These results therefore show that the poverty comparisons are robust in two ways. First, no matter the poverty line or measure of well-being that we choose, poverty will always be lower for urban areas than for rural areas. Second, the poverty comparisons here are all statistically robust, using consistent, distribution-free estimators of the sam-

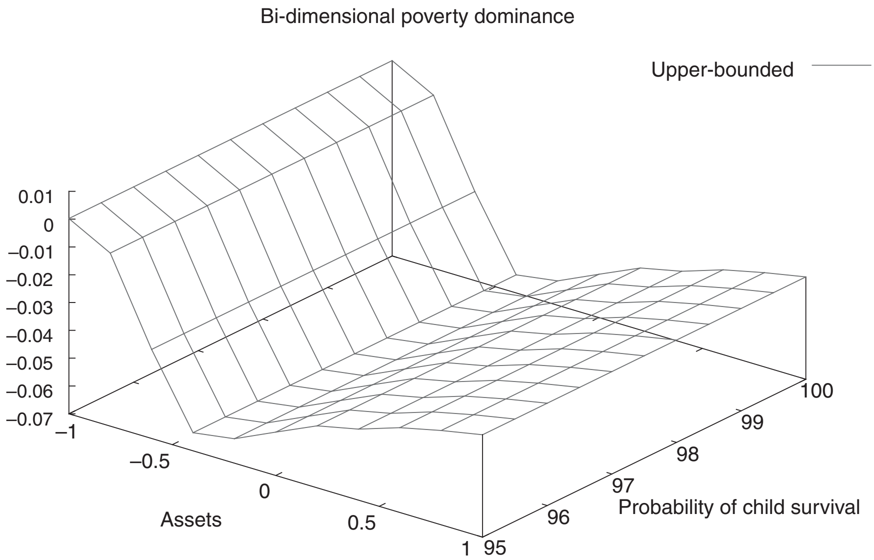

Fig. 8 Bi-dimensional dominance of poverty difference between urban and rural areas – poverty line (−1, 1)

pling distributions of the statistics of each poverty comparison. Our findings support literature on multidimensional poverty comparisons (Duclos et al., 2006a, b, c).

We try to disentangle the first-order dominance results presented in Fig. 2 by testing for bi-dimensional dominance between specific provinces (see Fig. 9). The results are only illustrative of the results for the bi-dimensional dominance of the difference between two provinces. In this case, we test for the difference between Central and Nyanza provinces. The diagram shows that Central province clearly dominates Nyanza province. Further comparisons show that Central province also dominates all other provinces. Other regions we compare include Western and Nyanza provinces, where Nyanza is dominated by Western province. Though Rift Valley province is dominated by Central, there is no dominance between Rift Valley and the other provinces.

4.2.4 Measuring Inequality in Child Welfare

We test for inequality in child welfare by considering decomposition of asset inequality by childhood mortality groups.[13] The results (see Table 11) show that the absolute generalized concentration index for the group facing child death is only 0.24 compared to 0.37 for the group without death. This means that on average, there is less inequality within children facing mortality than the better off children.

[13] Inequality here is measured by the absolute Gini index. One can recall here that in the presence of negative values in the index of well-being, one cannot use the usual Gini index (See Araar 2006).

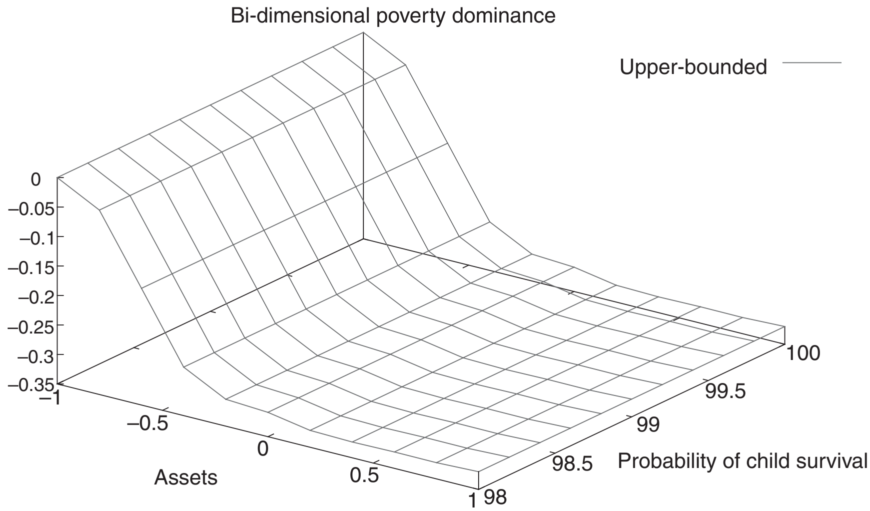

Fig. 9 Bi-dimensional dominance of poverty (difference between Central and Nyanza provinces)

Table 11 Decomposition of asset inequality by mortality groups

Component	Absolute contribution			Relative contribution
Intra-group	0.2138			0.6334
Inter-group	0.0531			0.1572
Residue	0.0707			0.2093
Total	0.3376			1
Component	*Absolute generalized concentration index*	*Population share*	*Absolute contribution*	*Relative contribution*
No child death	0.3663	0.7332	0.1969	0.5834
Child death	0.2372	0.2668	0.0169	0.05
Total (intra-group)	0.6035	1	0.2138	0.6334

Another important result is that taking the two groups into account, the between-group inequality is quite modest at about 0.05, while intra-group inequality is 0.21. The overlap explains about 7% of the total inequality.[14] Overall, the group that experienced mortality only contributed 5% to total inequality compared to 58% contribution by their counterparts that did not experience mortality.

[14] Overlap refers to the cases where childhood mortality may be the same but using the asset index ranks the children into different wealth groups. For instance, some less poor children may be from households that experienced more deaths than poorer children. When decomposing inequality by area of residence, the overlap would refer to children ranked as less poor in one area but would be ranked poorer if the mean level of the wealth measure in another area is considered.

Table 12 Decomposition of the probability of child survival by area of residence

Component	Absolute contribution			Relative contribution
Intra-group	0.1190			0.7561
Inter-group	0.0088			0.0561
Residue	0.0295			0.1878
Total	0.1573			1
Component	*Absolute generalized concentration index*	*Population share*	*Absolute contribution*	*Relative contribution*
Rural areas	0.1632	0.843	0.116	0.737
Urban areas	0.1220	0.157	0.003	0.0191
Total (intra-group)	0.2851	1	0.119	0.7561

We are also interested in estimating the contribution of each area of residence and province (region) to the probability of child survival. The decomposition results by area of residence are presented in Table 12. The results show that the absolute concentration indices for rural and urban areas are quite close at 0.16 and 0.12, respectively, though the respective relative contributions to mortality inequality differ significantly. The between-group inequality is very low at only 0.01. The relative contribution of the group overlap is also small at 2.95%. We test for the dominance in inequality and statistical significance using the difference in Lorenz curve and difference in concentration indices approach (Araar and Duclos, 2007). The results show that rural areas dominate urban areas in inequality and the difference is statistically significant at the 5% level.

In Table 13, we decompose mortality inequality by region. It is important to note that in this case, the relative contribution of the within-group inequality is only 16%. The lowest and largest contributions to inequality come from Nairobi and Nyanza

Table 13 Decomposition of the probability of child survival by region

Component	Absolute contribution			Relative contribution
Intra-group	0.0249			0.1585
Inter-group	0.0542			0.3443
Residue	0.0782			0.4972
Total	0.1573			1
Component	*Absolute generalized concentration index*	*Population share*	*Absolute contribution*	*Relative contribution*
Nairobi	0.1094	0.0551	0.0003	0.0021
Central	0.0713	0.1063	0.0008	0.0051
Coast	0.1630	0.0844	0.0012	0.0074
Eastern	0.1225	0.1772	0.0038	0.0244
Nyanza	0.2346	0.1871	0.0082	0.0522
Rift valley	0.1137	0.2488	0.0070	0.0447
Western	0.1782	0.1411	0.0035	0.0226
Total (intra-group)	0.9927	1	0.0249	0.1585

provinces, respectively. The between-group inequality (5.4%) is more than twice the within-group inequality (2.5%), but the contribution of the overlap is much larger (7.8%). One can test for dominance of inequality between regions using the same approach as for area of residence.

Next we test whether there is inequality using both measures of well-being. We use the absolute Lorenz and absolute concentration curves to test for inequality and progressivity. The absolute Lorenz curve for assets and the absolute concentration curve for child-survival probability are presented in Fig. 10. The absolute Lorenz curve suggests that inequality in assets is pronounced. The absolute concentration curve indicates that child survival probability is more equally distributed than assets (or progressive). Figure 11 indicates that there is much higher inequality in urban than in rural areas, while Fig. 12 indicates that progressivity is relatively higher in urban areas than in rural areas.

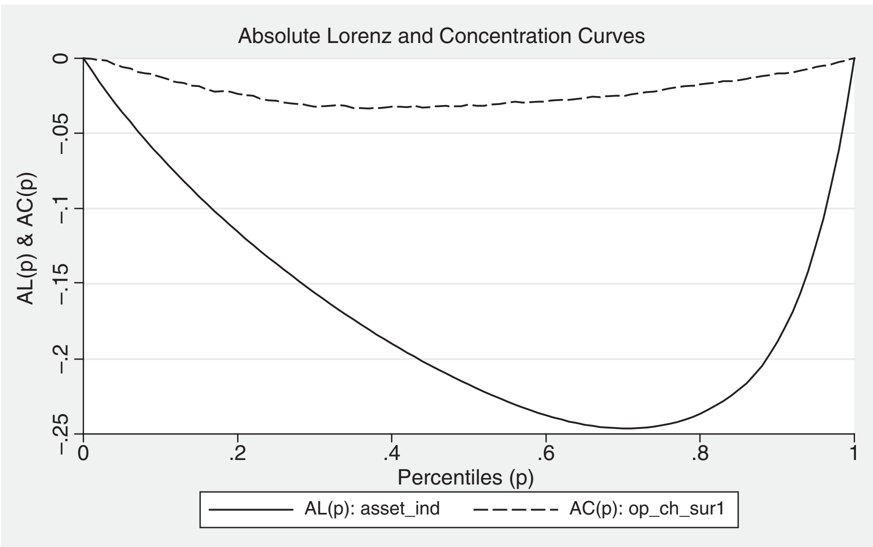

Fig. 10 Absolute Lorenz curve for assets and absolute concentration curve for probability of child survival: full sample

4.2.5 The Linkage Between Well-Being and Probability of Child Survival

The analysis carried out above seems to suggest that children are poor in both dimensions of well-being: probability of child survival and assets. The question that one can ask is whether the probability of child survival is correlated with assets. We check this using the local linear non-parametric regression approach. Non-parametric regression is useful to show the link between two variables without specifying a functional form. It is more flexible than parametric regression in that it allows the slope to change at all points of the curve and is therefore robust to

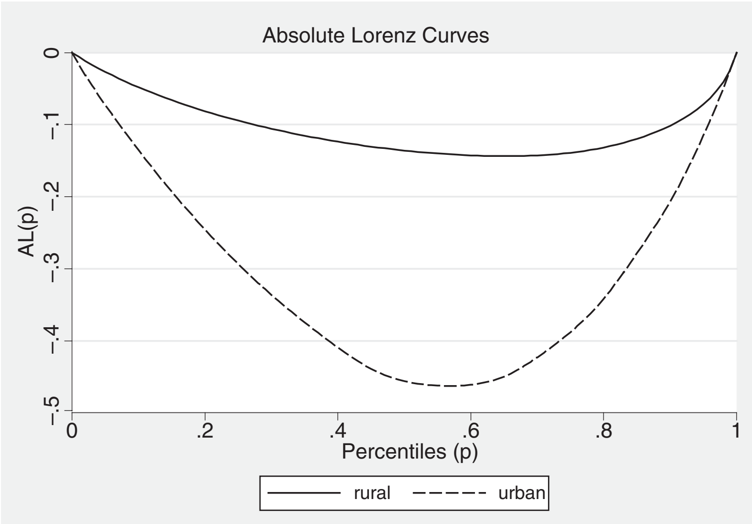

Fig. 11 Absolute Lorenz curve for assets in rural and urban areas

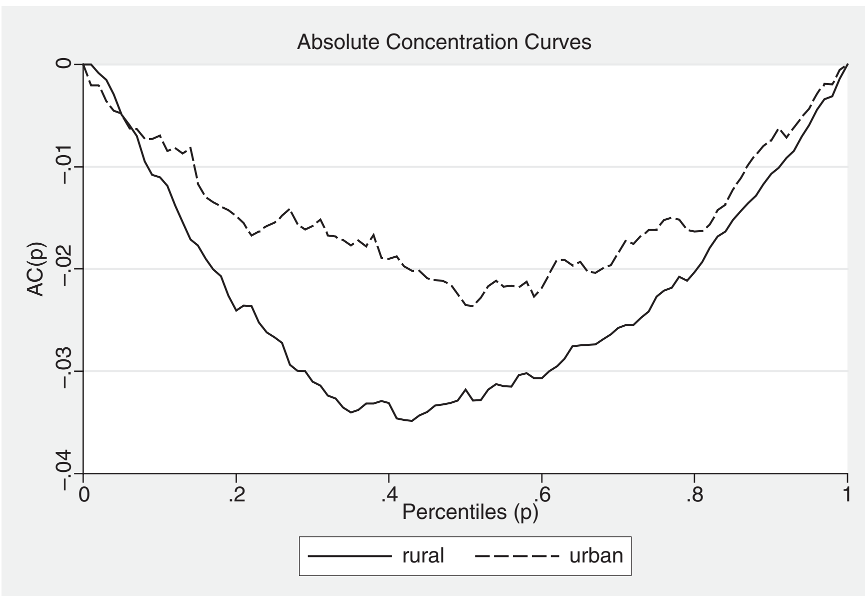

Fig. 12 Absolute concentration curves of the probability of child survival: rural and urban groups

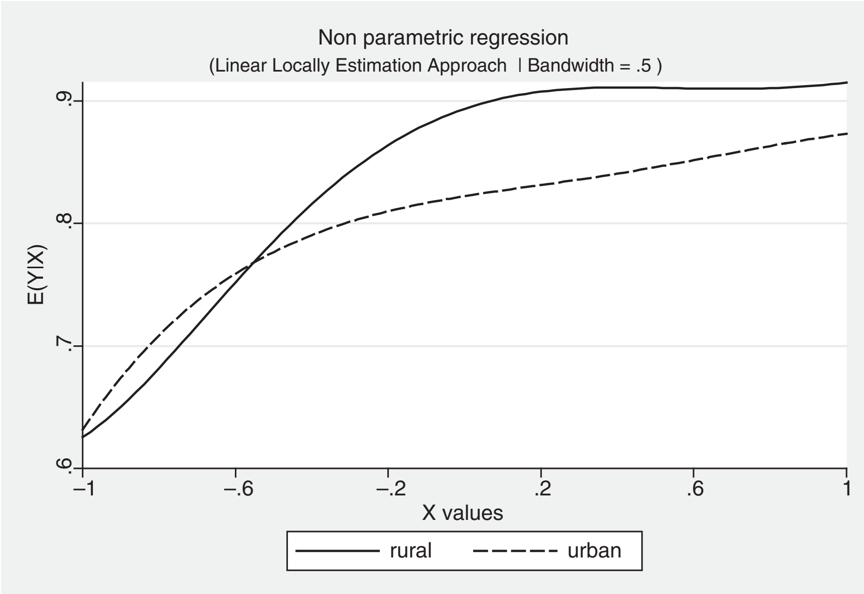

Fig. 13 Linkage between assets and probability of child survival: rural and urban areas

the choice of the poverty line in multidimensional poverty comparisons. The results (Fig. 13) suggest that the probability of child survival is positively linked with assets, but that assets are a much more important determinant of mortality in rural than in urban areas. The results further suggest that assets are more important for the very poor than for the less poor groups. Figure 14 shows the slopes of the curves presented in Fig. 13.

4.3 Correlates of Childhood Mortality

To investigate the correlates of under-five mortality, we estimate models for the full sample and break the sample further into rural and urban areas of residence and then into gender of the child. For the full sample, we estimate five variants of the basic mortality regression (Table 14). The second column of the table presents the basic model, column three presents the basic model plus the time trend variables, while column four presents the variant omitting time trend, but introducing GNP, health expenditure, and health facilities. Column five presents a variant omitting time trend GNP and health expenditure and facilities, but introducing district-level health-care variables. The introduction of the district health-care averages reduces the number of observations from 38,733 to 27,035 because the information on health care is only available for children born up to 5 years before the survey. The last column presents a variant of the basic model, but introduces a variable that captures the period between birth of a child and the survey year. The results for the basic model

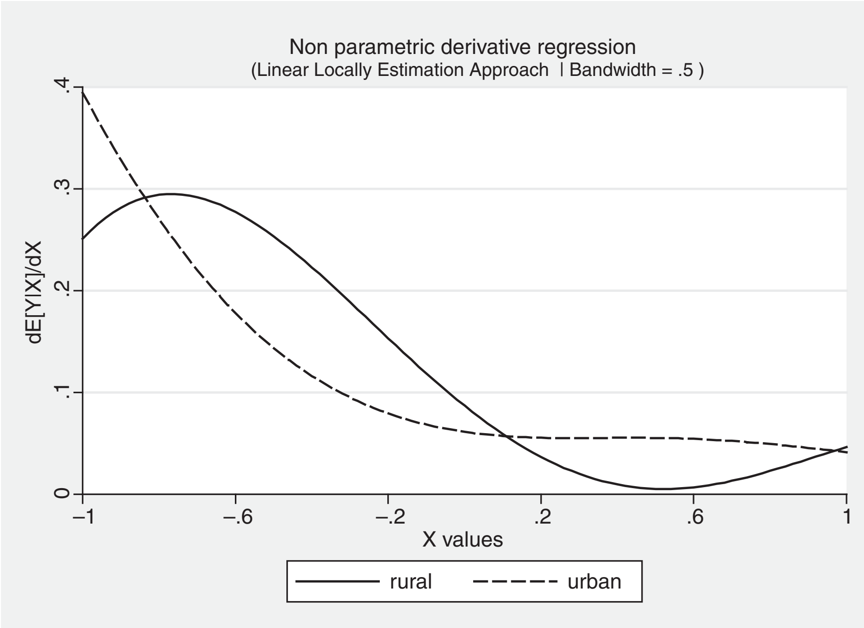

Fig. 14 Derivatives of non-parametric regression curves

Table 14 Weibull model estimates for under-five mortality: full sample

	Model 1	Model 2	Model 3	Model 4	Model 5
No of women 15–49 in household	0.9719	0.992	0.9862	0.9933	1.0003
	[0.85]	[0.24]	[0.42]	[0.20]	[0.01]
Log asset index	0.7556	0.6464	0.7122	0.6439	0.6846
	[1.72]*	[2.58]***	[2.05]**	[2.61]***	[1.90]*
Public tap	1.0064	1.0456	1.0134	1.0481	1.1535
	[0.08]	[0.55]	[0.16]	[0.58]	[1.51]
Piped water in residence	1.0951	1.143	1.1047	1.144	1.2332
	[0.94]	[1.36]	[1.03]	[1.38]	[1.82]*
Other water	1.0499	1.0539	1.0536	1.0556	1.0996
	[0.36]	[0.39]	[0.38]	[0.40]	[0.62]
Well water	0.9919	1.0134	0.9937	1.0122	1.0856
	[0.14]	[0.22]	[0.11]	[0.20]	[1.17]
Flush toilet	0.8831	0.9451	0.9014	0.9484	0.935
	[0.77]	[0.35]	[0.65]	[0.33]	[0.36]
Other toilet	1.1578	1.1268	1.1492	1.1248	1.1216
	[2.21]**	[1.80]*	[2.09]**	[1.78]*	[1.44]
Gender of child dummy: 1 = male	1.1352	1.1322	1.1332	1.1328	1.1266
	[3.29]***	[3.21]***	[3.24]***	[3.23]***	[2.56]**
Child is first birth	7.5068	9.854	9.9471	9.6712	8.3091
	[2.38]**	[2.68]***	[2.72]***	[2.65]***	[2.05]**
Child is of multiple birth	3.0933	3.0783	3.1113	3.0736	2.8953
	[12.14]***	[11.92]***	[12.22]***	[11.93]***	[8.98]***
Mother is primary graduate	0.6368	0.6472	0.6383	0.646	0.6307
	[4.95]***	[4.79]***	[4.93]***	[4.81]***	[4.22]***

Table 14 (continued)

	Model 1	Model 2	Model 3	Model 4	Model 5
Mother has secondary education or higher	0.5983	0.6098	0.5989	0.6082	0.5553
	[4.29]***	[4.13]***	[4.30]***	[4.16]***	[4.55]***
Mother's age at child's birth	0.8623	0.8636	0.8651	0.8626	0.8678
	[4.94]***	[4.92]***	[4.83]***	[4.94]***	[3.98]***
Mother's age at child's birth squared	1.0025	1.0024	1.0024	1.0024	1.0023
	[4.91]***	[4.71]***	[4.67]***	[4.73]***	[3.89]***
Mother's age/first-born interaction	0.8042	0.7828	0.7828	0.784	0.7925
	[2.87]***	[3.20]***	[3.25]***	[3.18]***	[2.53]**
Mother's age/first-born interaction squared	1.0051	1.0057	1.0057	1.0057	1.0056
	[3.00]***	[3.33]***	[3.39]***	[3.31]***	[2.73]***
Mother's height in cm	0.9908	0.9902	0.9908	0.9902	0.9888
	[2.86]***	[3.06]***	[2.88]***	[3.07]***	[2.87]***
Use of modern contraception (cluster average)	0.3871	0.3816	0.3924	0.3818	0.3664
	[5.32]***	[5.40]***	[5.21]***	[5.39]***	[4.93]***
Nairobi	1.8747	1.8368	1.8458	1.8307	2.0217
	[3.56]***	[3.46]***	[3.47]***	[3.45]***	[3.39]***
Central	0.8806	0.889	0.8811	0.8888	1.0118
	[0.99]	[0.92]	[0.99]	[0.92]	[0.08]
Coast	1.4531	1.4302	1.4374	1.4298	1.2883
	[3.86]***	[3.67]***	[3.77]***	[3.67]***	[2.29]**
Eastern	1.1592	1.1816	1.1556	1.1825	1.2046
	[1.71]*	[1.95]*	[1.67]*	[1.96]*	[1.84]*
Nyanza	3.0044	3.0329	3.0041	3.0291	2.9272
	[13.50]***	[13.64]***	[13.36]***	[13.63]***	[11.64]***
Western	1.9934	2.0202	1.984	2.0207	2.0357
	[8.27]***	[8.62]***	[8.20]***	[8.64]***	[7.05]***
Time trend		0.4711			
		[1.94]*			
Time trend squared		1.0186			
		[1.91]*			
Time trend cubed		0.9999			
		[1.81]*			
Years between birth and survey date			0.9728		
			[4.88]***		
Log GNP per capita				1.1199	1.0587
				[0.85]	[0.29]
Log health expenditure per capita				1.1248	1.2129
				[0.80]	[0.98]
Number of hospitals per 100,000 population (provincial estimate)				0.9828	1.0439
				[1.33]	[0.63]
Year/district average, all vaccinations					0.8453
					[1.46]
Year/district average, any professional birth attendant					0.6138
					[2.70]***
Year/district average, any prenatal care					2.218
					[2.14]**
Year/district average, tetanus toxoid					0.9608
					[0.11]
Observations	38,733	38,733	38,733	38,733	27,035

Robust *z* statistics in brackets – *significant at 10%; **significant at 5%; ***significant at 1%.

and the variants differ in terms of the goodness of fit. Though the new variables affect the overall fit of the model, all models fit the data better than the intercept-only model.

The results presented are the hazard ratios estimates and the respective z statistics. The hazard ratios can be interpreted as follows: if the ratio is equal to 1, the estimated coefficient is equal to zero and thus the explanatory note has no impact on the probability of childhood mortality. If the hazard ratio is less than one, the coefficient is negative and reduces mortality by the difference between 1 and the coefficient. For example, if the ratio is 0.5, an increase in the regressor in question by 1 will lower the probability of mortality by 50%. If the ratio is greater than 1, the regressor is positively correlated with mortality.

4.3.1 Child Characteristics

All child characteristics included in the model are positively correlated with mortality. Boys have higher hazard rates, *ceterius paribus,* than girls (i.e., boys have higher conditional death rates and hence lower survival times). The estimates further show that at each survival time, the hazard rate for boys is 13% higher than the hazard rate for girls. All results for dummy variables can be interpreted this way. First-born children are more likely to suffer mortality than other children, while children of multiple births have a remarkably higher mortality rate than children of single births.[15] Compared to other variables in the model, first-born children and twins have exceptionally huge impacts on mortality.

4.3.2 Mothers' Characteristics

Mother's education has a large, significant impact in reducing the risk of childhood mortality. A surprising result is that compared to no education, completion of primary schooling reduces the hazard rate by a much larger proportion than completion of secondary education. The hazard ratio for mother's age at child's birth suggests that an increase in mother's age lowers the hazard of mortality, though the quadratic term suggests higher hazards for children born of more elderly women. Predicted mortality rates at each year of mother's age at birth of a child suggests that each year of the mother's age at the child's birth on average lowers the hazard of mortality by about 0.1%. Since the highest mortality rates are observed for the age set 15–24 years, this result implies that delaying births – particularly teenage births – would lower childhood mortality in Kenya. To test for the expected impact of mother's age at first birth, we introduce an interaction term of mother's age with a dummy

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[15] Studies on fertility argue that multiple births may not be purely exogenous because women with high fertility are more likely to experience a twin birth. For this reason, such studies recommend the use of first-born twins or ratio of twins to total births as experiments to instrument fertility. There is no evidence that twins may be endogenous to mortality. Either way, we try to use twins at first birth and the results are robust with the use of any multiple birth, except for urban areas where the number of observed first born twins is too small.

variable for first-born children. The impact of the variable shows a similar pattern with mother's age but the hazard rates are much lower for the linear term and twice as much for the quadratic term. However, the relationship is not constant across age and birth order. Children born of tall mothers are less likely to die than children born of shorter mothers, though the impact is quite small (1%). This is probably due to the positive correlation between mother's height and the children's nutrition, holding genetics constant (Kabubo-Mariara et al., 2006). The results for mother's characteristics are consistent with literature on mortality rates, which indicates that these variables play a crucial role in reducing mortality.

4.3.3 Household Characteristics

The coefficient of the asset index variable shows the expected negative correlation between level of well-being and childhood mortality in the first three models. The impact is large and significant, suggesting that an increase in a household's level of assets by 1 unit would lower the probability of childhood mortality by between 24 and 36%. Since we use the log of asset index, the hazard rate represents a semi-elasticity of childhood mortality with respect to assets.

We do not uncover any significant impact of water supply and sanitation on childhood mortality. In fact, most of the dummies have an unexpected positive impact, suggesting that controlling for other factors, water and sanitation conditions may be positively correlated with mortality. While this finding may be surprising, it is consistent with studies on mortality and child nutrition using DHS data (see for instance Ssewanyana and Younger, 2005; Kabubo-Mariara et al., 2006; Rutstein, 2000). These results could be due to unobserved attributes of water and sanitation. For example, microbiological examination of samples of water may probably be useful to test for the levels of environmental contamination in each of these sources (Strauss and Thomas, 1995). The unexpected results could also be due to the possibility of unobserved correlation between these variables and other household, cluster, and district-level characteristics.[16] Presence of other toilets relative to latrines is positively correlated with mortality as would be expected. When we do not control for other factors that affect mortality (Table 15), the results show that water and sanitation variables have the expected impact of reducing the hazard ratio. Compared to availability of surface water (e.g., from river), water supplied through public taps and from wells have a small, insignificant mortality-reducing impact. Availability of privately piped water and other water sources (such as bottled water) reduce the probability of mortality by 34 and 23%, respectively. Relative to latrines, flush toilet in residence reduces the risk of mortality by 25%. Other toilets (flying toilets/bush toilets) increase the risk of mortality by 48%.

[16] Examination of possible collinearity between the environmental variables and other explanatory variables suggests however that there is no serious correlation problem as all the correlation values are less than 0.5 (see separate appendix accompanying this report).

Table 15 Impact of water and sanitation on for under-five mortality: Weibull model

	Hazard ratio	Robust standard error	z	$P > z$
Public tap	0.9401	0.0734	−0.79	0.429
Piped water in residence	0.6669	0.0605	−4.47	0.000
Other water	0.7683	0.0893	−2.27	0.023
Well water	0.9545	0.0579	−0.77	0.443
Flush toilet	0.7319	0.0853	−2.68	0.007
Other toilet	1.4811	0.1011	5.75	0.000
Observations		48,772		

4.3.4 Cluster-Level Variables

The cluster share of women using a modern method of birth control at the time of the survey is included as a proxy for the availability of health-care services. Controlling for other factors, this variable has a very large, significant impact in terms of lowering the probability of childhood mortality. An increase in the share of mothers using modern contraception by 1 would reduce childhood mortality by close to 60%. Contraception plays an important role in health care through reduced fertility, birth spacing and also the prevalence of HIV and other sexually transmitted diseases (through condom use, specifically). This suggests the importance of health care in child survival and thus calls for reorienting health-care interventions in order to intensify the fight against childhood mortality. Mother's knowledge of oral rehydration was dropped from the model because it was highly correlated with mother's education.

4.3.5 Regional Dummies

The results for the regional dummies suggest that relative to Rift Valley province, all provinces except Central are likely to suffer higher childhood mortality. The impacts are significant for all provinces. The magnitudes of the hazard ratios indicate that consistent with descriptive statistics, Nyanza province appears to be at highest risk for childhood mortality followed by Western and Nairobi provinces.

4.3.6 Macro-Level Variables

The results discussed above are consistent across all the variants of the basic model. In model 2, we introduce the time trend variables. The hazard ratios suggest unexplained trend fluctuations in mortality up to the third-level polynomial. The hazard ratio of the level is quite low, compared to the quadratic and cubed terms. Predicting the hazards of mortality for each trend value suggests that mortality increased by about 2.5% between 1978 and 2003. This implies that on average, mortality rose by about 0.1% per year due to unexplained trend variations.

As explained in the methodology section, one weakness of the data we have used is that some explanatory variables are available only at the time of the survey, while we have information on mortality for up to 15 years prior to the survey (Model 3).

We check on the appropriateness of using long lags for mortality by introducing a variable for the number of years between the relevant survey and the year when a child was born.[17] The coefficient for this variable could be interpreted as the trend in childhood mortality for years before the survey, controlling for other regressors. The coefficient for this variable is statistically significant and suggests that an increase in the years before the survey by one biases mortality downwards by less than 3%. Since this model does not include a time trend, this variable probably also picks up the generally increasing trend in U5MR in Kenya.

A further test of the appropriateness of creating the long lags is done by interacting all the policy-relevant explanatory variables in model 3 with the variables for years before the survey. The results indicate that: first, the coefficients and significance of policy-relevant variables generally remain the same, and; second, only the interaction term with the asset index variable is marginally significant at the 10% level. While the first result suggests that there is no problem with generating long lags for mortality, the second suggests that assets may have grown over time, which therefore leads us to overestimate assets in the distant past by using current values. However, as shown later in the simulation section, assets grew by a rather insignificant rate over this period, and therefore any bias that may be present would be insignificant. A last test carried out was to reduce the estimation sample to cover only the survey period (5 years before the date of the survey). The results obtained were quite close to the results with long lags, suggesting that there are no serious biases arising from using the generated time series data.

In model 4, we introduce GNP per capita and health expenditure and facilities. We drop most facilities due to collinearity and retain only hospitals (for illustration purposes only). Health expenditure and GNP have positive but insignificant coefficients implying that growth in GNP and in health expenditure are likely to be associated with higher mortality. The results are puzzling. From the literature, one would expect to find none or at the least a weak negative correlation between mortality and GNP, and would expect increased health expenditures to reduce mortality. Though one may expect the results to be due to unobserved correlation between health expenditure and GNP, alternative models using share of health expenditure to GNP, or the share alone, or GNP alone, still yield a positive impact.

Two points should be noted here: first, the results seem to be consistent with what is happening at present in Kenya. While economic growth is rising, the health indicators show declining trends. Second, the declining mortality could be due to factors not controlled for in the model. For instance, HIV/AIDS will lead to increasing childhood mortality even as GNP and share of health to GNP rises. The unexpected results for both GNP and health expenditures are however not uncommon in the literature (see for instance Matteson et al., 1998; Ssewanyana and Younger, 2005).

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[17] If some women who died between a given year and the survey date, and were thus not surveyed, also had children more likely to die (most frail children could have died before the survey), then their exclusion from the sample would cause a downward bias in the estimated mortality rate for years before the sample, and that bias should be greater with longer lags (Strauss and Thomas, 1995; Ssewanyana and Younger, 2005).

These results could also be due to endogeneity of health-care facilities arising from program placement bias. If for instance the government chooses to construct health-care facilities in areas where child health is poorest, then the coefficients of the health-care facilities will be biased downwards. That is, the health-care facilities will be correlated with poor child health (Pitt et al., 1995). However, the Kenyan health-care services do not work this way. Though there may be increased expenditure allocations in areas of poor health, location of facilities may be pegged more on population density rather than prevalence of health problems and is thus exogenous to health problems. Hospitals per 100,000 persons have a small, insignificant impact of reducing mortality.

4.3.7 District Characteristics

Model 5 includes district average health indicators for children and their mothers. We investigate the impact of a child having received all vaccinations (district averages), whether a child's mother received a tetanus toxoid injection during her pregnancy with that child, and whether she received any prenatal care and birthing assistance from a health professional. The results suggest that vaccination of children and their mothers have the expected impact of reducing mortality, but the impacts are insignificant. Birthing assistance by a professional has a huge mortality-reducing impact (Rutstein, 2000). Holding other factors constant, an increase in the proportion of mothers in a district receiving birthing assistance from a professional by one would reduce the risk of mortality by 39%. Prenatal care by a professional has the unexpected impact of increasing the risk of mortality. This is probably due to the possible correlation between this variable and the other proxies for availability of health-care services included in the model. A district where, say, birthing assistance by a professional is high is also likely to have more general health care than a district with low birth care attendance. Birthing assistance may therefore be capturing the impact of the general state of health care in a district. This may also explain the insignificance of vaccination of mothers with tetanus toxoid. Our results therefore suggest that most health-care variables are important factors in reducing the risk of mortality. The insignificance of health-care facilities implies that it is the quality of care and availability of drugs at these facilities, rather than the facilities *per se*, that matter in reducing mortality.

For regional and gender analysis, we focus on the basic model but include a rural area dummy for the gender models (Table 16). The results for rural areas are generally consistent with those of the full model, while most variables in the urban model are insignificant. This is probably due to the relatively fewer number of observations in urban areas compared to rural areas. The key result to note in the regional models is that presence of more adult women in urban areas increases the risk of mortality in urban and not in rural areas, while boys are at a higher risk of mortality in urban compared to rural areas.

Turning to the gender model, the results show that most explanatory variables are more important and significant determinants of the risk of mortality for girls than for boys. However, though all first-born children are at a higher risk of mortality than all

Table 16 Weibull model estimates for under-five mortality: area of residence and gender of child

	Rural	Urban	Boys	Girls
No of women 15–49 in household	0.9996	1.1279	1.0074	1.0277
	[0.01]	[1.69]*	[0.16]	[0.56]
Log asset index	0.6632	1.0357	0.7161	0.8425
	[1.78]*	[0.13]	[1.36]	[0.73]
Public tap	1.0115	1.3045	0.9373	1.0665
	[0.09]	[0.91]	[0.48]	[0.48]
Piped water in residence	0.8596	1.3425	0.9924	0.8456
	[1.05]	[0.86]	[0.05]	[1.14]
Other water	0.8065	1.3453	0.9886	0.6652
	[1.29]	[0.83]	[0.07]	[1.89]*
Well water	1.0155	1.0206	1.0572	0.9552
	[0.19]	[0.05]	[0.60]	[0.41]
Flush toilet	1.1495	0.7697	0.8046	1.2759
	[0.34]	[1.29]	[1.01]	[0.99]
Other toilet	1.0621	1.3667	1.0424	1.1968
	[0.63]	[1.27]	[0.36]	[1.68]*
Gender of child dummy: 1 = male	1.0857	1.4246		
	[1.62]	[2.95]***		
Child is first birth	25.8108	0.4103	3.5765	14.1714
	[2.99]***	[0.47]	[0.90]	[2.07]**
Child is of multiple birth	2.8389	3.5378	2.7353	3.1516
	[8.03]***	[4.42]***	[6.67]***	[7.59]***
Mother is primary graduate	0.7361	0.4836	0.6997	0.666
	[2.53]**	[3.63]***	[2.66]***	[2.75]***
Mother has secondary education or higher	0.6706	0.3186	0.5558	0.5482
	[2.90]***	[5.09]***	[3.52]***	[3.48]***
Mother's age at child's birth	0.8643	0.9279	0.8857	0.8426
	[3.85]***	[0.75]	[2.74]***	[3.57]***
Mother's age at child's birth squared	1.0024	1.0009	1.002	1.0028
	[3.77]***	[0.50]	[2.71]***	[3.36]***
Mother's age/first-born interaction	0.7153	1.0093	0.8523	0.7649
	[3.43]***	[0.06]	[1.30]	[2.37]**
Mother's age/first-born interaction squared	1.0078	1.0007	1.0041	1.0059
	[3.53]***	[0.22]	[1.52]	[2.34]**
Mother's height in cm	0.995	1.0093	1.0008	0.9923
	[1.16]	[0.92]	[0.18]	[1.30]
Year/district average, all vaccinations	0.4677	0.968	0.4932	0.5184
	[7.45]***	[0.14]	[5.58]***	[4.93]***
Year/district average, any professional birth attendant	0.6934	0.8233	0.7906	0.6396
	[2.17]**	[0.52]	[1.19]	[2.11]**
Year/district average, any prenatal care	0.9604	0.5789	0.7502	1.2596
	[0.12]	[0.56]	[0.69]	[0.46]
Year/district average, tetanus toxoid	3.1428	0.4143	3.2509	2.0057
	[3.15]***	[1.03]	[2.29]**	[1.47]
Cluster average, use of modern contraception	0.2347	0.6531	0.2676	0.2675
	[5.21]***	[0.91]	[4.73]***	[4.46]***
Rural			0.6978	1.0273
			[2.83]***	[0.18]
Observations	22,272	4,763	13,541	13,494
Robust z statistics in brackets				

*Significant at 10%; **significant at 5%; ***significant at 1%.

other children, first-born girls are at very high risk compared to boys. This is further supported by the interaction of mother's age and first born. Birthing assistance by a professional reduces the risks of mortality for girls by 36% but by only 21% for boys. The impact is only significant for girls. The coefficient for the dummy variable for rural areas has reversed signs for the two models. Boys in rural areas are at lower risk of mortality (30%), which is statistically significant. Girls on the other hand are at a 3% higher risk of mortality if they are from rural areas, but the coefficient is not significant.

4.4 Policy Simulations for Economic Recovery Strategies and Millennium Development Goals

Two policy documents provide the framework for implementation of child-focused poverty policies in Kenya. These are the economic recovery strategy[18] – ERS (Republic of Kenya, 2004) and the millennium development goals (MDGs). Though the welfare of children is not addressed in isolation of broad poverty reduction measures in the ERS, some of the interventions have direct implications on child survival while others are indirect through impacts on maternal and household well-being. The MDGs are more specific in terms of child-focused policies. The ERS targets for child health were to reduce under-five mortality from 115/1000 in 2003 to 100/1000 by 2008 and to increase the proportion of fully immunized children from 74 to 85%.[19] Consistent with the ERS, the relevant MDG goal is to reduce child mortality, with a specific target of reducing by two-thirds the under-five mortality rate between 1990 and 2015.

In this section, we use the Weibull model results to simulate the impact of relevant policy variables on reducing under-five mortality and therefore test the likelihood of Kenya achieving the ERS and MDG targets. The results obtained suggest that mortality is unlikely to fall over time, given the diminishing rate of change of the trend variables. This means that it is important to put more policy emphasis on variables that show potential for reducing mortality. At the national and regional levels, the relevant policy variables that would in theory be expected to reduce mortality (GNP, health expenditure, and health facilities) turned out to be unimportant. This makes it difficult for us to make any meaningful policy simulations with these variables. Some of the other explanatory variables that do have significant effects in reducing the probability of mortality include household assets, maternal education, and access to health-care variables (Table 14). We simulate the expected impact of changes in policies affecting these variables on mortality reductions for both the ERS and MDG target levels. We use the variable means and the estimated coefficients of model 5

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[18] The Economic Recovery Strategy Paper (ERS) was designed in 2003 to implement the Poverty Reduction Strategy Policies and the Government's development agenda to restore economic growth and reduce poverty through employment and wealth creation.

[19] A separate appendix of this paper reviews the conceptualization of child poverty and recent policy interventions for child welfare and survival in Kenya.

(Table 14) to simulate the impact of a given change in an explanatory variable on the hazard rate ratio and thus on mortality.[20]

4.4.1 Improved Household Well-Being

As noted elsewhere in this chapter, assets are used as a proxy for household resources or a measure of well-being in the absence of an income or expenditure measure. The estimated elasticity of mortality with respect to assets implies that growth in assets may be expected to significantly reduce mortality. Still, the question is whether the expected reduction would have a significant contribution toward achievement of ERS and MDGs. To answer this question, we compute the annual rate of growth in the asset index over the decade covered by the three surveys. The annual rate of improvement is very minor at only 0.5% per year. We project this increase from 2003 (time of last survey) to 2008 (ERS target) and from 2003 to 2015 for the MDGs. The results show very low mortality reductions at only 2 and 3 children per 1,000 live births for the ERS and MDGs periods, respectively. These simulations imply that holding other factors constant, the current rate of improvement of household well-being is too low to help the country achieve both the ERS and MDGs targets for childhood mortality.

We posited whether if the situation would be less bleak, the household well-being was to grow at a faster rate. The target rate of growth of GDP to achieve the MDGs is 7%. The asset index cannot grow as fast as GDP because it is not scaled in money terms, like incomes, but is expressed in a -1 to 1 scale rather than in Kenya shillings. While we have estimated a 0.5% growth rate in assets from 1993 to 2003, GDP is estimated to have grown by about 1.9% over the same period. For the country to achieve the desired 7% GDP growth rate, then this rate of 1.9% must grow by a multiple of about 3.5. If we apply this multiple to asset growth, then we would expect assets to grow at an annual rate of only 1.75% by the year 2015. This alternative simulation shows that a 1.75% annual rate of improvement in household well-being would have resulted in a reduction in mortality by only 3 and 4 per 1,000 live births by 2008 and 2015, respectively, still not good enough for the achievement of the respective targets.

4.4.2 Improved Maternal Education

Most maternal characteristics have been found to reduce child mortality, malnutrition, and improve education. Thus, any policy that improves maternal welfare will improve child welfare. Unfortunately, most of these characteristics (e.g., age and height) cannot be influenced by policy. However, policy can be used to influence

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[20] Since the estimated model is nonlinear, we carry out simulations for each observation in the estimation sample and then find the average impact on the mortality risk. If we define the mortality hazard as $Y = \alpha + \beta X$, the new mortality hazard resulting from a change in X is given by $Y^1 = \alpha + \beta X^1$, where a $Y^1$is the new probability of death resulting from a change in the policy variable from X to X^1.

maternal education, and thus reduce childhood mortality in the long term. In addition to the MDGs target of achieving universal primary education by 2015, the third MDG focuses on the promotion of gender equality and women empowerment as effective ways to combat poverty, hunger, and disease, and to stimulate development that is truly sustainable. The policy target is to eliminate gender disparity at all levels of education no later than 2015.

We simulate the impact of two policy changes. First, if all mothers were to have complete primary education by 2015, childhood mortality would decline by 4 per 1,000 live births. Kenya adopted universal primary education (UPE) in 2003. Thus, the children who enrolled for primary education under UPE will complete primary education in 2011 and secondary education in 2015 – the MDG target year. If all girls enrolled for primary education with the UPE, and assuming 100% completion rates, then Kenya would have to wait for close to two decades (for these girls to mature into motherhood) to enjoy this mortality reduction. For secondary and higher levels of education (we combine these two categories because the latter has relatively few observations), we simulate the impact of raising completion rates to the primary school level. In the sample, 43% of the women had graduated primary compared to only 23% who had some secondary education or higher. The results show that raising the proportion of the secondary women graduates to 43% would reduce childhood mortality by 12 per 1,000 live births. This result affirms the importance of maternal education in improving children's health and shows that targeting women through secondary and post-secondary education would make an enormous contribution toward the achievement of MDGs.

4.4.3 Improved Health Care

Childhood mortality declined rapidly in Kenya between the 1970s and the 1990s, but saw a reversal thereafter. Immunization rates also started slipping during the late 1990s. Children aged 12–23 months receiving full vaccination against vaccine preventable diseases fell from 65% in 1998 to 60% in 2003 (UNDP et al., 2005). Holding other factors constant, increased immunization coverage can help reduce mortality from immunizable diseases. The ERS target to increase the proportion of fully immunized children from 60% in 2003 to 85% in 2008, while the MDGs target 80% coverage by 2015. Our simulations show that if Kenya is to achieve 100% immunization coverage, the country would reduce childhood mortality rates by only 6 per 1,000 live births. Increased vaccination would therefore contribute toward the effort, but not assure achievement of the ERS and MDGs targets. Simulations of the impact of achieving 100% tetanus toxoid injections for pregnant women show that this has no impact on childhood mortality.

One strategy toward achieving the MDG target of reducing the neonatal and maternal mortality ratio is to significantly raise the proportion of births assisted by skilled health personnel. Yet, this proportion is estimated to have declined from 51% in 1989 to 42% in 2003. The policy documents do not have specific targets for reducing child mortality. However, the estimated hazard rate ratios suggest that birth care by a professional would have a large mortality-reducing impact. Estimates of district-level attendance of births by a professional (nurse, midwife, or doctor) suggest high levels of inequality, with at least 1% of the districts having no professional care at all. Our simulation focuses on ensuring that birthing care is available in the districts with the lowest level of coverage. We therefore give each of the districts that are below the mean the average sample coverage of 44%, which would in effect raise the sample mean from 44 to 53%. The simulation results support the estimated hazard rate ratios and suggest that such a policy change would reduce childhood mortality by 4 per 1,000 live births. Though this reduction may look small, it illustrates the potential impact if Kenya was to achieve 100% birth attendance by a professional.

The use of modern contraceptive methods has remained quite low in Kenya with a contraceptive prevalence rate of about 32% over the survey decade. There is still unmet demand (almost 40%) and persistent contraceptive stock-out. Yet, the estimated hazard rate ratios show that contraception plays a large, significant role in reducing childhood mortality, other factors being constant. In birth care, for example, we focus on clusters with below average coverage of 30% in the estimation sample. The simulations suggest that if all these clusters were to achieve at least 30% coverage of mothers with modern contraception methods, childhood mortality would decline by 7 per 1,000 live births. Even with this change however the average coverage would still be very low (37%). The province with the highest cluster-level coverage over the survey decade was Central province with 46%. Suppose family planning campaigns were intensified so that we can push the lowest clusters to the Central province coverage. Such a change would raise the mean coverage to 48% and would reduce mortality by 16 per 1,000 live births. This again suggests that boosting use of modern contraception would have a huge impact on child survival.

Is Kenya Likely to Achieve Her MDG Goal of Reducing by Two-Thirds Its Under-Five Mortality Rates by 2015? In 1990, under-five mortality in Kenya was estimated at 97 per 1,000 live births. However, by 2003, this rate had risen to 115/1000 (UNDP et al., 2005). This means that evaluation of the MDG target is more realistic based on the 2003 than the 1990 mortality rate. This requires a mortality reduction of 77/1000 ($115 - (0.67 \times 115)$). The policy simulations presented in this chapter focus more on what we consider realistic scenarios rather than the best possible policy scenarios. The results suggest that though there is potential of making some progress, the MDG target cannot be achieved. Even if all the simulated impacts were to be achieved by 2015, there would still be a shortfall of 42 per 1,000 live births (Table 17). We would argue that all the simulated policy scenarios are long term rather than short term, holding constant the availability of program financing. In education, even if the government is to introduce universal secondary education today, the immediate impact of such a policy change would be on children already enrolled in school, and the expected impact on mortality would only be felt once this cohort enters motherhood. On the health front, improving use of modern contraception and birthing assistance would have significant impacts on child survival, but there exists issues of access and equity in service provision. Socio-cultural factors, information asymmetry, and other barriers would need to be addressed if improvements are to be made in clusters/districts with very low coverage.

Table 17 Simulated reductions in childhood mortality rates in Kenya

Policy change	Predicted reduction in mortality[a]	Under-five mortality (2003)	MDG target reduction
Increase household assets at present rate by 2015	2 per 1,000 (0.061)		
All mothers complete primary education	4 per 1,000 (0.060)		
Increase the proportion of mothers who complete secondary education from 23 to 43%	12 per 1,000 (0.063)		
Give all districts with below mean (%) birth assistance by a professional the mean level	4 per 1,000 (0.054)		
Give all clusters with below mean (%) use of modern contraception the mean level	7 per 1,000 (0.045)		
Increase vaccination rates for all children to 100%	6 per 1,000 (0.060)		
Total	35 per 1,000	115 per 1,000	77 per 1,000

[a]Standard errors in parenthesis.

5 Summary and Conclusions

This chapter addresses the issue of child survival in Kenya and uses three rounds of DHS data for the period 1993–2003 to construct a national time series for childhood mortality over a longer period of time (1978–2003). This is supplemented by secondary data for macro- and regional-level variables. The chapter focuses on three key tasks. First, we carry out multidimensional poverty and inequality comparisons for the probability of child survival ranked by the asset index. Second, we use hazard functions to analyze the determinants of childhood mortality. Third, we use the estimated hazard rates to simulate the impact of key policy variables on the possibility of achieving ERS and MDG targets for childhood mortality.

The first task gave some insightful results on the distribution of childhood poverty in Kenya. Poverty decompositions of the probability of child survival suggest that only 28% of children in rural areas are poor, compared to 19% in urban areas. The results further indicate that the relative contribution of rural areas to child poverty is 89% while the contribution of urban areas is only 11%. Further, FGT curves for child mortality suggest that children from households that did not experience mortality dominate children from households that experienced mortality in poverty. Nairobi dominates all other regions but there is no dominance between the other regions. At the lowest end of the distribution, Central province is less poor than all other regions except Nairobi and the poorest children are from Coast region.

Bivariate poverty dominance analysis shows that children with the lowest probability of survival are from households with the lowest level of assets. Density curves for childhood mortality suggest that at very low levels of assets, poor households are more likely to experience child death than at higher levels of assets, but there is no evidence of stochastic dominance in the distribution of childhood mortality. Bi-dimensional dominance analysis by area of residence shows that urban areas dominate rural areas by the two indicators of well-being. Analysis by region shows that Central province dominates all other provinces except Nairobi, but there is no clear dominance of poverty between the other provinces. The results further show that the poverty orderings are robust to the choice of the poverty line and to the measure of well-being.

Inequality analysis suggests that there is less mortality inequality within children facing mortality than the better off children. Rural areas dominate urban areas in inequality and the difference is statistically significant at the 5% level. The lowest and largest contributions to mortality inequality come from Nairobi and Nyanza provinces, respectively. The absolute Lorenz curves suggest that inequality in assets is pronounced, while the absolute concentration curves indicate that child survival probability is progressive. The results suggest that both inequality and progressivity are relatively higher in urban areas than in rural areas.

Non-parametric regression of the probability of child survival by asset index suggest that the probability of child survival is positively linked with assets, but that assets are a much more important determinant of mortality in rural than in urban areas and for the very poor relative to the less poor groups.

The estimated hazard rates for childhood mortality show that a number of variables included in the model are important and significant determinants of child survival. The results show that boys, first borns, and children of multiple births face a higher risk of mortality than the respective reference groups. Maternal education significantly lowers the risk of mortality, while age variables suggest the importance of reducing teenage births. The results further suggest high elasticity of mortality with respect to assets. An increase in assets by 1% would lower mortality by between 24 and 36%. When we control for other factors, we do not uncover any impact of water and sanitation, except for lack of toilets. When we do not control for other factors, we find that water and sanitation are important and significant determinants of mortality. Controlling for other factors, cluster-level use of modern contraception has a large significant impact of reducing the risk of mortality.

Relative to Rift Valley, all provinces except Central are likely to suffer higher childhood mortality. We also find that there are unexplained macroeconomic variations that reduced the risk of mortality at a diminishing rate between 1978 and 2003. We uncover no important impact of macro- and regional-level variables (GNP, health expenditure, and health facilities) on mortality. District-level health-care services are important factors for lowering the hazard rates of mortality, more-so birthing assistance by a professional.

The policy simulations focused on the impact of changes in household assets, maternal education, and access to health-care services on mortality reductions. The results do not hold much promise for achievement of ERS and MDG targets, but show that these policy variables can make some contribution. Assets grew at a very low rate over the survey decade. Projecting this growth to the ERS and MDG target years suggest very modest reductions in mortality at only 2 and 3 children per 1,000 live births for the ERS and MDGs periods, respectively. Further simulations show that even a higher rate of growth in assets would not make a significant reduction in child mortality, *ceteris paribus.*

For maternal education, if all mothers were to have complete primary education by 2015, childhood mortality would decline by only 4 per 1,000 live births. If all girls enrolled for primary education with the UPE, and assuming 100% completion rates, then by 2011, they would all graduate with primary education. However, Kenya would still have to wait for close to two decades (for these girls to mature into motherhood) to enjoy this modest mortality reduction. For post-secondary education, we simulate the impact of raising completion rates from the sample average of 23% to the primary school level of 43%. This would reduce childhood mortality by 12 per 1,000 live births. Thus, targeting women through secondary and post-secondary education would make an enormous contribution toward mortality reduction in the long run.

Simulations for improvement in health-care service provision focus on 100% immunization coverage for infants, improved coverage of birthing assistance by a professional, and increased coverage of mothers with modern contraception at the cluster level. The simulations show that if Kenya is to achieve 100% immunization coverage, the country would reduce childhood mortality rates by only 6 per 1,000 live births. We further simulate the impact of improving birthing care in the districts with the lowest level of coverage. If the government was to raise coverage in these districts to the average sample coverage of 44%, childhood mortality would drop by 4 per 1,000 live births. For use of modern contraceptive methods, we also focus on raising coverage of clusters at the lowest end of the distribution. Raising the coverage of the bottom clusters to the highest provincial mean (46% for Central province) would reduce mortality by 16 per 1,000 live births. Use of modern contraception therefore has a substantial potential of improving child survival.

The policy simulations presented in this chapter focus more on what we consider realistic scenarios rather than the best possible policy scenarios. The results suggest that there is potential of making some progress in reducing mortality, but the ERS and MDG targets cannot be achieved. The simulated policy scenarios are also quite long term holding constant availability of funding. This is due to long gestation periods between enrollment in school and motherhood and low completion rates in schooling. To substantially improve health-care service provision in clusters and districts with very low coverage, issues of access and equity in service provision, information asymmetry, and socio-cultural and other barriers would need to be addressed.

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Profiling Child Poverty in Four WAEMU Countries: A Comparative Analysis Based on the Multidimensional Poverty Approach

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Abstract The general objectives of this study are to identify and analyze the factors that contribute to child poverty and then quantify inequalities in child welfare for Côte d'Ivoire, Guinea-Bissau, Niger, and Togo. Our methodology is based on the multidimensional poverty approach, with the results showing that the following factors explain child poverty in these countries: access to vitamin A; use of iodized salt; breastfeeding; vaccinations against polio, diphtheria, measles, and yellow fever; and the prevalence of illnesses such as diarrhea, bronchitis, fevers, and other respiratory ailments. An absolute child poverty line is defined in order to determine the number of children living in poverty, with the results suggesting that 19.4% of children in Togo, 21.1% in Côte d'Ivoire, 29.0% in Guinea-Bissau and 49.7% of children in Niger live in poverty.

Keywords Multidimensional child poverty · Inequality · Multiple Correspondence Analysis

JEL Classification I31, I32, D63

1 Introduction

Since its creation, the main objective of the West African Economic and Monetary Union (WAEMU) has been to simultaneously promote trade and ensure sustained economic growth among its member countries. The latter is viewed as an important factor in the fight against poverty, a social phenomenon characterized by major deprivation of basic needs such as income, nutrition, food, and access to basic social services and assets.

Economic policies that have been put into place have not been accompanied by the strong and sustained growth required to reduce or eradicate poverty in WAEMU.

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Poverty has become a reality which affects a significant proportion of the population in many WAEMU member states. Per capita GDP, an indicator of economic and social development, has been declining. Indeed, between 1990 and 2000, average GDP per capita fell from US$847 to US$776 in Côte d'Ivoire, from $345 to $320 in Togo, from $200 to $161 in Guinea-Bissau, and remained at $209 in Niger. The UNDP Human Development Index (HDI) shows that WAEMU countries are at or near the bottom of the list of least developed countries. Of 177 countries ranked in 2005, Niger places 177th, Guinea-Bissau 172nd, Côte d'Ivoire 163rd and Togo places 143rd.

At the household level, poverty comes in monetary terms as well as in terms of basic needs. For example, the ESAM2 investigation (2001) in Senegal showed that 58.4% of households were affected by multidimensional poverty and 48.5% by monetary poverty (Ki et al., 2005). The EBC (1994) states that the incidence of monetary poverty in Niger was at 63% and that 34% of the population were extremely poor. In Côte d'Ivoire, UNDP/INS (2000) used the results of the 1985–1988, 1993, 1995 and 1998 Permanent Household Surveys to show that poverty in the country has significantly worsened. A World Bank (1996) study, using data from the 1989 and 2004 Consumer Budget Surveys in Togo, estimates that poverty affects about 32.3% of the population who live below the poverty line in that country.

Regarding child poverty, the literature pertaining to Europe rarely targets the child as a unit of analysis. Related studies are relatively abundant in the Anglo-Saxon literature, however, likely due to a greater prevalence of child poverty in the United States and Great Britain. What little literature exists in relation to Africa is fairly recent.

Two arguments can be made in favor of addressing child poverty. The first is economic, since children are a long-term investment in human capital for a society. The second argument rests on a social ethic that the community has an obligation to protect the child, since they are at the mercy of their parents' position and have no ability to determine their own socio-economic situation. Child poverty seems to be a multidimensional phenomenon, but little of the scant empirical work that measures and analyzes child poverty in developing countries adopts the multidimensional approach. Gordon et al. (2003) were the first to conduct such a study, doing so in terms of deprivation. The numerous studies relating to children have tended to focus on analyzing children's general state of health and the determinants of the malnutrition that affects them.[1]

[1] Among others, the work on children in developing countries includes Asenso-Okyere et al. (1997) for Ghana; Charasse (1999), Maluccio et al. (2001) and Maitra and Ray (2004) for South Africa; Hoddinott and Kinsey (2001) for Zimbabwe; Lachaud (2001) for Burkina Faso; Strauss (1990), Sahn (1994) and Thomas et al. (1996) for Côte d'Ivoire; Glewwe (1999) for Morocco; Nakabo-Ssewanyana (2003) for Uganda; Sahn and Alderman (1997) for Mozambique; Glewwe et al. (2002) for Vietnam; Barcat (1998) for Indonesia; Bishai (1996) for Bangladesh; Gunasekara (1999) for Sri Lanka; Koffi-Tessio et al. (2003) for Togo; Fambon (2004) for Cameroon; and Vodounou et al. (2004) for Benin.

This study conducts a comparative analysis of poverty among children under the age of five in four WAEMU countries: Côte d'Ivoire, Niger, Guinea-Bissau, and Togo. The goal is to strengthen the analysis and understanding of poverty, especially as it affects children, using a non-monetary approach.

The study seeks to answer the following fundamental questions:

- What is the prevalence of child poverty in the WAEMU countries?
- Does the level of child poverty differ significantly by place of residence?
- Is there a relationship between child poverty and poverty in the child's household?
- Is there inequality in the distribution of the level of child poverty by place of residence at the national level?

The first goal is to identify factors that contribute to the welfare of children then to identify the existence, and sources, of inequalities in child welfare. Specifically, this entails

- describing multidimensional child poverty;
- building a composite indicator to measure their welfare;
- measuring the proportion of poor children;
- analyzing the distribution of child poverty by place of residence;
- confirming or denying the existence of relationship(s) between child poverty and household poverty in the WAEMU countries;
- describing and analyzing the profile of inequality in the welfare of children under 5 years of age.

2 Literature Review

2.1 Literature on Child Poverty

2.1.1 Definition of Child Poverty

The United Nations defines poverty as "a human condition characterized by the sustained or chronic deprivation of resources, capabilities, choices, security and power necessary to have an adequate standard of living and other civil, cultural, economic, political and social rights." Generally speaking, poverty is the deprivation of basic goods and services, but may also refer to inadequacies in terms of other essential aspects of human rights that broaden the individual's scope of choice and allows him to make full use of his abilities, such as rest and leisure or protection from violence and conflict.

Given that poverty negatively affects children's mental, physical, emotional, and spiritual state, it is important to broaden the definition of this concept beyond low household income or consumption. In its 2005 report, UNICEF proposes the following definition for characterizing children living in poverty: "Children living in poverty are deprived from resources needed for their material, spiritual and emotional survival, which prevents them from enjoying their rights, making full use of their capacities or participating in the society as full members and at the same level."

This definition draws attention to the interdependence among various dimensions of child poverty which weigh on their body, heart, and spirit. For example, material poverty at home is felt early in the day with the lack of a nutritious meal. This is often accompanied by the constraint of having to work, sometimes in dangerous environments that impede their cognitive ability and physical growth. Moreover, living in such an uninspiring environment may deprive the child of the positive effects of emotional support he could have received in a family with more resources. By reducing their scope of potentiality, child poverty is not only a source of suffering, but is also a factor in reduced participation in society.

These deprivations may lead children to despair in the short term and hinder their development in the long term. These unmet needs are generally associated with three factors: low household income, lack of adequate physical infrastructure (linked to inadequate public investment), and weak public institutions. The numerous dimensions of poverty – including mortality, morbidity, hunger, illiteracy, lack of fixed housing, and lack of resources – cannot be assessed using a single measurement method. A common measure is the US dollar a day at purchasing power parity, a concept introduced by the World Bank in 1990. Despite the relevance of a general assessment of poverty, neither the income indicator used by the World Bank nor the UNDP composite indicators have been specifically designed to assess child poverty. They therefore cannot specify either the number of children living in poverty or the rights they are deprived of.

2.1.2 The Empirical Work on Child Poverty

As noted above, the two main streams of empirical work on child poverty use either the monetary or the non-monetary approach. The work that uses the monetary approach has mostly focused on developed countries and has generally measured child poverty as a function of their parents' income (UNICEF, 2005). According to the European Union, a person is poor if he earns less than half of the average income, yielding a child poverty rate of less than 3% in Denmark and Finland but over 20% in the United States.

Since 1990, child poverty in Germany has increased much more than in most other industrialized countries, with one in ten children now experiencing poverty. A similar trend has been confirmed by Jenkins and Schluter (2003) for Germany and the United Kingdom, by Harding and Szukalska (2000) for Australia, and by Dickens and Ellwood (2003) for the United Kingdom and the United States.

The following seven areas form the basis of our non-monetary approach to analyzing child poverty: nutrition, drinking water, sanitation, health, housing, education, and information. Using these criteria, Gordon et al. (2003) estimated the level of children's deprivation from data across the 46 countries included in the Demographic and Health Surveys. The results of this study show that 62% of sub-Saharan

African children live in absolute poverty while 82% are severely deprived of at least one basic need; the corresponding figures are 54 and 81% in South Asia.

2.2 Literature on Theoretical Approaches to Measuring Poverty

Some authors, including Ki et al. (2005), describe poverty measures as coming from differing theoretical approaches and quantitative or qualitative indicators. The two major trends in the literature on poverty measurement are the monetary approach, upheld by welfarists and utilitarians, and the non-monetary approach, preferred by non-welfarists. These two approaches differ in terms of the analyst's views on how individuals judge their own welfare, and the range of factors considered in their analysis.

2.2.1 The Monetary Approach

This approach conceives welfare in terms of utility. It bases the comparisons of individual and public welfare on individuals' utility, i.e., on their preferences (Ravallion, 1994). The degree of satisfaction obtained by an individual via consumer goods and services is presumed to define their well-being. Since utility cannot be observed directly, income and expenditures are used to estimate well-being. The proponents of the utilitarian approach to poverty assessment avoid making judgments that are inconsistent with the way that rational individuals assess their well-being.

The utilitarian approach is grounded on the concept of preference ranking for goods, which we generally suppose can be represented by a "utility function" that numerically summarizes a person's well-being. Utilities can also form the basis of social preferences, such as poverty comparisons. This approach has been the basis of a substantial body of empirical work relating to various aspects of public intervention.

2.2.2 The Non-monetary Approach

In contrast to the monetary approach which treats well-being as a function of resources, the non-monetary approach views well-being in terms of freedoms and accomplishments. This approach also promotes and encourages targeted policies. The non-monetary approach evaluates an individual's situation in terms of basic capacities, such as the ability to adequately feed or clothe oneself. As such, this approach has little or no interest in utility per se.

Non-monetary approaches have identified deprivation of specific types of goods and are frequently used to study poverty in both developed and developing countries. They range from "absolute deprivation of goods" when focusing on nutrition or other "basic needs" (more common in studies on developing countries), to "relative goods deprivation" (Townsend, 1979). Of the various non-utilitarian approaches, we identify two subgroups: the capacity approach as per Sen (1985) and the basic needs approach.

Sen's capacity approach considers well-being in terms of positive individual rights in order to make the concept of "functionings" measurable. An individual must have certain capacities that are viewed as essential to achieve a given standard of living. For example, he must be adequately nourished, be educated, be healthy, have adequate housing, be able to take part in community life, appear in public without shame, etc.

The basic needs approach implies that an individual must satisfy certain basic needs that are required to achieve a certain quality of life. Typically considered needs are education, health, hygiene, sanitation, drinking water, housing, and access to basic infrastructure.

In terms of economic policies, the non-monetary approach lends itself toward targeted interventions, which have the advantage of more accurately selecting the poor than a general intervention.

2.3 The Practical Tools for Measuring Multidimensional Poverty

A review of the literature suggests several indicators of well-being that can be used to build a composite indicator at the statistical unit as well as a child welfare index. A composite indicator of welfare is defined for each unit of a given population and represents the aggregate value of several welfare indicators with a functional form. We use this welfare indicator to measure non-monetary poverty.

2.3.1 The Well-Being Composite Indicator

There are two main approaches to the composite indicator of welfare: the entropy approach and the inertia approach. The entropy approach comes from quantum-mechanical dynamics and the inertia approach is derived from mechanical statics. The inertia approach refers to methods that eliminate as much arbitrariness and bias as possible from the composite indicator. This second approach is based on multidimensional scaling techniques and multivariate statistical analysis.

2.3.2 The Welfare Index

Chakravarty et al. (1997) have developed excellent methods to create composite welfare indicators. A welfare index can be constructed using the poverty threshold for each of the primary indicators that are used in the index. This involves an initial aggregation of different indicators for each individual in the population (equivalent to a composite indicator) and a second aggregation of the entire population of the composite indicator, which are both used to obtain a general measure of poverty. The way that a composite index of well-being is constructed depends on how it is defined. The micro-multidimensional index of poverty developed in this study follows this approach.

3 Study Methodology

The methodology developed[2] to achieve the study's objectives is to aggregate a number of non-monetary dimensions of well-being to build a composite indicator of child welfare. Adopting the non-monetary approach of poverty based on basic or vital needs implies that this study conceptualizes welfare in terms of accomplishments rather than money. Thus, the main areas of consideration are health and nutrition, access to water and electricity, possession of durable goods, housing, environment, and sanitation.

Studies on the distribution of income or wealth clearly distinguish between inequality and poverty. The first is concerned with the distribution of income as a whole, while the other is focused on the scale of the distribution. In other words, while poverty is defined in terms of the portion of the population (the poor) who are under some poverty threshold, inequality analyzes the relative differences in the standard of living within a society. Both phenomena are investigated in this study.

3.1 Analysis of Multidimensional Poverty

3.1.1 Constructing the Composite Welfare Indicator (CWI)

The factor analysis technique chosen for our study is a multiple correspondence analyses (MCA) characterized by the use of binary information, since the primary indicators of welfare are qualitative. Multivariate statistical analysis, also known as factor analysis, can represent a number of points (p) or a field of vectors in m-dimensional space ($m > 2$), so long as $p < m$. The method allows the relationships between the variables to be expressed visually and summarizes the information provided by the variables.

Individuals form points around a circle in the space of variables, with a weight assigned to each point. An appropriate method to determine the weights must be selected. The approach taken by Sahn and Stifel (2000) uses factor analysis. Filmer and Prittchet (1998), however, use a variant of factor analysis called principal component analysis (PCA). Another option, chosen by Asselin (2002), is to use MCA, which is a special case of generalized component analysis (GCA) that is for dichotomous qualitative variables.

Dichotomous variables are all coded as 0 or 1, so it is not necessary to normalize the variables. This process of binary coding is very old and is widely used when searching for information in data. It also helps eliminate linearity observed when using PCA. An MCA, which can treat qualitative variables numerically for each category, has a further advantage over PCA, which can only be used for quantitative variables. The MCA approach is thus more appropriate if the primary indicators of child welfare can be coded in binary form. The result is a multidimensional database

[2] The study was largely inspired by the methodology already used by various PEP works in recent years, in particular by Ki et al. (2005) and Lawson-Body (2007).

where all the primary indicators are codified as 0 or 1. With K indicators and n individuals, each unit of the population can be represented by a vector of dimension $(1, K)$. Similarly, each indicator category may be represented by a column vector of dimension $(n, 1)$. The relationships between variables and/or individuals are not directly observable in this space of dimension (n, K).

Like all the other methods of factor analysis, MCA seeks an optimal subspace in which it can trace the (nonlinear) link between indicators, between individuals, or between individuals and indicators. Determining the optimal areas involves maximizing the inertia of the points. The next step is to determine which proper vectors in the data matrix are associated with the proper values that measure the inertia of the projected data points. The largest proper vector, associated with the largest proper value, is also called the first factorial axis, and has a specific meaning under certain conditions. It is the axis that maximizes the variation in the data points. Each indicator in this axis has a factorial category called a score, which is equivalent to its magnitude on the first axis. The weight sought in the functional form of the composite indicator corresponds to this normalized score (the ratio between the score and the value).

This study uses MCA to determine the criteria for selecting the indicators included in the CWI. The main criterion generally used is the first axis ordinal consistency (FAOC) factor, which clearly describes the level of well-being. Variables with the FAOC property consistently show that well-being deteriorates with wealth along the entire first axis. For dichotomous variables, this simply implies that the rich are on one side of the axis and the poor are on the other. Other second-order criteria are concerned with the ability to distinguish between groups along the first axis when there are high non-response levels or low frequencies for certain terms. This makes it possible to reconsider some variables that are initially rejected by the FAOC criterion.

The functional form of the composite indicator is simply the average weight for each category, themselves the average of standardized scores. If m is the indicator for a given household and C_m its value for the composite welfare indicator (CWI), the functional form of the indicator, as defined by Asselin (2002) is

$$C_m = \frac{\sum_{k=1}^{K} \sum_{jk=1}^{\mathrm{Jk}} W_{jk}^{k} I_{jk}^{k}}{K} \tag{1}$$

where

K = number of category indicators;
Jk = number of categories of the indicator k;
W_{jk}^{k} = Weight (score of normalized first axis) of class Jk;
I_{jk}^{k} = Binary variable taking the value 1 when the individual belongs to category Jk.

The weight obtained by the MCA corresponds to standardized scores on the first factorial axis. The CWI for child m is simply the weighted average of the binary categorical variables. With N children, the weight of a category is simply the average of the standardized scores according to the size of the population in that category.

The factorial methods used in this work do face some limits. Although the method's pertinence depends on the type of data and assumptions about the phenomenon of interest, the MCA approach does not allow simultaneous analysis of several tables. This means that neither differing dimensions within and between the tables nor the structure of large disparities among children, are accounted for. In other words, an MCA may understate the inertia for some variables that are actually relevant to poverty analysis. Additionally, it does not account for possible interactions between variables or groups of variables. These issues are addressed by using multiple factor analysis, which can simultaneously study groups of numerical and/or qualitative variables.

3.1.2 Techniques for Measuring the Index of Multidimensional Poverty

Determining the Multidimensional Poverty Threshold

Composite indicator i of the child's welfare can be used to calculate the multidimensional poverty index once the absolute poverty threshold has been identified. The resulting poverty threshold ranks children's well-being according to their standard of living. The goal is thus to assert a value below which children are not considered to have attained a minimum acceptable level of welfare. There are several methods to determine this threshold.

According to Asselin (2002), there are three ways to calculate multidimensional poverty. First, the threshold can be the non-monetary dimension of the MCA with the lowest weight. In this case, a poor child is the one who is poor in at least one of the non-monetary dimensions. The author believes that this is a necessary but not sufficient criterion. Second, a sufficient but not necessary criterion is to be poor in all dimensions. Finally, the necessary and sufficient condition is to treat the maximum weight of the dimensions as the threshold, in consideration of the fact that the average of the composite child poverty indicator is higher.

Another method is to take a reference child with certain characteristics such as being or having been breastfed, consuming iodized salt and clean water, and having received immunizations. The average weight of these modalities will be called threshold $S1$. We then calculate composite indicator CWI1 for each child by comparing them with the reference child. We similarly calculate composite indicator CWI2 from the weight of previously unused modalities. With K variables, the CWI can be broken down as follows:

$$\text{ICP}_i = \frac{\text{score}_{i1}}{K\sqrt{\lambda_\alpha}} + \frac{\text{score}_{i2}}{K\sqrt{\lambda_\alpha}} + \ldots + \frac{\text{score}_{iK}}{K\sqrt{\lambda_\alpha}}$$

where

score_{i1}: child i's score for variable 1
score_{i2}: child i's score for variable 2

K = number of categories of variables
$\sqrt{\lambda_\alpha}$ = largest proper value

The $S2$ threshold is the average of CWI2 for any CWI1 below $S1$. The absolute threshold is calculated as follows:

$$S = S1 + S2 \tag{2}$$

Measuring the Multidimensional Poverty Index

The composite welfare indicator can take negative values, so the magnitude of the largest negative value among the indicators is added to each initial value to determine the multidimensional poverty index and proceed with the dominance tests. This is carried out following Sahn and Stifel (2003a, b) and Ki et al. (2005), whose assumption that the index has an average of zero and a variance of one preserves the rank of the children for any linear transformation across the distribution.

Once the poverty line is defined with positive CWI values, we can calculate the composite welfare index. Among the various poverty measures based on the indices, this study follows a Foster–Greer–Thorbecke (1984)[3] poverty index, which has properties that are useful for comparing the poverty level between specific groups of children (such as rural vs. urban children). The FGT index is calculated as follows:

$$P(\alpha, z) = \frac{1}{N} \sum_{h=1}^{H} \left(\frac{G_n}{z} \right)^{\alpha} \text{ with } \alpha \geq 0, \tag{3}$$

where α is a parameter that indicates how sensitive the inequality is to income within a group of the poor, z is the poverty line, Gj is the child j's poverty gap where $Gj = z - xj$ and x is the level of income (or equivalently, expenditure or wealth) for child j (with $Gj = 0$ when $xj > z$).

The main issues that can be addressed when speaking of poverty are the number of poor, the observed depth of poverty (the additional wealth needed to eliminate poverty), and the severity of poverty. Indexes that try to quantify these concepts in the literature include

- the FGT(0)[4] index, which counts the number of the poor;
- the FGT(1) index, or the average poverty gap, which estimates the average amount of resources needed to eradicate poverty; and
- the FGT(2) index, which accounts for the unequal distribution of consumption expenditures among the poor.

Since the composite welfare indicators were translated before calculating the index, only the FGT(0) index was measured and analyzed, the FGT(1) and FGT(2)

[3] The DAD software (Duclos and Araar, 2006) is used to calculate the FGT index and the inequality indexes especially in the set up of different curves of inequality.
[4] FGT(0) indicates FGT when $\alpha = 0$ and so on.

indexes not having a socio-economic meaning after the transformation. Using the FGT index for analysis can be enhanced with FGT curves, which can be used to address the dominance of poverty in the distribution of each CWI index in relation to the other. The FGT(0) curves can thus be used to test for first-order stochastic dominance whether there are more poor in distribution A or distribution B.

3.1.3 Decomposing the Impact of Child Poverty by Source

The Shapley approach is used to measure and assess the role of each component of the child's[5] welfare in reducing multidimensional child poverty. The approach identifies the relative strength of the different components of children's well-being in explaining non-poverty among children.

3.1.4 Verifying the Relationship Between Child Poverty and Poor Children

The relationship between child poverty and poor children is verified by checking for statistically significant differences between the composite indicators of child poverty according to households' standard of living, measured by a composite needs index. The sample averages for the five modalities can then be used to put together the variable that measures a child's well-being.

3.2 Tools for Analyzing Inequality

The tool of choice for the inequality analysis is the absolute Gini index, which is also effective when the measure of welfare takes on negative values.

3.2.1 The Absolute Gini Index

According to Araar (2006), the absolute Gini index AI can be defined as:

$$\mathrm{AI} = I^{*}\mu \tag{4}$$

where I is the Gini coefficient and μ the average income (or some related variable, such as the CWI) which is assumed to be greater than zero. When $\mu = 0$, we use a functional form, which shows that the absolute Gini index is simply the expected relative deprivation.

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[5] In applying the Shapley method for the breakdown of poverty, the following components have been built on the selected indicators: immunization (various vaccinations), food (water + lactation + vitamin A + minerals) children's health (HAZ score), care (prenatal and childbirth, family planning), and the household's poverty (index of household wealth).

3.2.2 Decomposition of the Absolute Gini Index

To measure each group's contribution to total inequality, Araar (2006) proposed a technique to decompose the absolute Gini index. This technique is relevant when the variable of interest (income or CWI) contains negative values.[6] $\bar{\delta}_i$, the expected deprivation for child i, is defined as:

$$\bar{\delta}_i = \frac{\sum_{j=1}^{N} (y_j - y_i)_+}{N} \tag{5}$$

where y_k is child k's income (CWI for our purposes) and N is the population size. This equation shows that each child's contribution to total inequality depends on their level of deprivation in relation to the average. If child K belongs to group g, we can rewrite the average relative deprivation as follows:

$$\bar{\delta}_k = \phi_g \bar{\delta}_{k,g} + \tilde{\delta}_{k,g} \text{ with } \tilde{\delta}_{k,g} = \sum_{\substack{j=1 \\ j \notin g}}^{N-K_g} \frac{\left(y_k - y_j\right)_+}{N}$$

where ϕ_g is the proportion of the population of group g, K_g is the number of children belonging to group g, $\bar{\delta}_{k,g}$ is the expected relative deprivation of the child k in group g and $\tilde{\delta}_{k,g}$ is the expected relative deprivation for each child in the group. Rewriting the Gini index, we have

$$\text{AI} = \sum_{g=1}^{G} \sum_{k=1}^{K_g} \left[\frac{\phi_g \bar{\delta}_{k,g} + \tilde{\delta}_{k,g}}{N} \right] \tag{6}$$

$$= \sum_{g=1}^{G} \left[\phi_g^2 \frac{\sum_{k=1}^{K_g} \bar{\delta}_{k,g}}{K_g} \right] + \sum_{g=1}^{G} \sum_{k=1}^{K_g} \frac{\tilde{\delta}_k}{N} \tag{7}$$

$$= \sum_{g=1}^{G} \phi^2 \text{AI}_g + \tilde{\text{AI}} \tag{8}$$

where G is the number of groups and $\tilde{\text{AI}}$ is equal to the absolute Gini index, within-group differences in deprivation being ignored. As for intergroup compar-

[6] The author has developed specific executable programs in Stata.

isons, inequality is defined such that each child's income, or well-being, is the group average. The decomposition of the AI index thus takes the following form:

$$\mathrm{AI} = \sum_{g=1}^{G} \phi^2 \mathrm{AI}_g + \mathrm{AI}(\mu_g) + R \tag{9}$$

If there is no overlap between the income groups, the residue $R = \tilde{\mathrm{AI}} - \mathrm{AI}(\mu_g)$ is equal to zero.

3.3 Nature and Sources of Data

The primary well-being indicators are used to implement the methodology described above. The data is from the Multiple Indicator Cluster Surveys (MICS-2) that were conducted in many developing countries in 2000 with financial support from UNICEF and WHO and technical support from Macro International Inc. The MICS surveys are part of a UNICEF global assistance program to collect, process, and analyze data related to children's survival, development, and protection. The MICS-2 sample was designed to provide estimates for a number of health indicators for children under the age of 5 at the national level for both rural and urban areas and for all regions in the concerned countries.

Three types of questionnaires were used in the MICS-2: the child questionnaire, the questionnaire targeting women aged 15–49 years, and the questionnaire for children under the age of 5. The MICS-2 was adapted by the National Technical Steering Committee from the standard model proposed by UNICEF to suit the specific realities in each country. Different modules have been selected, as shown in Table 1.

Table 1 MICS-2 modules in two WAEMU countries

Modules for the household	Modules for women	Modules for children
Non-monetary assets	Infant mortality	Demographic characteristics
Children's education	Tetanus toxoid	Vitamin A
Child labor	Mother and newborn's health	Breastfeeding
Water and sanitation	Family planning	Care for illnesses
Socio-economic status	Vitamin A	Prenatal care
Iodization of salt	HIV/AIDS	Vaccination

Source: UNICEF.

4 Presentation and Analysis of Results

The results are produced using a variety of software, namely SPSS, STATA, DAD, SPAD, and Excel. The descriptive and multivariate analysis and the inequality analysis are used to assess the level of child welfare in the WAEMU countries.

4.1 Poverty Analysis

4.1.1 Descriptive Analysis of Children's Situation

According to the fourth Millennium Development Goal (MDG), the rate of child malnutrition must not exceed 12%. Vitamin A supplement programs have been implemented in several WAEMU countries to overcome nutritional deficiencies.

Analyzing the distribution of children according to the primary indicators of child well-being (Table 2) reveals that there are large disparities between them. For example, 29% of children in Togo and just 25% of children in Côte d'Ivoire received vitamin A, compared to 4 in 10 children in Guinea-Bissau and 6 in 10 children in Niger.

Côte d'Ivoire does the best in terms of the availability of immunization cards for children – at over 86%, followed closely by Togo, where around more than 8 in 10 children have an immunization card. In all four countries, more than half of children involved in the study have an immunization card. This result in WAEMU may be due to government and non-state action to promote mother- and child-oriented policies. According to the UN World Water Development Report (2006), diarrheal diseases cause the death of 6,000 people each day, the main victims being children under five in poor countries and particularly in Africa.

An average of 3 in 10 children in the WAEMU countries had diarrhea in the 2 weeks preceding the survey. This proportion is lowest in Côte d'Ivoire at 20% and highest in Niger (36%), where water problems are relatively severe. The prevalence of diarrhea is strongly linked to the quality of drinking water, and thus affects countries like Niger and Guinea-Bissau more intensely.

The proportion of children with fever in the 2 weeks before the survey varies slightly from Guinea-Bissau to Togo and from Niger to Côte d'Ivoire. On average, three out of ten children had fever in the 2 weeks preceding the survey. This is not surprising given the prevalence of malaria in these parts of Africa, especially among children who do not have protection against the disease. The occurrence of other diseases was almost the same in all countries involved in the study; more than 20% of children were hit by another illness during this 2 week period.

The sixth MDG states that the percentage of children under the age of 5 years without a treated mosquito net should not exceed 5%. According to the WHO (2005), malaria affects the African continent more than any other disease and the mosquito net is the most effective way to prevent it. Unfortunately, few children in sub-Saharan Africa sleep under a mosquito net. The results are particularly alarming in Togo and Niger, where about 13 and 22% of children, respectively, sleep under a mosquito net. Policies favoring the use of nets have been enacted in Guinea-Bissau, leading to 67% of children using mosquito nets.

Data regarding mosquito nets are not available for all the countries studied. Only 16.2% of treated nets that were counted in Niger were in rural areas. The disparities between rural and urban areas in terms of health infrastructure, lack of information, level of instruction, and behavior and lifestyles may explain these figures.

Table 2 Distribution of children according to the primary indicators of child well-being

Countries	Vitamin A %	Immunization card %	Diarrhea %	Fever %	Other illnesses %	Mosquito net %	Mosquito net %	Iodized salt %
Côte d'Ivoire	24.6	86.3	20.4	30.8	24.2	–	–	59.1
Guinea-Bissau	40.8	54.8	31.9	43.1	–	67.3	–	–
Niger	65.5	56.3	36.4	37.4	21.0	21.5	1.9	59.9
Togo	28.5	81.5	24.5	35.9	32.3	12.8	–	60.5

Sources: MICS-2 from different countries and authors' calculations.

The socio-economic studies also often show large disparities in the distribution of child poverty. These differences can usually be attributed to the mother's level of literacy, the lack of infrastructure in rural areas, urbanization, lack of local institutions, and lack of certain life skills; in short, the low standard of living characterizing poor countries.

More than half of the children in WAEMU countries have an immunization card in both urban and rural areas except for those in Niger (Table 3), where three-quarters of children in rural areas lack an immunization card. Côte d'Ivoire stands out with 77% of urban and 65% of rural children having immunization cards. This general trend holds in Niger, where nearly 74% of urban children and just 26% of rural children have an immunization card.

Several studies such as WHO (1995) and FAO (2005) have shown that the occurrence of diarrhea is strongly linked to environmental factors. As such, rural people are more likely to get diarrhea than city dwellers in many countries. This pattern has been confirmed for children in each country in this study: in Niger, more than 42% of rural children and 26% of urban children had had diarrhea in the previous 2 weeks; in Togo, 26% of rural and 32.9% of urban children were afflicted; the respective proportions were 32.9 and 30.4% in Guinea-Bissau and 22.3 and 17.2% in Côte d'Ivoire. Altogether, these numbers show profound disparities in terms of the means of preventing diarrhea in rural and urban areas.

A similar trend is observed for fevers. The proportion of children having fevers remains higher in rural areas in Cote d'Ivoire, Niger and Togo, while Guinea-Bissau goes against the trend with 1.1 times more urban children getting fevers. This trend holds for other diseases as well. This is likely due to factors such as the quality of drinking water, sanitation issues and food hygiene, and the greater use of mosquito nets in urban areas. It should be noted that prevention campaigns are much more focused on the use of nets, especially among children and pregnant women, in areas where malaria is endemic.

Table 4 shows the level of child poverty through the index of wealth in different WAEMU countries. The analysis shows that vitamin A supplement use is low in Côte d'Ivoire, Guinea-Bissau, and Togo for children in the lowest quintile, with less than a third of all children getting vitamin A supplements. This proportion increases with each quintile in Guinea-Bissau and Togo. The proportion of children with diarrhea declines by 7 points between the first and fifth quintiles, suggesting that more affluent households are more able to pursue strategies prevent diarrheal diseases among children under 5 years. The difference between the percentages of children who have fever according to their household's quintile is also substantial for Togo and Niger.

Niger and Togo have the lowest usage rate of treated mosquito nets. Only 9% of children in the first quintile of households in these countries use a net whereas more than 25% of children of the fifth quintile use one. The use of nets increases among richer households, from 13 to 36% in Niger and from 9 to 26% in Togo. As for iodized salt consumption, Togo and Côte d'Ivoire have the highest rate.

Table 3 Distribution of children according to primary indicators of child poverty and by place of residence

Countries		Vitamin A %	Immunization card %	Diarrhea %	Fever %	Other illness %	Mosquito net %	Protection by mosquito net %	Iodized salt %
Côte d'Ivoire	Rural	25.7	64.6	22.3	31.6	22.6	–	–	56.5
	Urban	22.9	77.0	17.2	29.6	26.8	–	–	63.2
Guinea-Bissau	Rural	34.0	51.3	32.9	40.7	–	63.4	–	–
	Urban	51.6	60.4	30.4	46.8	–	73.4	–	–
Niger	Rural	61.7	25.7	42.1	43.9	19.9	13.6	16.2	41.7
	Urban	72.2	73.9	26.4	26.2	23.0	35.3	53.8	54.2
Togo	Rural	27.5	54.9	26.0	38.8	32.5	11.0	–	59.2
	Urban	31.6	66.0	19.6	18.7	31.5	18.7	–	65.1

Sources: MICS-2 for each country and authors' calculations.

Table 4 Distribution of children according to the primary indicators of child well-being and the composite index of household wealth

Countries	Household wealth indicator (quintile)	Vitamin A	Immunization card	Diarrhea	Fever	Other illnesses	Mosquito net	Protection against mosquito	Iodized salt
Cote d'Ivoire	1st	23.5	75.8	23.1	31.6	28.8			49.8
	2nd	28.2	85.5	22.5	32.8	31.5			58.9
	3rd	27.2	87.3	19.4	30.4	29.2			59.9
	4th	20.8	95.2	18.7	29.1	31.1			67.6
	5th	20.2	98.2	13.2	28.2	33.2			67.6
Guinea-Bissau	1st	32.6	51.6	37.7	42.8		60.2		
	2nd	34.5	51.8	36.0	40.6		62.9		
	3rd	34.9	52.1	29.4	41.4		67.2		
	4th	45.3	56.3	27.1	45.4		72.1		
	5th	59.0	63.4	30.3	45.4		74.3		
Niger	1st	66.8	29.2	44.7	45.6	34.4	13.4	1.9	33.1
	2nd	59.9	33.9	40.9	44.1	34.4	8.5	3.2	43.3
	3rd	58.2	39.4	34.9	39.8	33.1	15.4	4.6	42.1
	4th	61.1	43.6	43.8	46.4	35.4	14.8	0.8	49.5
	5th	72.3	89.0	28.6	26.6	31.1	35.5	13.1	50.5
Togo	1st	24.4	73.0	27.1	40.1	43.3	8.8		55.1
	2nd	29.5	80.2	27.3	38.6	43.3	10.2		59.6
	3rd	28.3	80.1	26.6	37.6	43.6	11.2		64.4
	4th	29.7	88.0	20.0	33.7	42.7	15.5		60.1
	5th	34.2	96.4	15.6	20.8	39.5	25.7		67.2

Sources: MICS-2 for each country and authors' calculations.

This analysis illustrates that the primary indicators of child poverty move together with household poverty; the higher the household's standard of living, the more the primary indicators of child poverty decrease.

4.1.2 Interpretation of the Results of the Multiple Correspondence Analyses

An MCA was carried out for all the primary indicators that could be used to construct the CWI for the four countries. The results emerging from this first MCA are analyzed to select a final set of primary variables that meet the criterion of first axis ordinal consistency (FAOC). These latter variables were used to conduct the final MCA, which thus has greater explanatory power on the first factorial axis, as shown in Table 5.

Table 5 Explanatory power of the first factorial axis using MCA (%)

Country	First MCA	Final MCA
Côte d'Ivoire	33.43	43.59
Guinea-Bissau	35.94	44.81
Niger	35.08	35.24
Togo	30.03	41.24

Sources: MICS-2 for each country and authors' calculations.

The increase in the explanatory power of the first factorial axis results from eliminating variables that do not exhibit FAOC after the first MCA. In four out of five cases, the variables that do not have the FAOC property are those related to diseases (diarrhea, coughing, breathing difficulties, fever). Broadly speaking, the final MCA results clearly show that the first factorial axis distinguishes between poor and non-poor children.

The graphs illustrate that terms which are associated with child poverty are negatively associated with the first axis and those associated with wealth are positively correlated with this axis. In other words, child welfare increases from left to right on the first factorial plane. Based on the MCA results, the Table 6 provides a summary of the descriptive terms of children's poverty and wealth.

Analysis of the Weight of the Primary Indicators of Child Poverty

An analysis of the weights of the primary indicators (see Table 7 below) shows a set of factors that contribute to improved child welfare and those that are likely to reduce it. In the first group are access to vitamin A and iodized salt, breastfeeding, and immunization against polio, diphtheria, measles, and yellow fever. The occurrence of diseases such as diarrhea, cough, fever and breathing difficulties, and the lack of immunization or not having an immunization card each contribute to a higher score on the composite child poverty index.

Table 6 Summary of descriptive aspects of child poverty and non-poverty

Child poverty	No child poverty
– Has not received vitamin A	– Has received vitamin A
– Non-iodized salt	– Iodized salt
– Immunization card not available	– Immunization card available
– Does not sleep under a mosquito net	– Sleeps under a mosquito net
– Has not been immunized against BCG	– Has been immunized against BCG
– Has not been immunized against Polio 0	– Has been immunized against Polio 0
– Has not been immunized against Polio 1	– Has been immunized against Polio 1
– Has not been immunized against Polio 2	– Has been immunized against Polio 2
– Has not been immunized against Polio 3	– Has been immunized against Polio 3
– Has not been immunized against DPT1	– Has been immunized against DPT1
– Has not been immunized against DPT2	– Has been immunized against DPT2
– Has not been immunized against DPT3	– Has been immunized against DPT3
– Has not been immunized against measles	– Has been immunized against measles
– Has not be immunized against yellow fever	– Has been immunized against yellow fever
– Malnourished	– Well nourished
– Underweight	– Not underweight
– Emaciated	– Not emaciated
– No protection against malaria	– Protected against malaria

Sources: MICS-2 for each country and authors' calculations.

4.1.3 Measurement and Analysis of the Effects of Child Poverty

In order to calculate the absolute child poverty threshold as described in the methodology, we began by defining the characteristics of a non-poor child in relation to a poor one (Table 8). These vary from one country to another, depending on the availability of data.

The Impact of Child Poverty at the National Level

An FGT-type index of child poverty was calculated based on the absolute threshold for each country. The calculated values suggest that child poverty affects a significant portion of children in WAEMU countries. Indeed, the incidence of multidimensional child poverty is 19.4% in Togo, 21.1% in Côte d'Ivoire, 29.0% in Guinea-Bissau and 49.7% in Niger. Overall, more than one in five children in these countries is poor.

Niger stands out as the most severely hit by child poverty, which affects nearly half of its children (Fig. 1).

The Incidence of Child Poverty by Place of Residence (%)

The incidence of child poverty varies by place of residence. The chart (Fig. 2) below shows that rural areas are more than twice as likely as their urban counterparts to be affected by child poverty. This is probably due to the lack of health facilities in rural areas.

Table 7 Weight of the primary indicators according to the MCA, by country

Primary indicators	Factors	Côte d'Ivoire	Guinea-Bissau	Niger	Togo
Vitamin A	Yes	0.28	0.49	0.33	0.42
	No	−0.07	−0.35	−0.45	−0.15
Breastfeeding	Yes			0.00	0.01
	No			−0.11	−0.40
Diarrhea	Yes			−0.21	
	No			0.13	
Other illnesses	Yes				
	No				
Fever	Yes			−0.22	
	No			0.14	
Cough	Yes			−0.17	−0.03
	No			0.06	0.02
Breathing difficulties	Yes			−0.27	
	No			0.05	
Mosquito net	Yes		0.04	0.96	0.26
	No		−0.08	−0.14	−0.05
Protection against mosquitoes	No protection				
	Mosquito net				
	Insecticide				
	Other				
Iodized salt	Non-iodized	−0.16		−0.08	
	Iodized-15PPM	−0.05		0.09	
	Iodized 15PPM+	0.23			
Severe malnutrition	Yes		−0.01	−0.11	
	No		0.00	0.08	
Underweight	Yes		−0.18	−0.28	
	No		0.02	0.04	
Emaciated	Yes		−0.08	−0.14	
	No		0.03	0.11	
BCG immunization	Yes	0.27	0.46	0.72	0.41
	No	−1.44	−1.34	−0.99	−1.38
Polio 0 immunization	Yes	0.17	0.63	0.97	0.52
	No	−0.03	−0.73	−0.45	−0.94
Polio 1 immunization	Yes	0.37	0.48	0.74	0.34
	No	−1.57	−1.36	−1.01	−1.42
Polio 2 immunization	Yes	0.53	0.66	0.84	0.52
	No	−1.33	−1.08	−0.89	−1.09
Polio 3 immunization	Yes	0.72	0.90	0.99	0.75
	No	−1.00	−0.77	−0.68	−0.74
DPT1 immunization	Yes	0.46	0.58	0.84	0.49
	No	−1.44	−1.24	−0.92	−1.32
DPT2 immunization	Yes	0.60	0.75	1.00	0.69
	No	−1.27	−1.00	−0.80	−1.03
DPT3 immunization	Yes	0.74	0.95	1.12	0.89
	No	−1.03	−0.75	−0.66	−0.76
Measles immunization	Yes	0.59	0.55	0.92	0.89
	No	−0.82	−1.05	−0.62	−0.76
Yellow fever immunization	Yes	0.88			
	No	−0.63			
All Immunizations	Yes	0.92	1.02	1.30	1.08
	No	−0.69	−0.65	−0.46	−0.48
Immunization card	Yes	0.41	0.60	0.89	0.59
	No	−0.98	−0.72	−0.60	−0.73

Table 8 Characteristics of the reference child, by country

Côte d'Ivoire	Guinea-Bissau	Niger	Togo
Has received vitamin A	Has received vitamin A	Has received vitamin A	Has received vitamin A
Has been immunized against BCG	Not underweight	Not malnourished	Has been immunized against BCG
Has been immunized against Polio 0	Not emaciated	Not emaciated	Has been immunized against Polio 0
Has been immunized against Polio 1	Not malnourished	Not underweight	Has been immunized against Polio 1
Has been immunized against Polio 2	Has been immunized against BCG	Has been immunized against BCG	Had Polio 2
Has been immunized against Polio 3	Has been immunized against Polio 0	Has been immunized against Polio 0	Has been immunized against Polio 3
Has been immunized against DPT1	Has been immunized against Polio 1	Has been immunized against Polio 1	Has been immunized against DPT1
Has been immunized against DPT2	Had Polio 2	Has been immunized against Polio 2	Has been immunized against DPT2
Has been immunized against DPT3	Has been immunized against Polio 3	Has been immunized against Polio 3	Has been immunized against DPT3
Has been immunized against measles	Has been immunized against DPT1	Has been immunized against DPT1	Has been immunized against measles
Has been immunized against yellow fever	Has been immunized against DPT2	Has been immunized against DPT2	
	Has been immunized against DPT3	Has been immunized against DPT3	
	Has been immunized against measles	Has been immunized against measles	

Sources: MICS-2 for each country and authors' calculations.

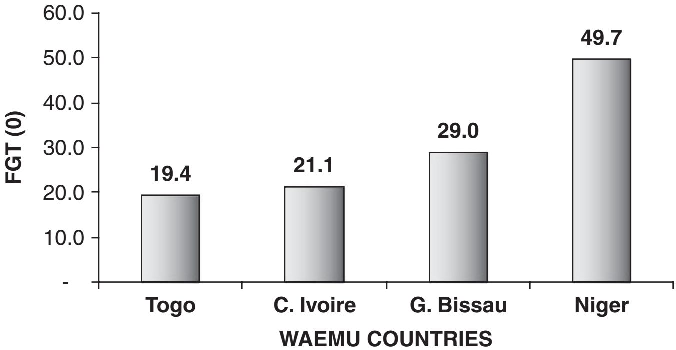

Fig. 1 Incidence of child poverty by country (%).
(Sources: MICS-2 for each country and authors' calculations)

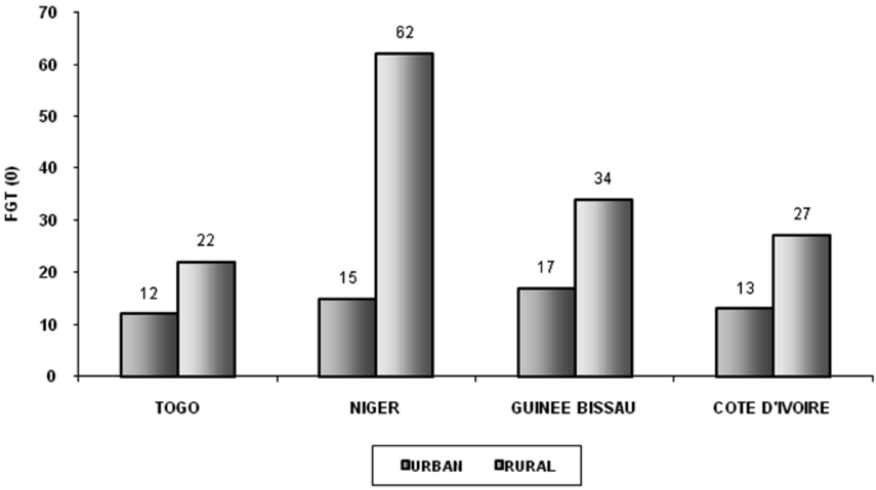

Fig. 2 Incidence of child poverty by country and by place of residence (%).
(Sources: MICS-2 for each country and authors' calculations)

The Impact of Child Poverty Across Regions

Child poverty by economic or administrative region varies substantially in the MICS (Table 9). The regions least affected by this poverty are usually the capital city or regions closest to the country's political capital. However, some distant regions also have relatively low levels of child poverty. One explanation is that certain regions have benefited from various health and nutrition projects over the years due to the poverty experienced there. This is especially the case for Togo's Central Region, which has benefited from child-targeted activities carried out in the preceding 20 years by PLAN-Togo, a subsidiary of the NGO Plan International.

Table 9 Incidence of child poverty across regions

Countries	Regions	Poor children (%)
Côte d'Ivoire	Center	22.77
	North Center	16.31
	North East	18.87
	Center East	9.78
	South (Except Abidjan)	19.40
	South West	38.15
	Center West	25.25
	West	16.98
	North West	35.51
	North	31.58
	Abidjan	8.98
Guinea-Bissau	Tombali	29.06
	Quinará	27.31
	Oio	40.11
	Biombo	29.78
	Bolama/Bijagós	23.53
	Bafatá	26.56
	Gabú	44.34
	Cacheu	25.59
	SAB	12.27
Niger	Agadez	11.10
	Dosso	32.79
	Maradi	59.67
	Tillaberi	58.10
	Tahoua	59.86
	Zinder-Diffa	61.34
	Niamey	7.46
Togo	Lome	7.63
	Maritime region	24.01
	Plateau region	22.84
	Central region	8.81
	Region of Kara	17.33
	Savannah region	21.76

Sources: MICS-2 for each country and authors' calculations.

The Impact of Child Poverty According to the Index of Household Wealth

The results contained in Table 10 show that child poverty is more common in households classified as very poor and low in households classified as wealthy by the multidimensional household wealth index. The proportions of poor children in the first three quintiles are higher than the national average, suggesting that households' standard of living is a factor explaining the level of child poverty in the countries cited in this study.

Table 11 shows that differences in the CWI values between quintiles as defined by household standard of living are significantly different.

Table 12 presents the results of a simulation that indicates the source that contributes most to reducing child poverty in each country. In this case, we are in a

Table 10 Incidence of child poverty according to the index of household wealth (Note: Here, the quintiles represent the index of household wealth)

		Quintile				
Countries	National	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile
Côte d'Ivoire	21.08	30.94	24.78	20.74	12.90	7.88
Guinea-Bissau	29.02	34.82	32.73	34.27	26.47	11.50
Niger	49.71	68.87	66.13	58.90	56.95	17.78
Togo	19.43	30.54	21.19	19.80	13.14	5.44

Sources: MICS-2 for each country and authors' calculations.

Table 11 Test for the CWI sample mean by household standard of living

	Average					Fisher statistics	
Countries	1st quintile	2nd quintile	3rd quintile	4th quintile	5th quintile	Value	Sig
Côte d'Ivoire	−0.2929	−0.1182	−0.0469	0.1188	0.2565	129.87	0.000
Guinea-Bissau	−0.0902	−0.0715	−0.0772	0.0609	0.2841	60.03	0.000
Niger	−0.2554	−0.2233	−0.1385	−0.0913	0.4665	485.04	0.000
Togo	−0.1480	0.0171	0.0224	0.0974	0.3216	37.46	0.000

Sources: MICS-2 for each country and authors' calculations.

Table 12 Simulation values for child well-being indicator (CWI)

Countries	Base[a]	Vitamin A	Immunization	Illness
Côte d'Ivoire	21.2	20.4	18.8	19.1
Guinea-Bissau	29	28.7	27.9	28.3
Niger	47.9	46.6	45.3	46.2
Togo	19.4	19.1	17.4	18.3

[a]Child well-being indicators according to the reference child.
Sources: MICS-2 for each country and authors' calculations.

situation where every child receives vitamin A and all vaccinations, and is saved from all diseases. It turns out that immunization contributes the most to reducing child poverty in each country. Therefore, if all children are vaccinated, the poverty indicator in Côte d'Ivoire will decrease by 2.4 percentage points.

The same observation is also made in Guinea-Bissau, where immunizing all children reduces child poverty by 1.1 percentage points. In Niger, the child well-being index goes from 47.9 to 45.3 when all children are fully immunized. Similarly, in Togo, the child poverty is reduced by two percentage points if the state vaccinates all children.

Breakdown of Child Poverty by Source

Decomposing the incidence of child poverty by source using the Shapley approach has identified the factors which play a large or small role in determining children's welfare. Vaccination emerges as the factor that contributed most to the welfare of children (Table 13). The states' expanded national vaccination programs thus had a positive impact on child welfare. The other two factors – vitamin A and

Table 13 Breakdown of the FGT($\alpha = 0$) indicator by source of child welfare

	Sources					
	Vitamin A and minerals		Immunization		Illness	
Countries	Absolute contribution	Relative contribution	Absolute contribution	Relative contribution	Absolute contribution	Relative contribution
Côte d'Ivoire	−0.00407	0.00748	−0.540	0.993	–	–
Guinea-Bissau	0.00506	−0.0101	−0.504	1.009	−0.000765	0.00153
Niger	−0.00410	0.00974	−0.351	0.833	−0.0664	0.157
Togo	−0.00688	0.0130	−0.514	0.974	−0.00681	0.0129

Sources: MICS-2 for each country and authors' calculations.

minerals – only contributed slightly to children's welfare. Therefore, there remains a lot of room for the state to implement strategies pertaining to these two factors in order to improve child welfare.

4.2 Inequality Analysis

Unequal wealth distribution is important when analyzing the poverty profile, since it appears to play a greater role than poverty per se. The concept of inequality brings the entire population into the analysis, whereas poverty itself is only concerned with the poor portion of the population. Both concepts are, of course, very closely linked. For any given level of development, the emergence of more inequality results in greater poverty, since the poor receive less than the rich (Wodon and Yitzhaki, 2002). In addition, the higher the initial level of inequality, the lower the growth rates, therefore further restricting opportunities to reduce poverty.

As described in Section 2.1, the absolute Gini index of inequality is first used to assess the level of inequality in each country and then to decompose the total inequality in terms of the within group and between group contribution.

4.2.1 Analysis of the Gini Index at the National Level

The Gini index calculates the average distance between the classes of cumulative population and cumulative level of the standard of living. It is equal to twice the area between the Lorenz curve and the equality line. This index is between 0 (when there is perfect equality) and 1 (one individual holds the entire quality of life). Table 14 gives an overall view on the level of inequality in children's well-being. Inequality is substantial in every country in this study and is most extreme in Niger (0.43) and Guinea-Bissau (0.36), compared to 0.30 in Côte d'Ivoire and Togo.

Given the broad inequality across these countries, it would be interesting to assess these inequalities by place of residence, by decomposing the Gini index using the Shapley approach.

Table 14 Absolute Gini index in the WAEMU countries

Countries	Gini indicator
Côte d'Ivoire	0.299
Guinea-Bissau	0.355
Niger	0.427
Togo	0.297

4.2.2 Breakdown of the Absolute Gini Index by Place of Residence According to the Shapley Approach

The decomposition of the Gini index by place of residence according to the Shapley approach reveals inequality in all the countries studied, including the relative contribution of inter-group inequality. For example, Table 15 shows that 50% of

Table 15 Breakdown of the absolute Gini index by place of residence and country

Côte d'Ivoire	**S-Gini: decomposition by groups (inequality)**		
Estimated S-Gini	0.299		
Intra-group	0.149		
Inter-group	0.151		
Venue	Estimated S-Gini	Absolute contribution	Relative contribution
Urban	0.221	0.0453	0.151
Rural	0.354	0.105	0.352
Inter-group	0.149	0.149	0.497
Guinea-Bissau	**S-Gini: decomposition by groups (inequality)**		
Estimated S-Gini	0.356		
Intra-group	0.147		
Inter-group	0.208		
Venue	Estimated S-Gini	Absolute contribution	Relative contribution
Urban	0.255	0.0262	0.0736
Rural	0.397	0.182	0.513
Inter-group	0.147	0.147	0.414
Niger	**S-Gini: decomposition by groups (inequality)**		
Estimated S-Gini	0.298		
Intra-group	0.117		
Inter-group	0.181		
Venue	Estimated S-Gini	Absolute contribution	Relative contribution
Urban	0.233	0.0195	0.0656
Rural	0.320	0.161	0.542
Inter-group	0.117	0.117	0.392
Togo	**S-Gini: Decomposition by Groups (Inequality)**		
Estimated S-Gini	0.427		
Intra-group	0.206		
Inter-group	0.221		
Venue	Estimated S-Gini	Absolute contribution	Relative contribution
Urban	0.195	0.0217	0.0508
Rural	0.471	0.199	0.467
Inter-group	0.206	0.206	0.482

total inequality in Côte d'Ivoire, as measured by the absolute Gini index, can be explained by intra-group inequality. This means that half of the well-being inequality observed in children is due to their place of residence, implying that the other 50% of inequality is due to factors within the region. In Guinea-Bissau, 41% of this inequality can be attributed to the region of residence and 59% to intra-community factors. The amount of poverty that can be explained by region of residence is 39% in Niger and 48% in Togo.

4.2.3 Breakdown of the Gini Index by Economic Region

The data in Table 16 illustrate varying degrees of inequality. An analysis of the relative contribution of inter-group inequalities reveals that over 89% of the total inequality measured by the absolute Gini index is due to inter-group inequality. The proportion is 87% in Guinea-Bissau, 84% in Niger and 81% in Togo.

Table 16 Gini inequality index by region for each the country

Côte d'Ivoire			
Estimated S-Gini	0.299		
Intra-group	0.267		
Inter-group	0.0324		
Region	Estimated S-Gini	Absolute contribution	Relative contribution
Center	0.292	0.000999	0.00334
North Center	0.248	0.00202	0.00677
North East	0.282	0.000492	0.00164
East Center	0.204	0.000163	0.000547
South (not Abidjan)	0.276	0.00803	0.0268
South West	0.450	0.00292	0.00975
West Center	0.347	0.00626	0.0209
West	0.278	0.00388	0.0130
North West	0.414	0.000427	0.00143
North	0.381	0.00150	0.00501
Abidjan	0.177	0.00574	0.0192
Inter-group	0.267	0.267	0.892
Guinea-Bissau			
Estimated S-Gini	0.356		
Intra-group	0.308		
Inter-group	0.0473		
Region	Estimated S-Gini	Absolute contribution	Relative contribution
Tombali	0.350	0.00158	0.00445
Quinará	0.339	0.000757	0.00213
Oio	0.446	0.0139	0.0392
Biombo	0.364	0.00125	0.00351
Bolama/Bijagós	0.302	0.000330	0.000928
Bafatá	0.321	0.00854	0.0240
Gabú	0.482	0.00553	0.0156
Cacheu	0.329	0.00674	0.0189
SAB	0.215	0.00860	0.0242
Inter-group	0.308	0.308	0.867

Table 16 (continued)

Niger			
Estimated S-Gini	0.427		
Intra-group	0.360		
Inter-group	0.0669		
Region	Estimated S-Gini	Absolute contribution	Relative contribution
Agadez	0.167	0.000363	0.000850
Diffa	0.293	0.00778	0.0182
Dosso	0.479	0.0293	0.0685
Maradi	0.469	0.00835	0.0195
Tillaberi	0.460	0.0101	0.0236
Tahoua	0.491	0.00925	0.0217
Zinder	0.137	0.00176	0.00411
Inter-group	0.360	0.360	0.843
Togo			
Estimated S-Gini	0.298		
Intra-group	0.240		
Inter-group	0.0573		
Region	Estimated S-Gini	Absolute contribution	Relative contribution
Lomé	0.200	0.00245	0.00824
Maritime	0.328	0.0190	0.0637
Plateaux	0.326	0.0196	0.0659
Centrale	0.207	0.00191	0.00642
Kara	0.286	0.00492	0.0165
Savanes	0.306	0.00944	0.0317
Inter-group	0.240	0.240	0.807

A number of economic, political and social factors may explain regional inequalities. Developing countries' concentration of infrastructure in urban centers limits rural access to health services, while seasonal unavailability of certain services is a negative side effect of institutional decentralization. Socio-cultural setting also determines and modulates a group's norms and values, to varying degrees. These factors may all accentuate the inequality to some degree.

4.2.4 Breakdown of the Gini Absolute Inequality Index by Source

Vitamin A and minerals, vaccination and disease are assessed as determinants of the Gini index to determine which of these factors are effective at reducing inequality.

Table 17 shows which sources contribute most to absolute inequality. Broadly speaking, vaccination best explains the inequality in the distribution of well-being. Vaccination reduces child poverty in Côte d'Ivoire by about 89%, followed closely by the effectiveness of vitamin A supplements at 88%. The reduction of child poverty in Guinea-Bissau is 98% with vaccination, and nearly 97% with vitamin A supplements. On the other hand, the prevalence of disease increased child poverty by about 97%. In Niger, provision of vitamin A contributes to a 97% reduction in child poverty, in contrast to disease which increases poverty by 98%. In Togo, Guinea-Bissau and Côte d'Ivoire, the factor that helps reduce child poverty the most

Table 17 Absolute Gini index by source and country

Côte d'Ivoire		
Decomposition approach	Shapley	
Estimate of Gini	−7.068	
Source	Absolute contribution	Relative contribution
Vitamin A and minerals	58.0354	−8.210
Vaccination	−65.104	9.210
Guinea-Bissau		
Decomposition approach	Shapley	
Estimate of Gini	−251.421	
Source	Absolute contribution	Relative contribution
Vitamin A and minerals	−7,344.945	29.213
Vaccination	14,636.514	−58.215
Illnesses	−7,542.990	30.001
Niger		
Decomposition approach	Shapley	
Estimate of Gini	−17.676	
Source	Absolute contribution	Relative contribution
Vitamin A and minerals	−0.486	0.0275
Vaccination	−17.247	0.976
Illnesses	0.0568	−0.00321
Togo		
Decomposition approach	Shapley	
Estimate of Gini	31.773	
Source	Absolute contribution	Relative contribution
Vitamin A and minerals	−49.792	−1.567
Vaccination	70.173	2.209
Illnesses	11.392	0.359

is vaccination. The occurrence of a disease has heavily aggravated child poverty in the rest of the countries, although no conclusions can be drawn for Côte d'Ivoire, which did not have this information available in its database.

5 Conclusion

This study has explored factors which contribute to children's well-being in four WAEMU countries: Côte d'Ivoire, Niger, Guinea-Bissau and Togo. The results show that there are two sets of factors that determine the child's well-being. The first group includes access to vitamin A and iodized salt, breastfeeding, immunization against polio, diphtheria, measles, and yellow fever, and the second group considers the occurrence of diseases such as diarrhea, cough, fever, and breathing difficulties, and lack of immunization or an immunization card. Among these factors, the analysis showed that vaccination has contributed the most to reducing the composite welfare indicator, while infant vitamin A supplements and other diseases have increased it.

Based on the (FGT-type) absolute child well-being threshold, it is clear that child poverty affects a significant portion of children in WAEMU countries. Considering the incidence of multidimensional child poverty, we can rank the countries from lowest to highest for the incidence of child poverty: Togo, Côte d'Ivoire, Guinea-Bissau, and Niger. More than one in five children in these countries are poor, and this figure climbs to nearly one half when looking at Niger alone. The study found large regional disparities in child poverty across the WAEMU countries. This trend increases as we move away from capitals and child poverty is higher in rural areas than in urban areas.

It is also clear from the analysis that child poverty is correlated with the household wealth indicator. Child poverty is high in households classified as poor and low in households which are classified as wealthy, according to the multidimensional index of household wealth. This means that the households' standard of living is a factor in explaining the level of child poverty in the countries studied.

In terms of inequality analysis, the absolute Gini index indicates that there are significant inequalities in child welfare and well-being in the WAEMU countries regardless of whether the children live in urban or rural areas. We conclude that children in urban areas are less poor than those in rural areas and that there is also inequality between regions within each country.

Decomposing the absolute Gini index shows that differences in vaccination most significantly explain inequalities in child poverty. This is not surprising, since health ministries administer immunizations – such as those against polio – in almost all the WAEMU countries. This also holds true for the provision of vitamin A supplements, while disease is the factor that has contributed the least to the reduction of child poverty in each country.

The results of the study (from a descriptive analysis to an analysis of inequality through multivariate analysis), suggest that health ministry officials in each country, managers of NGOs in the fight against poverty, members of the Document Reduction Strategy (PRSP) monitoring team, and other actors in the field of poverty reduction should lay an emphasis on preventing childhood ailments other than nutritional deficiency and polio. This will drastically reduce child poverty in WAEMU countries in general. Similarly, reducing child well-being and welfare inequality between regions of residence will require effective local institutions in each country in order to ensure that local health services that contribute to reduced child poverty may be implemented.

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Multidimensional Poverty Among West African Children: Testing for Robust Poverty Comparisons

Yélé Maweki Batana and Jean-Yves Duclos

Abstract This paper develops new procedures for testing for robust multidimensional poverty comparisons and applies them to the welfare of children in six countries of the West African Economic and Monetary Union (WAEMU). Two dimensions are considered, nutritional status and assets. The estimation of the asset index is based on two data reduction methods. The first method uses Multiple Correspondence Analysis; the second is based on factor analysis. Using Demographic and Health Surveys (DHS), pivotal bootstrap tests lead to statistically significant dominance relationships between 12 of the 15 possible pairs of the six WAEMU countries. Multidimensional poverty is also inferred to be more prevalent in rural than in urban areas. These results tend to support those derived from more restrictive unidimensional dominance tests.

Keywords Stochastic dominance · Factor analysis · Bayesian analysis · Multidimensional poverty · Empirical likelihood function · Bootstrap tests

JEL Classification C10, C11, C12, C30, C39, I32

1 Introduction

The literature on poverty measurement generally follows either of two approaches. The first one is based on monetary indicators (e.g., Atkinson 1998, Chen and Ravallion 2001) and essentially treats income or consumption as a unidimensional proxy for welfare; the second approach makes use of a broader set of multidimensional variables (see for instance Streeten et al. 1981 or Maasoumi 1999). The second approach has gained significantly in popularity since the seminal work of Sen (1985). It also underlies the promotion of the Millenium Development Goals

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(MDG) by the United Nations, since the MDG focus on deprivation in multiple dimensions.

Although it is indeed now common to assert that poverty is a multi-dimensional phenomenon, there exist, however, significant difficulties in implementing a truly multidimensional analysis of poverty. In performing such a task, a number of intrinsically arbitrary measurement assumptions are often made, consisting inter alia in choosing aggregation procedures across dimensions of well-being, aggregation procedures across individuals, and multidimensional poverty lines to separate the poor from the non-poor. Each of these choices raises concerns over the possible non-robustness of the results that are obtained.

For instance, an important branch of the literature that considers multiple dimensions of welfare – of which the best-known example is probably the Human Development Index of the United Nations Development Program (1990) – aggregates simple summary measures of welfare (in terms of life expectancy, literacy, and GDP) into a single one-dimensional index. The across-dimension and across-individual aggregation procedures used in that exercise can easily be criticized – see for instance Kelley (1991) – and several alternative procedures can be (and have been) proposed that can lead to alternative views of poverty across time and space.

To allay such concerns over issues of arbitrariness and non-robustness, an alternative to comparing summary indices of multidimensional poverty is to seek poverty comparisons that are valid for a broad class of measurement assumptions. Dominance (or robustness) tests have been in existence in the context of unidimensional comparisons of poverty for many years now (e.g., Atkinson 1987, Foster and Shorrocks 1988a, b, Anderson 1996, Davidson and Duclos 2000, or Barrett and Donald 2003). It is well known that one important advantage of such tests is that they are capable of generating poverty comparisons that are robust to the choice of both poverty indices and unidimensional poverty lines. Multidimensional poverty dominance tests have been the object of more recent attention (see for instance Bourguignon and Chakravarty 2002, Atkinson 2003, Duclos et al. 2006). In performing multidimensional dominance tests, one is seeking robustness over aggregation procedures across dimensions of welfare, robustness over aggregation procedures across individuals, and robustness over choices of multidimensional poverty lines.

One difficulty with tests for multidimensional poverty dominance is due to the "curse of dimensionality" (see Bellman 1961), a curse that affects all non-parametric comparisons of distributions with multiple variates. This curse is likely to strike in many practical applications of the above multidimensional dominance methodology. The monitoring of the MDG suggests for instance that one should look jointly at a variety of income, health, mortality, educational, and environmental indicators. The typical "poverty reduction strategies" drawn by many developing countries draw attention to several dozens of welfare indicators. Comparing the joint distributions of these various indicators across time and space will often prove to be statistically too demanding.

As an alternative to the above, Section 2 of this paper proposes and implements a new statistical procedure that stands as a compromise between a desire for greater robustness to measurement assumptions than is usually found in the multidimensional poverty literature, and a practical need for statistical and empirical tractability. To do this, the paper estimates asset indices that incorporate various attributes of difficult-to-aggregate individual indicators of living standards. This is done in the spirit of Sahn and Stifel (2000) and (2003), for instance, who apply data reduction methods on multiple welfare indicators to derive a unidimensional welfare index, and on the basis of which they then perform tests for unidimensional dominance in poverty over time and across countries. An important advantage of this approach is to avoid having to specify a priori difficult-to-assign index values to various goods and services. Two methods are used to estimate the asset indices. The first one uses Multiple Correspondence Analysis; the second is based on factor analysis.

The paper subsequently performs a two-dimensional dominance analysis that takes into account an additional indicator of welfare, this time in the dimension of health and nutrition, an indicator that may be distributed quite differently from the above asset index. Hence, we compare welfare using two dimensions, an asset index and health, allowing significant flexibility in mixing up the two dimensions while enforcing sufficient statistical and informational manageability.

Testing for multidimensional dominance then involves comparing joint distribution functions over an infinite number of combinations of possible poverty thresholds in each dimension. This raises obvious computational and statistical challenges. The second main contribution of the paper is thus to develop and implement new statistical procedures that enable inferring multidimensional population dominance from sample data for univariate distributions to the case of multivariate distributions. This is done by extending the use of the empirical likelihood method that Davidson and Duclos (2006) have suggested to test the existence of unidimensional poverty dominance relationships. The outcome is the derivation of an intersection–union statistical test procedure that enables inferring strict dominance relationships in a multivariate context. These measurement and statistical methods are described in Section 3.

The above measurement and statistical methodology is then applied in Section 4 to comparing multidimensional poverty among children in six member countries of the West African Economic and Monetary Union: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, and Togo. Wide disparities are observable across these countries, with Côte d'Ivoire accounting for nearly 40% of the output of the Union. Child poverty is also compared within each country across rural and urban areas, in part to check whether the usual monetary comparisons that show lower poverty in urban areas also carry over to the case of multiple dimensions. It is indeed possible that, even with lower overall average incomes, rural children may live in households that possess greater assets, that have better and more direct access to agricultural produce, and that are better nourished than city dwellers, who must frequently pay a higher price for what may be lower-quality foodstuffs.

Section 5 concludes by summarizing the paper's main results.

2 Estimating the Welfare Indicators

We first define the two indicators of welfare used for the paper's multidimensional poverty analysis. The first indicator is a measure of nutrition and health; the second measures assets and is derived from two estimation procedures, i.e., an inertia method based on Multiple Correspondence Analysis (MCA) and a factor analysis procedure using likelihood.

2.1 Calculating an Indicator of Health and Nutrition

Several measures of health and nutrition are used in the literature, the main ones being weight-for-height indices, height-for-age indices, and weight-for-age indices. These indices are obtained from comparisons of weights or heights with the mean or median value of a reference population. For children, Sahn and Stifel (2002) argue for the use of a height-for-age index since it is not as much affected as other indices by episodes of stress, diarrhoea, malaria, or other conditions that may temporarily modify the health and nutritional status of an individual. Instead, height-for-age indices tend to capture the cumulative impact on health of longer-term factors, such as average socio-economic conditions and public health policy – vaccination programs, efforts to combat endemic diseases and other chronic illnesses, or sanitation programs for instance.

A height-for-age Z_score for a child i can be computed as

$$Z\_\text{score}_i = \frac{H_i - H_{\text{median}}}{\sigma_H}, \tag{1}$$

where T_i is the child's body height, H_{median} is the median body height of a healthy and well-nourished child from the reference population used by the US National Center for Health Statistics, and σ_H is the standard deviation of body heights in the reference population. The children in question are between 3 and 35 months. By convention, a child with a Z_score falling below -2 (a nutritional poverty "threshold") is usually deemed to be suffering from malnutrition.

2.2 Estimating the Asset Index

2.2.1 An Inertia Approach

An inertia approach is used to derive an asset index. Let each of N individuals, indexed $i = 1, \ldots, N$, exhibit J welfare attributes, $j = 1, \ldots, J$. These N individuals can be represented by a cloud of points around a centroid (the weighted means) in the space of the J attributes, with each point having some weight. The total inertia of the cluster of points is the weighted sum of the distance of each point from the centroid.

The main issue is how to proceed to the estimation of an asset index for each household using a weighted sum of the welfare attributes. Let X_i be the asset index for individual i, x_{ij} be his endowment of attribute j, and α_j be the weight assigned to each attribute. X_i is then given by

$$X_i = \alpha_1 x_{i1} + \ldots + \alpha_J x_{iJ}. \tag{2}$$

In order to check for robustness over the choice of the inertia method for the data reduction operation implicit in (2), two methods are used, both being suitable when we deal with qualitative variables. The first one, a MCA procedure, is well known and will not be described in detail here (see for instance Greenacre 1993, Greenacre and Blasius 2006). The second method, which involves a maximum likelihood procedure, has proven to be quite useful in social sciences (such as psychology) and is based on confirmatory factor analysis with qualitative variables. Since it is less familiar to economists, we outline it below.

2.2.2 A Factor Analysis Approach

The factor analysis involving categorical variables has been widely discussed in the literature (see for instance Bartholomew 1983, 1984, Moustaki 2000, Jöreskog and Moustaki 2001 among others).

Consider the following model:

$$x_{ij}^* = \lambda_j f_i + \varepsilon_{ij}, \quad j = 1, 2, \ldots, J \quad \text{and} \quad i = 1, 2, \ldots, N. \tag{3}$$

The factor f_i, which is specific to each individual i, captures the individual's unobserved welfare level. The error term, ε_{ij}, also unobserved, is specific to each household and to each variable. The difference with the linear model of Sahn and Stifel (2000) and (2003) is that the continuous response variable x_{ij}^* is unobserved in the present case. The model in (3) also differs from standard limited dependent variable models in that f_i is unobserved. Dropping the index i (without loss of generality), x_j^* and x_j (which is observed) are linked as follows:

$$x_j = a \Leftrightarrow \gamma_{a-1}^{(j)} < x_j^* \leq \gamma_a^{(j)}, \quad a = 1, 2, \ldots, m_j, \tag{4}$$

where $\gamma_0^{(j)} = -\infty$, $\gamma_1^{(j)} < \gamma_2^{(j)} < \cdots < \gamma_{m_j-1}^{(j)}, \gamma_{m_j}^{(j)} = +\infty$ are the threshold parameters. Thus, for m_j categories of response for a given variable, there are $m_j - 1$ threshold parameters. Since the mean and the variance of x_j^* are not identified, we set them equal to 0 and 1, respectively. We also assume that f and ε_j are independently and normally distributed with $f \sim N(0, 1)$ and $\varepsilon_j \sim N(0, \psi_j)$. Since the first two moments of x_j^* have been normalized to 0 and 1 respectively, we have $\psi_j = 1 - \lambda_j^2$. The distribution of $x_1^*, \ldots, x_J^*$ is then multivariate normal with mean zero, variance one, and a correlation matrix $\Gamma = (\rho_{jk})$, where $\rho_{jk} = \lambda_j \lambda_k$. The parameters to be estimated are the threshold parameters $\gamma_a^{(j)}$ and the coefficients of the factors λ_j, with $j = 1, 2, \ldots, J$ and $a = 1, 2, \ldots, m_j - 1$. The total number of parameters to be estimated is then $\Sigma_{j=1}^J m_j$.

The estimation of (3) will be performed using the Underlying Bivariate Normal (UBN) procedure suggested by Jöreskog and Moustaki (2001). The score will then be computed from a Bayesian approach proposed by Shi and Lee (1997). Section A.3 in Appendix provides further details.

3 Multidimensional Stochastic Dominance

The dominance techniques used here are drawn from Duclos et al. (2006) and are multidimensional extensions to the stochastic dominance techniques developed by Atkinson (1987), Foster and Shorrocks (1988a, b) for a one-dimensional framework. They make ordinal poverty comparisons possible over classes of procedures for aggregating across dimensions and across individuals. They also allow for robustness over areas of possible multidimensional poverty "frontiers" – analogous to the usual unidimensional poverty lines. We outline these techniques briefly below.

3.1 First-Order Dominance

Duclos et al. (2006) start by defining a generic additive multidimensional poverty index as

$$P(\lambda) = \int\int_{\Lambda(\lambda)} \pi(x_1, x_2; \lambda)\, \mathrm{d}F(x_1, x_2), \tag{5}$$

where $\lambda(x_1, x_2)$ is a function that captures individual welfare (analogous to a utility function), $\lambda(x_1, x_2) = 0$ is a poverty "frontier" that separates the rich from the poor, and $\Lambda(\lambda)$ is the (x_1, x_2) area defined as $\lambda(x_1, x_2) \leq 0$ within which the set of poor people can be found.

Note that the definition of $\lambda(x_1, x_2)$ is general enough to encompass what are known as union, intersection, or intermediate definitions of the poor. This is illustrated in Fig. 1, where x_1 and x_2 are two dimensions of welfare. $\lambda_1(x_1, x_2)$ provides an "intersection" definition of poverty: it considers someone to be in poverty only if he is poor in *both* of the two dimensions. $\lambda_2(x_1, x_2)$ gives a union poverty index: it considers someone to be in poverty if he is poor in *either* of the two dimensions. $\lambda_3(x_1, x_2)$ provides an intermediate definition: someone can be poor even if $x_1 > Z_1$, if his x_2 value is sufficiently low to lie to the left of $\lambda_3(x_1, x_2) = 0$. Alternatively, someone can be non-poor even if $x_1 < Z_1$ if his x_2 value is sufficiently high to lie to the right of $\lambda_3(x_1, x_2) = 0$.

The dominance test that Duclos et al. (2006) propose then uses a two-dimensional extension of the well-known FGT index (Foster et al. 1984),

$$P^{\alpha_1,\alpha_2}(z_1, z_2) = \int_0^{z_1}\int_0^{z_2} (z_1 - x_1)^{\alpha_1} (z_2 - x_2)^{\alpha_2}\, \mathrm{d}F(x_1, x_2), \tag{6}$$

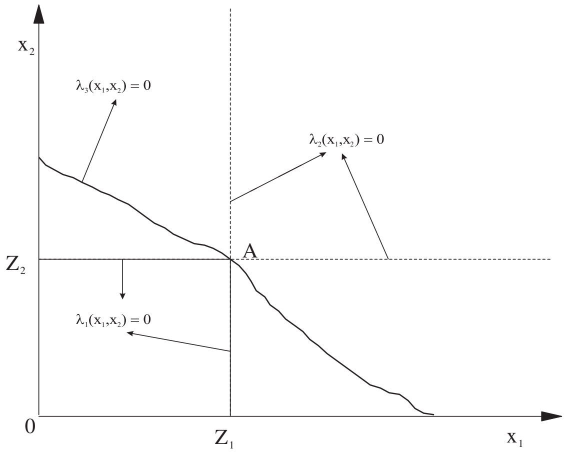

Fig. 1 Definitions of union, intersection, and intermediate poverty

where F is the bivariate cumulative distribution function and α_1 and α_2 are non-negative parameters that capture aversion to inequality in poverty in each of the two dimensions. With dominance orders s_1 and s_2 set to $s_1 = 1 + \alpha_1$ and $s_2 = 1 + \alpha_2$, plotting (6) over an area of z_1 and z_2 provides a dominance surface for a distribution F. The difference in that surface between distributions F and G is then given by

$$\Delta P^{s_1-1,s_2-1}(z_1, z_2) = \int_0^{z_1}\int_0^{z_2} (z_1 - x_1)^{s_1-1}(z_2 - x_2)^{s_2-1} d(F - G)(x_1, x_2). \tag{7}$$

To show how (7) can serve to order distributions in terms of multidimensional poverty, Duclos et al. (2006) use (5) to define the following first-order class of poverty indices $\Psi^{1,1}(\lambda^+)$:

$$\Psi^{1,1}(\lambda^+) = \left\{ P(\lambda) \left| \begin{array}{c} \Lambda(\lambda) \subset \Lambda(\lambda^+) \\ \pi(x_1, x_2; \lambda) = 0 \text{ if } \lambda(x_1, x_2) = 0 \\ \dfrac{\partial \pi(x_1, x_2; \lambda)}{\partial x_1} \le 0 \text{ and } \dfrac{\partial \pi(x_1, x_2; \lambda)}{\partial x_2} \le 0 \, \forall \, x_1, x_2 \\ \dfrac{\partial^2 \pi(x_1, x_2; \lambda)}{\partial x_1 \partial x_2} \ge 0 \, \forall \, x_1, x_2. \end{array} \right. \right\} \tag{8}$$

The first row of (8) defines the maximum set of poor people. The second row assumes continuity of the poverty indices along the poverty frontier. The third row follows from an axiom of *monotonicity* and states that the indices should be weakly decreasing in the attributes x_1 and x_2. The last row reflects an axiom of *attribute substitutability* – essentially saying that the greater the value of an attribute, the lesser the impact on poverty of an increase in the value of the other attribute.

None of these properties of π seems particulary problematic. Theorem 1 in Duclos et al. (2006) on first-order dominance then says that all of the multidimensional poverty indices in the class of measures $\Psi^{1,1}\left(\lambda^{+}\right)$ will be greater in F than in G if and only $\Delta P^{0,0}(z_1, z_2) > 0\, \forall\, (z_1, z_2) \in \Lambda\left(\lambda^{+}\right)$. The class $\Psi^{1,1}\left(\lambda^{+}\right)$ includes the FGT intersection indices $P^{0,0}\left(z_1, z_2\right)$, but all other multidimensional indices that obey the conditions defined in (8) also belong to $\Psi^{1,1}\left(\lambda^{+}\right)$.

3.2 Higher-Order Stochastic Dominance

It is possible to derive higher-order dominance conditions by making assumptions on the sign of the derivatives of order higher than in (8). The order of dominance can be increased in either of the dimensions individually, or in both simultaneously, leading, for example, to such classes as $\Psi^{2,1}\left(\lambda^{+}\right)$, $\Psi^{1,2}\left(\lambda^{+}\right)$ or $\Psi^{2,2}\left(\lambda^{+}\right)$. $\Psi^{2,1}\left(\lambda^{+}\right)$ can for instance be defined as

$$\Psi^{2,1}\left(\lambda^{+}\right) = \left\{ P\left(\lambda\right) \left| \begin{array}{c} P\left(\lambda\right) \in \Psi^{1,1}\left(\lambda^{+}\right) \\ \dfrac{\partial \pi\left(x_1, x_2; \lambda\right)}{\partial x_1} = 0 \text{ if } \lambda\left(x_1, x_2\right) = 0 \\ \dfrac{\partial^2 \pi\left(x_1, x_2; \lambda\right)}{\left(\partial x_1\right)^2} \geq 0\, \forall\, x_1 \\ \dfrac{\partial^3 \pi\left(x_1, x_2; \lambda\right)}{\left(\partial x_1\right)^2 \partial x_2} \leq 0\, \forall\, x_1, x_2 \end{array} \right. \right\} \quad (9)$$

The first row imposes compliance with the conditions of belonging to the class $\Psi^{1,1}\left(\lambda^{+}\right)$. The second row says that the first derivative with respect to x_1 should be continuous along the poverty frontier. The third imposes the well-known Pigou–Dalton *principle of transfer* on attribute x_1: it says that the poverty impact of increasing x_1 should decrease with x_1, or alternatively that an equalizing transfer in the x_1 dimension should diminish poverty. The last row assumes that the equalizing effect of such a transfer should decline with x_2; said differently, the greater the value of x_2, the lesser the importance of inequality in the dimension of x_1.

Theorem 2 of Duclos et al. (2006) then says that G dominates F in poverty over for the class $\Psi^{2,1}\left(\lambda^{+}\right)$ of poverty indices – namely, all of the multidimensional poverty indices in the class of measures $\Psi^{2,1}\left(\lambda^{+}\right)$ will be greater in F than in G – if and only if $\Delta P^{1,0}\left(z_1, z_2\right) > 0\, \forall\, \left(z_1, z_2\right) \in \Lambda\left(\lambda^{+}\right)$.

3.3 Statistical Inference

From the above, non-dominance of distribution F by distribution G implies that there exists a point (z_1, z_2) in $\Lambda\left(\lambda^{+}\right)$ for which $\Delta P^{s_1-1,s_2-1}\left(z_1, z_2\right) \leq 0$. This suggests the following set of null and alternative hypotheses for tests of multidimensional dominance:

$$H_0 : \Delta P^{s_1 s_2}(z_1, z_2) \leq 0 \text{ for some } (z_1, z_2) \text{ in } \Lambda\left(\lambda^+\right) \tag{10}$$

versus

$$H_1 : \Delta P^{s_1-1, s_2-1}(z_1, z_2) > 0 \text{ for all } (z_1, z_2) \text{ in } \Lambda\left(\lambda^+\right). \tag{11}$$

H_0 is a null of non-dominance of F by G. If this null is rejected, then all that is logically left is dominance of F by G, which is the alternative H_1.

Such tests are known in the literature as intersection/union tests. The most common procedure until now to test for such relations of "dominance" has been to posit a null hypothesis of dominance (an intersection set of hypotheses) against an alternative of non-dominance (a union set of converse hypotheses) – these being union/intersection tests. Rejection of the null in these tests of dominance fails, however, to rank the two populations. It may thus seem logically preferable to posit a null of non-dominance (as in (10)) and test we can infer the only other possibility, namely dominance (as in (11)).

To test for H_0 against H_1, we extend to the case of multivariate distributions the use of the empirical likelihood ratio (ELR) statistic suggested by Davidson and Duclos (2006) for univariate distributions. The ELR statistic captures the "distance" between the empirical distributions and the null hypothesis of non-dominance. It equals the difference between the unconstrained empirical likelihood of the distributions and the empirical likelihood constrained by H_0.

To see this more clearly, let n_i^F represent the number of sample observations that equal $\left(x_{i1}^F, x_{i2}^F\right)$, where $\left(x_{i1}^F, x_{i2}^F\right)$ are the values of indicators 1 and 2 taken by the ith observation of a sample of N_F independently and identically distributed observations drawn from distribution F – and analogously for n_j^G. Also, let $I(\cdot)$ be an indicator function assuming the value one when the argument is true, and zero otherwise, and let P_i^F and P_j^G be the empirical probabilities for the observations i and j of samples from F and G respectively. The ELR statistic (in log form) is then obtained first by maximizing the following empirical likelihood function

$$\max_{P_i^F, P_j^G} \sum_i n_i^F \log P_i^F + \sum_j n_j^G \log P_j^G \tag{12}$$

subject to

$$\sum_i P_i^F = 1, \quad \sum_j P_j^G = 1 \tag{13}$$

and constrained – or not – by

$$\sum_i P_i^F (z_1 - x_{i1}^F)^{s_1-1}(z_2 - x_{i2}^F)^{s_2-1} I\left(x_{i1}^F \le z_1, x_{i2}^F \le z_2\right)$$
$$\le \sum_j P_j^G (z_1 - x_{j1}^G)^{s_1-1}(z_2 - x_{j2}^G)^{s_2-1} I\left(x_{j1}^G \le z_1, x_{j2}^G \le z_2\right) \quad (14)$$

for some (z_1, z_2) in $\Lambda\left(\lambda^+\right)$.

It can be checked that the maximization of (12) unconstrained by (14) is given by $N \log N - N_F \log N_F - N_G \log N_G$. As for the constrained maximum, if F dominates G in the sample, then there is no cost to imposing (14); in this case, the constraint is not binding and the ELR statistic equals zero. We cannot then reject H_0.

If instead G dominates F in the sample, it is useful to distinguish between first-order and higher-order dominance. If $s_1 = s_2 = 1$, the constraint in (14) becomes

$$\sum_i P_i^F I\left(x_{i1}^F \le z_1, x_{i2}^F \le z_2\right) = \sum_j P_j^G I\left(x_{j1}^G \le z_1, x_{j2}^G \le z_2\right). \quad (15)$$

Proceeding to (12) subject to (15) yields the following empirical probabilities:

$$P_i^F = \frac{n_i^F I_i(z_1, z_2)}{\varpi} + \frac{n_i^F \left(1 - I_i(z_1, z_2)\right)}{\psi},$$
$$P_j^G = \frac{n_j^G I_j(z_1, z_2)}{N - \varpi} + \frac{n_j^G \left(1 - I_j(z_1, z_2)\right)}{N - \psi}, \quad (16)$$

with

$$I_i(z_1, z_2) = I\left(x_{i1}^F \le z_1, x_{i2}^F \le z_2\right), I_j(z_1, z_2) = I\left(x_{j1}^G \le z_1, x_{j2}^G \le z_2\right), \quad (17)$$

$$\varpi = \frac{N \times N_F(z_1, z_2)}{N_F(z_1, z_2) + N_G(z_1, z_2)}, \psi = \frac{N \times M_F(z_1, z_2)}{M_F(z_1, z_2) + M_G(z_1, z_2)}, \quad (18)$$

$$N_F(z_1, z_2) = \sum_i n_i^F I_i(z_1, z_2), N_G(z_1, z_2) = \sum_j n_j^F I_j(z_1, z_2), \quad (19)$$

$$N = N_F + N_G, \quad (20)$$

$$M_F(z_1, z_2) = N_F - N_F(z_1, z_2), M_G(z_1, z_2) = N_G - N_G(z_1, z_2). \quad (21)$$

The ELR statistic is then obtained by the difference between the unconstrained maximum and the maximum over $(z_1, z_2) \in \Lambda\left(\lambda^+\right)$ of the constrained likelihood (given by $\sum_i n_i^F \log P_i^F + \sum_j n_j^G \log P_j^G$ using (16)). The distributions consistent with the null of non-dominance that make the empirical distributions as plausible as possible are thus given by the (z_1, z_2) point in $\Lambda\left(\lambda^+\right)$ for which the likelihood cost of imposing the null $H_0 : \Delta P^{s_1 s_2}(z_1, z_2) \leq 0$ is lowest. The "least favorable case" for rejecting the null is thus the case in which the surfaces for the two distributions just touch at the (z_1, z_2) with lowest likelihood cost, without the surfaces having to be equal everywhere.

This is illustrated by Fig. 2. It depicts the difference between two surfaces representing respectively the cumulative distributions F and G. This difference is positive for all $(z_1, z_2) \in \Lambda(\lambda^*)$, denoting that G dominates F. However, the dominance is statistically significant only if all differences are. The A point in the figure is the one with the smallest difference between the surfaces. Constraining the two surfaces to be equal at this point induce the lowest likelihood cost, resulting in the lowest ELR statistic. In practice, we consider the minimum of the ELR statistics at all (z_1, z_2) for testing non dominance.

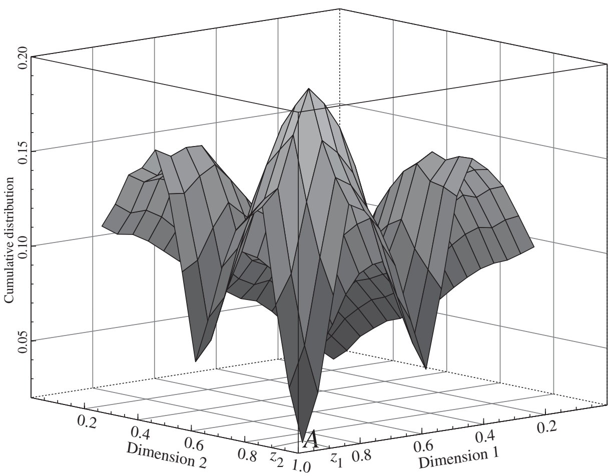

Fig. 2 Difference between two cumulative bidimensional distribution

The ELR statistics are given by:

$$\frac{1}{2}\mathrm{LR}(z_1, z_2) = \left\{ \begin{array}{c} N \log N - N_F \log N_F - N_G \log N_G \\ +N_F(z_1, z_2) \log N_F(z_1, z_2) + N_G(z_1, z_2) \log N_G(z_1, z_2) \\ +M_F(z_1, z_2) \log M_F(z_1, z_2) + M_G(z_1, z_2) \log M_G(z_1, z_2) \\ -(N_F(z_1, z_2) + N_G(z_1, z_2)) \log (N_F(z_1, z_2) + N_G(z_1, z_2)) \\ -(M_F(z_1, z_2) + M_G(z_1, z_2)) \log (M_F(z_1, z_2) + M_G(z_1, z_2)) . \end{array} \right\} \quad (22)$$

It is then a matter of notation to use Theorem 1 of Davidson and Duclos (2006) to show that (22) is asymptotically equivalent to the square of an asymptotically normally distributed t statistic used by Kaur et al. (1994) and given in our context by

$$\frac{N_F N_G \left(\widehat{F}(z_1, z_2) - \widehat{G}(z_1, z_2)\right)^2}{N_G \widehat{F}(z_1, z_2)\left(1 - \widehat{F}(z_1, z_2)\right) + N_F \widehat{G}(z_1, z_2)\left(1 - \widehat{G}(z_1, z_2)\right)}, \tag{23}$$

where $\widehat{F}(z_1, z_2)$ and $\widehat{F}(z_1, z_2)$ are the empirical distribution functions of F and G, respectively. An outline of proof is given in Section A.1 in Appendix. We can also show that, on the frontier of the null H_0 of non-dominance, both the ELR statistic and (23) are asymptotically pivotal, that is, they follow the same asymptotic distribution for all configurations of the population distributions that lie on the frontier.

As in Davidson and Duclos (2006), therefore, we can perform bootstrap tests to yield more satisfactory inference than tests based solely on the asymptotic distribution of the ELR statistic. To do this (again, this needs to be done only when dominance of F by G exists in the sample), we compute the maximum of the ELR statistic (22) over $(z_1, z_2) \in \Lambda\left(\lambda^+\right)$ – denote this maximum as $\mathrm{LR}_0(z_1, z_2)$ – and calculate the associated probabilities in (16). These probabilities are then used to generate a certain number (399 in the illustration below) of bootstrap samples for both distributions. For each pair of such bootstrap samples, a new ELR statistic in (22) is computed. A bootstrap value p is computed as the proportion of bootstrap ELR statistics that exceed $\mathrm{LR}_0(z_1, z_2)$.

For higher-order dominance, the same procedure can be followed, except that there exists no analytical solution analogous to (16). Details of the computations are provided in Section A.2 in Appendix for such cases.

4 Empirical Comparisons of Child Poverty in West Africa

4.1 The Data

We apply the above methodology to compare multidimensional child poverty across countries that are members of the West African Economic and Monetary Union (WAEMU) and for the period of the mid-1990s (1996–1998). The data come from nationally representative Demographic and Health Surveys (DHS) of urban and rural households, and cover six countries from West Africa: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, and Togo. Senegal, an important member of WAEMU, was excluded because nutritional data were not collected for the period under consideration. Basic descriptive information on the the surveys used can be found in Table 1. All estimates take into account the sampling weight of each observation.

The DHS surveys provide the necessary information required for calculating a nutritional index (Z_score) and an asset index (X) for each child. To compute the Z_score, we use data on the body height, age, and sex of children, as well as standard values for the reference children population. The asset index then takes into account household well-being, and the nutritional index is based on child well-being.

As to X, we estimate it from information on ownership of durable goods (radio, television, refrigerator, bicycle, motorcycle, car) and on access to other goods and

Table 1 Description of the demographic and health surveys used

Survey years	Benin 1996	Burkina Faso 1998–1999	Côte d'Ivoire 1998–1999	Mali 1995–1996	Niger 1998	Togo 1998
Number of households						
– Total	4,499	4,812	2,122	8,716	5,928	7,517
– Urban area (%)	32	26	67	32	28	32
– Rural area (%)	68	74	33	68	72	68
Number of women						
– Total	5,491	6,445	3,040	9,704	7,577	8,569
– Urban area (%)	33	26	68	36	31	36
– Rural area (%)	67	74	32	64	69	64
Number of men						
– Total	1,535	2,641	886	2,474	3,542	3,819
– Urban area (%)	33	30	66	36	34	35
– Rural area (%)	67	70	34	64	66	65

services (electricity, type of toilet, quality of flooring, potable water, education). All variables are qualitative, which is why MCA and factor analysis are used. We use all of the six samples combined to generate the factor scores.

Descriptive statistics on these indices are presented in Tables2 and 3. On an average, Côte d'Ivoire, Togo, and Mali post the best welfare levels, while Burkina Faso and Niger show the weakest ones.

Table 4 presents a sensitivity analysis on the two methods used to estimate the asset index. Whether the estimated indices describe welfare is informed by whether the percentage of households not affording a good or a service declines

Table 2 Descriptive statistics on the asset index (X)

	Factor analysis				MCA procedure			
Country	Means	Std dev.	Max	Min	Means	Std dev.	Max	Min
Benin	0.009	0.573	1.930	−0.486	0.020	0.587	2.819	−0.456
Burkina Faso	−0.150	0.472	2.045	−0.486	−0.133	0.496	2.819	−0.456
Côte d'Ivoire	0.663	0.754	2.044	−0.481	0.566	0.788	2.819	−0.449
Mali	0.066	0.498	1.989	−0.490	−0.010	0.496	2.647	−0.456
Niger	−0.179	0.482	2.009	−0.479	−0.159	0.485	2.819	−0.449
Togo	0.138	0.583	1.931	−0.491	0.104	0.580	2.819	−0.456
All	0.023	0.574	2.045	−0.491	0.000	0.572	2.819	−0.456

Table 3 Descriptive statistics on the nutritional indicator (Z_score)

Country	Mean	Std-dev.	Max	Min
Benin	−1.265	2.724	19.527	−28.471
Burkina Faso	−1.749	2.512	17.108	−28.921
Côte d'Ivoire	−1.350	2.312	7.294	−27.808
Mali	−1.294	2.428	45.800	−23.978
Niger	−1.762	1.944	10.954	−13.117
Togo	−1.196	2.345	37.817	−29.016
All	−1.449	2.389	45.800	−29.016

Table 4 Sensitivity analysis on the asset index (X) – % of quartile not enjoying a good or a service

	Factor analysis				MCA			
Quartiles of asset index	1st	2nd	3th	4th	1st	2nd	3th	4th
No electricity	100	100	100	57.3	100	100	99.7	57.0
No radio	82.7	31.6	35.2	18.9	72.0	56.2	20.7	16.7
No TV	100	100	100	59.0	100	100	99.8	58.5
No refrigerator	100	100	100	84.4	100	100	100	84.2
No bicycle	54.0	39.7	51.5	67.4	46.8	57.1	42.7	68.3
No motorbike	100	82.9	80.8	60.8	100	83.6	78.4	59.4
No car	100	100	99.9	87.4	100	100	99.9	87.2
Low quality floor	100	68.8	72.6	28.5	100	80.5	60.0	25.2
No toilet	100	95.0	36.0	14.8	100	78.4	45.5	18.2
No education	100	99.7	76.7	41.3	99.6	89.2	80.1	46.8
No water access	14.1	15.5	11.5	5.2	14.8	18.2	9.4	4.3

Table 5 The correlations between the asset indices produced by the factor analysis and the MCA procedures

Country	Coefficients
Benin	0.97
Burkina Faso	0.98
Côte d'Ivoire	0.94
Mali	0.96
Niger	0.97
Togo	0.96
All	0.96

with movement from a lower to a higher quartile of the asset indices. Both the MCA and factor analysis seem to work reasonably well. Table 5 also demonstrates that these two indices are highly (though not perfectly) correlated, with a correlation coefficient of 96 % for the entire sample. The factor analysis estimator is henceforth used rather than MCA estimator for presenting the results of the dominance analysis, although dominance is not said to be accepted below unless it is confirmed by both asset indices.

4.2 Results of the Dominance Tests

First, unidimensional poverty dominance relations are tested, for each dimension, using the procedure followed by Davidson and Duclos (2006). The higher-order dominance tests are performed by adapting the method described in Section A.2 in Appendix to the case of unidimensional dominance. Rather than to test over the full set of points in in Λ (λ^*), which is possible in theory but computationally expensive, a grid of 100 points is considered. Consider two countries represented respectively by distributions F and G. The test is conducted against the null hypothesis that G does not dominate F. With the six countries, there are 15 possible comparisons, and thus 15 possible dominance relationships.

The results of the dominance tests for assets and nutritional health are illustrated respectively in Figs. 3 and 4. These figures depict the countries' rankings in terms of unidimensional dominance. A solid arrow reflects first-order dominance, while a dashed arrow represents higher-order dominance. The position of each country vis-à-vis the peak reveals its position in terms of welfare.

For dominance in assets (Fig. 3), Côte d'Ivoire's presence at the peak reflects the fact that it has the lowest level of multidimensional poverty, while Burkina Faso is at the bottom with the highest level. Eleven dominance relations prove to be significant

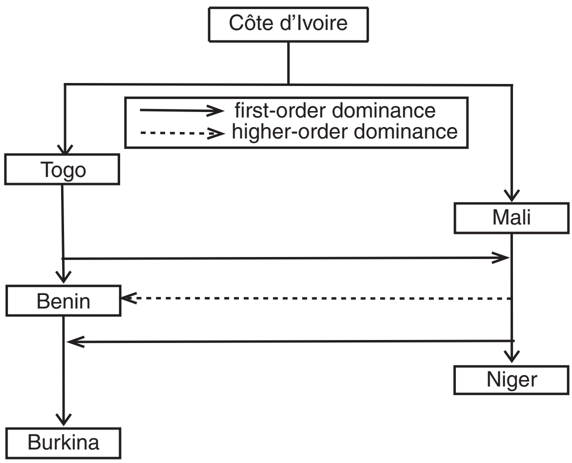

Fig. 3 Diagram of dominance in assets among the countries of WAEMU – *Solid arrows* indicate first-order dominance; *dashed arrows* show higher-order dominance

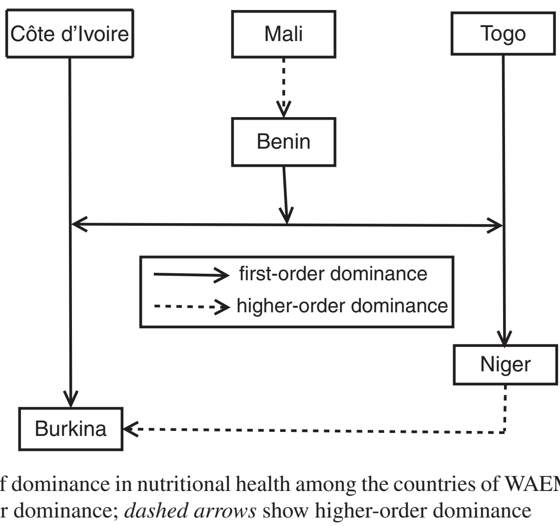

Fig. 4 Diagram of dominance in nutritional health among the countries of WAEMU – *Solid arrows* indicate first-order dominance; *dashed arrows* show higher-order dominance

at the first order and one more at the second order. We fail to rank Mali and Togo, Burkina Faso and Niger, and Niger and Benin.

We observe fewer dominance relationships in the case of nutritional health (Fig. 4). There are 8 first-order and higher-order dominance relations. One group of better-fed people includes Côte d'Ivoire, Mali and Togo between which no dominance is observed. Even if, at third-order dominance, the latter two countries seem better than the first, the statistical tests are inconclusive. Benin appears as an intermediate country since it is dominated only by Mali at the third order. The remaining countries, Burkina Faso and Niger, are the less well-fed group with Burkina as the worst country. These two countries are first-order dominated by all others, while Burkina Faso is dominated by Niger at the third order.

To test for multidimensional poverty dominance, we also use a grid of points (z_1, z_2), rather than consider all points in the two distributions F and G, with $z_1 \in \left[z_1^-, z_1^+\right]$, and $z_2 \in \left[z_2^-, z_2^+\right]$. To constitute the grid, we consider 20 quantiles for the asset index and 10 quantiles (deciles) for the nutritional index, which we determine after merging the two distributions to be compared. Moreover, rather than consider the quantiles as such, the grid is defined by taking the mean of each quantile. This yields a total of 200 points for each comparison. All of the checks we have made suggest, however, that the results below are robust to increasing the number of points within that grid.

Table 6 presents the country-wise results of the first-order multidimensional dominance tests. The first country represents distribution F and the second country represents distribution G. The results reveal the existence of 12 statistically significant dominance relationships with p values lower than 10%, 10 with p values lower than 5%, and 8 with p values lower than 1%.

Aside from the case Burkina–CI (CI stands for Côte d'Ivoire), which is a dominance relationship that extends over the full grid of $\Lambda\left(\lambda^*\right)$ described above, the 11 other dominance relationships are more limited, in the sense that it is necessary to exclude certain points on the grid (in the lower or upper extremities) to obtain dominance. Still, dominance in these other relationships is both statistically quite strong and normatively robust to both the choice of a wide area of possible poverty frontiers (so long as they fall in $\Lambda\left(\lambda^*\right)$) and to the choice of multidimensional poverty indices within the class $\Psi^{1,1}\left(\lambda^*\right)$).

The three cases of non-dominance shown in Table 6 correspond to situations in which there are several points of intersection between the two distributions, such that it proves impossible to obtain significant differences in dominance surfaces. Côte d'Ivoire dominates all countries, followed by Togo, which dominates 3 countries, to wit Benin, Burkina Faso, and Niger. Benin and Mali dominate Burkina Faso and Niger. We observe no dominance between Mali and Togo, Mali and Benin, and Burkina and Niger.

The case of non-dominance between Mali and Togo is illustrated in Fig. 5. Figure 5 depicts the distribution of the t-statistics over both dimensions. Values of t-statistics that significantly above zero can be observed for the lighter areas. A choice of a point in these areas (X for instance) as the multidimensional poverty thresholds could lead to some FGT measures to conclude that children in Togo

Table 6 Tests for first-order multidimensional poverty dominance, country F versus country G, over $[z^-, z^+]$ intervals

Countries $F - G$	$[z^-, z^+]$ intervals Asset X	Z_score	p-value of rejecting non-dominance of F by G
Benin–Côte d'Ivoire	[−0.46, 1.23]	[−2.96, 2.18]	0.000[a]
Burkina Faso–Côte d'Ivoire	[−0.48, 1.87]	[−5.97, 2.23]	0.003[a]
Mali–Côte d'Ivoire	[−0.44, 1.52]	[−3.27, 2.30]	0.000[a]
Niger–Côte d'Ivoire	[−0.45, 1.85]	[−3.46, 1.85]	0.000[a]
Togo–Côte d'Ivoire	[−0.44, 1.00]	[−2.87, 2.18]	0.000[a]
Benin–Togo	[−0.46, 0.24]	[−2.92, 2.36]	0.090[b]
Burkina Faso–Togo	[−0.47, 1.18]	[−5.64, 2.23]	0.013[c]
Mali–Togo	–	–	No dominance
Niger–Togo	[−0.44, 1.63]	[−5.03, 1.97]	0.033[c]
Benin–Mali	–	–	No dominance
Burkina Faso–Mali	[−0.47, 1.08]	[−5.46, 2.44]	0.000[a]
Niger–Mali	[−0.45, 1.62]	[−3.47, 2.28]	0.000[a]
Burkina Faso–Benin	[−0.47, 1.64]	[−5.85, 0.44]	0.003[a]
Niger–Benin	[−0.44, 1.10]	[−3.38, 2.11]	0.070[b]
Burkina Faso–Niger	–	–	No dominance

[a] Significant at 1%.
[b] Significant at 10%.
[c] Significant at 5%.

are less poor than children in Mali. However, significantly negative values can also be observed in the darker areas. Selecting, for example, point Y from these areas produces the opposite ranking of Mali and Togo. The dominance testing procedure cannot then rank unambiguously multidimensional poverty over the two countries.

Figure 5 also confirms the non dominance relationship between Mali and Togo in the unidimensional context. The right side of the whole surface, or the line linking A and B, shows the t-statistics over the unidimensional distribution of Z_scores, while the line linking A and C shows the t-statistics for the unidimensional distribution of

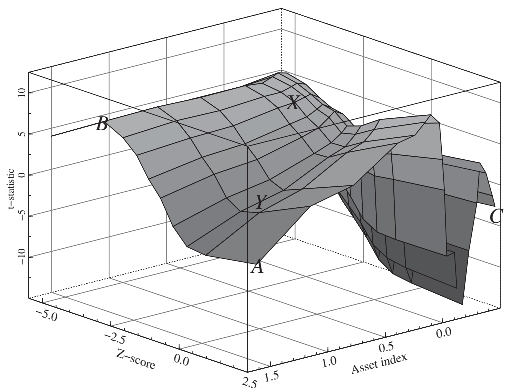

Fig. 5 Distribution of the t-statistics for the difference in the dominance curves between Mali (F) and Togo (G)

assets. Both lines post positive and negative values of t-statistics, denoting that the unidimensional dominance curves intersect.

Table 7 presents statistics for multidimensional comparisons of child welfare in rural and urban areas *within* each of the six different countries, and for all countries taken together. It clearly shows that the urban area dominates the rural one, for every country as well as for the global sample. All p values are below 5%, and 4 of the 7 dominance relationships for Burkina Faso, Mali, Togo, and the whole sample show unrestricted dominance, namely, over the widest possible $\left[z_1^-, z_1^+\right] \otimes \left[z_2^-, z_2^+\right]$ and thus over the entire range $\Lambda\left(\lambda^+\right)$ of possible poverty frontiers. The other dominance relationships are more restricted but still very robust.

Table 7 Tests of first-order multidimensional poverty dominance, rural area (F) versus urban area (G) within different countries, over $\left[z^-, z^+\right]$ intervals

	$\left[z^-, z^+\right]$ intervals		p-value of rejecting
Countries	Asset X	Z_score	non-dominance of F by G
Benin	[−0.48, 1.58]	[−3.00, 2.37]	0.018[b]
Burkina Faso	[−0.48, 1.68]	[−6.03, 2.43]	0.028[b]
Côte d'Ivoire	[−0.40, 1.92]	[−2.86, 1.84]	0.013[b]
Mali	[−0.46, 1.57]	[−5.02, 2.44]	0.033[b]
Niger	[−0.45, 1.62]	[−4.88, 1.63]	0.025[b]
Togo	[−0.47, 1.58]	[−5.08, 2.07]	0.008[c]
Total	[−0.47, 1.73]	[−5.33, 2.27]	0.000[c]

[a] Significant at 10%.
[b] Significant at 5%.
[c] Significant at 1%.

To order the countries that are not ranked by Table6, we may proceed to tests for higher-order dominance. Table 8 shows the results. The nulls of non-dominance still cannot be rejected for comparisons of Mali and Togo, even at order 3. This is because the curves of the two distributions intersect for each order. This is not the case for the two other relationships, since Mali dominates Benin in the second order, while Niger dominates Burkina in the third order.

Table 8 Tests for higher-order multidimensional poverty dominance, country F versus country G, over a $\left[z^-, z^+\right]$ interval

	$\left[z^-, z^+\right]$ intervals		p-value of rejecting
Countries $F - G$	Asset X	Z_score	non-dominance of F by G
Benin–Mali (order 2)	[−0.47, 0.10]	[−3.23, 2.71]	0.020[b]
Mali–Togo (orders 2 and 3)	–	–	No dominance
Burkina Faso–Niger (3)	[−0.45, 1.69]	[−5.44, −0.55]	0.040[b]

[a] Significant at 10%.
[b] Significant at 5%.
[c] Significant at 1%.

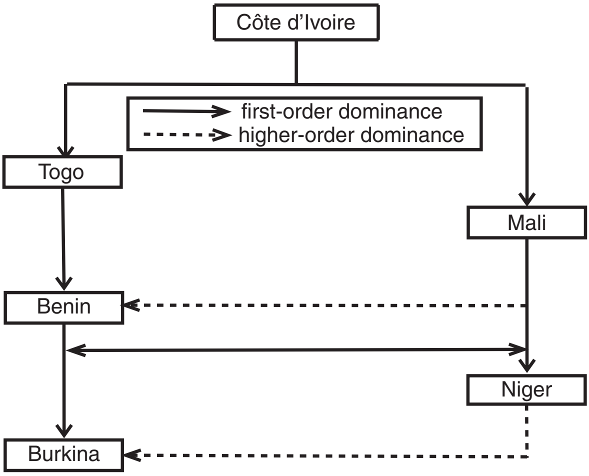

Fig. 6 Diagram of dominance among the countries of WAEMU – *Solid arrows* indicate first-order dominance; *dashed arrows* show higher-order dominance

Figure 6 depicts the classification of the countries in terms of multidimensional dominance. This classification is close to that obtained for assets and health (cf. Fig. 3). Overall, the results observed in the unidimensional dominance context are reinforced by the bidimensional analysis. There is no contradiction between the rankings derived respectively from the two dimensions taken individually. Benin now first-order dominantes Niger, and Niger higher-order dominates Burkina Faso.

We also fine-tune our analysis by decomposing country-wise dominance with respect to the rural-urban location of individuals. We thus obtain two diagrams in Fig. 7, representing country-wise dominance relationships for each of the rural and

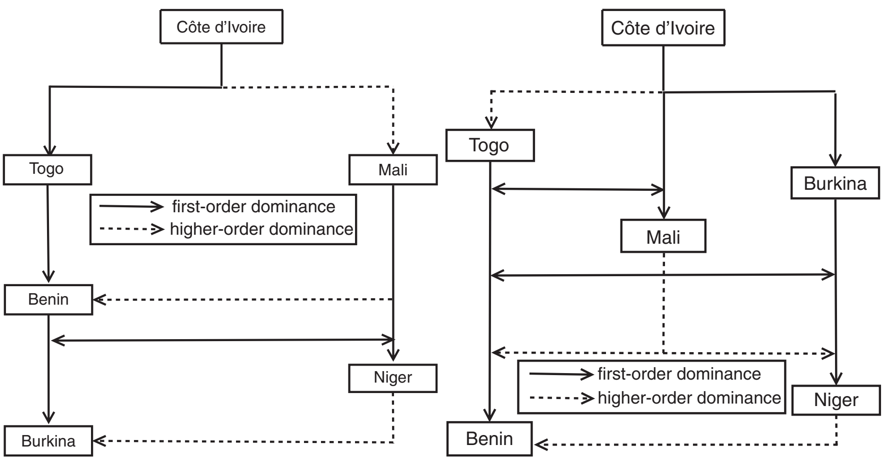

Fig. 7 Diagrams of dominance of WAEMU countries, by area: rural on the *left*, urban on the *right* – *Solid arrows* indicate first-order dominance; *dashed arrows* show higher-order dominance

urban areas, with the left-hand side representing dominance across rural areas, and the right-hand side dominance across urban areas. Note that the dominance relationships across rural areas are practically identical to those in Fig. 6. The only difference is that Côte d'Ivoire's rural zone dominates that of Mali only in the second, as opposed to the first, order.

Urban dominance results in Fig. 7 are more surprising. Burkina, which was previously dominated by all countries, is now dominated only by Côte d'Ivoire, and it dominates Niger. Benin, which significantly dominated Niger and Burkina, is now poorer than all in terms of its urban population. This situation reveals an imbalance between urban and rural standards of living in some countries, notably in Burkina Faso, where urban monetary poverty has regularly been estimated to be far less severe than the rural one.

This also points to the importance of disaggregating poverty comparisons within countries. Since the distribution of welfare across socio-economic groups may differ significantly across countries, cross-country comparisons of national poverty can indeed hide important discrepancies within countries. Uncovering these discrepancies helps understand the context-specific sources of national poverty.

5 Conclusion

Stochastic dominance has almost always been analyzed in the framework of univariate comparisons of welfare. In most cases, formal statistical tests have not been applied to the empirical comparisons. Sub-Saharan Africa, where child poverty is in all likelihood the greatest in the world, has relatively rarely been the object of empirical tests for poverty dominance, especially using data that are readily comparable across countries and time.

This paper attempts to move forward in all of these aspects of performing welfare comparisons. Drawing on recent work on making robust comparisons of multidimensional poverty, two dimensions of child welfare are considered and compared, nutritional status and assets, using a set of comparable variables drawn from the easily accessible Demographic and Health Surveys of six West-African countries. The estimation of the asset index is based on two data reduction methods. The first method uses Multiple Correspondence Analysis, and the second one is based on confirmatory factor analysis with qualitative variables.

Statistical inference for the paper's multidimensional poverty comparisons uses a multivariate extension of a recently proposed empirical likelihood ratio test. Because the test statistic that is derived and used is asymptotically pivotal, we are able to perform bootstrap tests that can be expected to yield more satisfactory inference than the usually considered tests that are based solely on analytic asymptotic distributions.

The statistical multidimensional dominance tests we perform across Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, and Togo confirm the usual (unidimensional) result that child poverty is more pronounced in the countryside than in the cities. They also lead to statistically significant dominance relationships between 12 of the 15 possible pairs of the six countries. Côte d'Ivoire dominates all other countries, followed by Togo, which dominates Benin, Burkina Faso and Niger. Benin and Mali also dominate Burkina Faso and Niger. Higher-order dominance tests cannot order Mali and Togo, but lead to Mali and Niger respectively dominating Benin in the second order and Burkina in the third order.

The results also translate into the finding of a considerable heterogeneity of the country-specific gaps between rural and urban poverty. The country rankings indeed depend considerably on whether we compare urban or rural poverty. Burkina, which is found to be poorest when it comes to rural multidimensional poverty, exhibits lower urban poverty than Niger and Benin, and is then dominated only by Côte d'Ivoire. Benin is also inferred to be urban-wise poorer than all other countries. This suggests that it may be useful and informative to disaggregate multidimensional poverty comparisons within countries before proceeding to country-wise comparisons of welfare.

Appendix

A.1 Proof of the Equivalence Between LR and t-Statistics

This proof is based on that provided by Davidson and Duclos (2006). First, an asymptotic expression of the squared t-statistic in (23) is derived. Assume that $F(z_1, z_2) = G(z_1, z_2)$ and $\Delta(z_1, z_2) \equiv \widehat{F}(z_1, z_2) - \widehat{G}(z_1, z_2)$. Also suppose that $N_F/N \to r$ when $N \to \infty$, where r is a constant between 0 and 1. If $N \to \infty$, the following equalities hold:

$$\widehat{F}(z_1, z_2) = \widehat{G}(z_1, z_2) = F(z_1, z_2) + O_P\left(N^{-\frac{1}{2}}\right) \tag{24}$$

and

$$\Delta(z_1, z_2) = O_P\left(N^{-\frac{1}{2}}\right). \tag{25}$$

The statistic (23) could be asymptotically reexpressed as follows:

$$t^2(z_1, z_2) = \frac{r(1-r)}{F(z_1, z_2)(1 - F(z_1, z_2))} P \lim_{N\to\infty} N\Delta^2(z_1, z_2) + O_P\left(N^{-\frac{1}{2}}\right). \tag{26}$$

Davidson and Duclos (2006) show that the LR-statistic is asymptotically equivalent to the above statistic. Indeed, consider the statistic LR(z_1, z_2) given in (22). Following their demonstration, knowing that $N_F(z_1, z_2) = N_F F(z_1, z_2)$, $N_G(z_1, z_2) = N_G G(z_1, z_2)$, $M_F(z_1, z_2) = N_F - N_F(z_1, z_2)$ and $M_G(z_1, z_2) = N_G - N_G(z_1, z_2)$, we can transform the expression (22) as the sum of the two following expressions multiplied by 2:

$$\left\{\begin{array}{l} -N_F\widehat{F}(z_1,z_2)\log\left(\dfrac{N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2)}{N\widehat{F}(z_1,z_2)}\right) \\ -N_G\widehat{G}(z_1,z_2)\log\left(\dfrac{N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2)}{N\widehat{G}(z_1,z_2)}\right) \end{array}\right\} \tag{27}$$

and

$$\left\{\begin{array}{l} -N_F(1-\widehat{F}(z_1,z_2))\log\left(\dfrac{N-(N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2))}{N-(1-\widehat{F}(z_1,z_2))}\right) \\ -N_G(1-\widehat{G}(z_1,z_2))\log\left(\dfrac{N-(N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2))}{N-(1-\widehat{G}(z_1,z_2))}\right) \end{array}\right\}. \tag{28}$$

Expression (27) can be rewritten as

$$\begin{array}{l} -(N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2))\log(N_F\widehat{F}(z_1,z_2)+N_G\widehat{G}(z_1,z_2)) \\ +N_F\widehat{F}(z_1,z_2)\log(N\widehat{F}(z_1,z_2))+N_G\widehat{G}(z_1,z_2)\log(N\widehat{G}(z_1,z_2)). \end{array} \tag{29}$$

Introducing $\Delta(z_1,z_2)$ in the expression (29), and knowing that $\Delta(z_1,z_2) \equiv \widehat{F}(z_1,z_2) - \widehat{G}(z_1,z_2)$ and therefore that $N_F\widehat{F}(z_1,z_2) + N_G\widehat{G}(z_1,z_2) = N\widehat{G}(z_1,z_2)+N_F\Delta(z_1,z_2)$, a reduced expression is obtained by a Taylor expansion:

$$\frac{1}{2}\frac{N_F N_G \Delta^2(z_1,z_2)}{N\widehat{F}(z_1,z_2)} + O_P\left(N^{-\frac{1}{2}}\right). \tag{30}$$

Given (24), the above expression is equal to:

$$\frac{1}{2}\frac{N_F N_G \Delta^2(z_1,z_2)}{NF(z_1,z_2)}. \tag{31}$$

Reducing the second expression in (28) similarly and multiplying it by 2, (22) becomes:

$$\frac{N_F N_G \Delta^2(z_1,z_2)}{NF(z_1,z_2)(1-F(z_1,z_2))} + O_P\left(N^{-\frac{1}{2}}\right). \tag{32}$$

Since $N_F/N \to r$ when $N \to \infty$, this becomes:

$$\frac{r(1-r)}{F(z_1,z_2)(1-F(z_1,z_2))} + O_P\left(N^{-\frac{1}{2}}\right) \text{Plim } N\Delta^2(z_1,z_2), \tag{33}$$

which is equivalent to the right-hand-side of (26).

A.2 Statistical Inference for Higher-Order Dominance

For a numerical solution to the problem of (12) with (13), (14) and $s_1, s_2 > 1$, consider the following Lagrangian ($\mathcal{L}$),

$$\mathcal{L} = \sum_i n_i^F \log P_i^F + \sum_j n_j^G \log P_j^G + \lambda_F \left(1 - \sum_i P_i^F\right) + \lambda_G \left(1 - \sum_j P_j^G\right)$$
$$-\mu \left(\sum_i P_i^F \Gamma_{F,i}^{s_1,s_2}() I_i(z_1, z_2) - \sum_j P_j^G \Gamma_{G,j}^{s_1,s_2}() I_j(z_1, z_2) \right), \tag{34}$$

with

$$\sum_i P_i^F \Gamma_{F,i}^{s_1,s_2}() I_i(z_1, z_2) = \sum_i P_i^F (z_1 - x_{i1}^F)^{s_1-1} (z_2 - x_{i2}^F)^{s_2-1} I\left(x_{i1}^F \le z_1, x_{i2}^F \le z_2\right)$$

and

$$\sum_j P_j^G \Gamma_{G,j}^{s_1,s_2}() I_j(z_1, z_2) = \sum_j P_j^G (z_1 - x_{j1}^G)^{s_1-1} (z_2 - x_{j2}^G)^{s_2-1} I\left(x_{j1}^G \le z_1, x_{j2}^G \le z_2\right)$$

and where λ_F, λ_G and $\mu \in R$ are Lagrange multipliers. The first-order conditions are given by:

$$\lambda_F + \lambda_G = N_F + N_G = N, \tag{35}$$

$$P_i^F = \frac{n_i^F}{\lambda + \mu \Gamma_{F,i}^{s_1,s_2}() I_i(z_1, z_2)} \text{ and } P_j^G = \frac{n_j^G}{N - \lambda - \mu \Gamma_{G,j}^{s_1,s_2}() I_j(z_1, z_2)}, \tag{36}$$

with $\lambda = \lambda_F$. For given (z_1, z_2), it is then possible to solve the problem of maximizing (34) by searching for $\widehat{\lambda}$ and $\widehat{\mu}$ as follows:

$$(\widehat{\lambda}, \widehat{\mu}) = \underset{\lambda,\mu \in R}{\arg\min} - \sum_i n_i^F \log(\lambda + \mu \Gamma_{F,i}^{s_1,s_2}() I_i(z_1, z_2))$$
$$- \sum_j n_j^G \log(N - \lambda - \mu \Gamma_{G,j}^{s_1,s_2}() I_j(z_1, z_2)). \tag{37}$$

For all pairs of thresholds (z_1, z_2), the probabilities $\widehat{P}_i^F(z_1, z_2)$ and $\widehat{P}_j^G(z_1, z_2)$ are obtained by replacing λ and μ in (36) by their estimates $\widehat{\lambda}$ and $\widehat{\mu}$ at (z_1, z_2). The likelihood ratio is then given as

$$\text{LR}_{s_1,s_2} = 2\left\{\begin{array}{c} -N_F \log N_F - N_G \log N_G + \sum_i n_i^F \log n_i^F + \sum_j n_j^G \log n_j^G \\ -\sum_i n_i^F \log \widehat{P}_i^F(z_1, z_2) - \sum_j n_j^G \log \widehat{P}_j^G(z_1, z_2). \end{array}\right\} \quad (38)$$

We can then use the techniques of Davidson (2007) to show that this ratio is asymptotically equivalent to the square of a minimum t-statistic analogous to (23). The rest of the procedures is similar to those outlined on page 106 for first-order dominance.

A.3 The Underlying Bivariate Normal (UBN) Method

Consider the following:

$$p(f|x) = \frac{p(f)\,\Pr(x|f)}{\int_R p(f)\,\Pr(x|f)df}. \quad (39)$$

$p(f)$ can be derived from the assumption that the distribution of f is $N(0, 1)$. Since the conditional distribution of x^* given f is $N(f\lambda, \psi)$, we have:

$$\Pr(x|f) = \Pr\left[\begin{array}{c} \gamma^1_{a_1-1} \le x_1^* \le \gamma^1_{a_1} \\ \cdot \\ \cdot \\ \cdot \\ \gamma^J_{a_J-1} \le x_J^* \le \gamma^J_{a_J} \end{array}\middle| f \right] =$$

$$\int_\Omega (2\pi)^{-J/2}|\psi|^{-1/2} \exp\left\{-\frac{(x^* - f\lambda)'\psi^{-1}(x^* - f\lambda)}{2}\right\} \text{dx}^*,$$

with

$$\Omega = \left[\begin{array}{c} \gamma^1_{a_1-1} \le x_1^* \le \gamma^1_{a_1} \\ \cdot \\ \cdot \\ \cdot \\ \gamma^K_{a_K-1} \le x_K^* \le \gamma^K_{a_K} \end{array}\right], \quad (40)$$

$$p(f)\,\Pr(x|f) = (2\pi)^{-(J+1)/2}|\psi|^{-1/2} \int_\Omega \exp\left\{-\frac{g(x^*)}{2}\right\} \text{d}x^*, \quad (41)$$

and where

$$g(x^*) = f^2 + (x^* - f\lambda)'\psi^{-1}(x^* - f\lambda) = B\left[f - \frac{1}{B}(\lambda'\psi^{-1}x^*)\right]^2 + x^{*\prime}Ax^*. \quad (42)$$

We also have that:

$$B = 1 + \lambda' \psi^{-1} \lambda \tag{43}$$

and

$$A = \psi^{-1} - \frac{1}{B} \psi^{-1} \lambda \lambda' \psi^{-1}. \tag{44}$$

When a quadratic loss function is used, the mean of the a posteriori distribution of the factor score is the Bayesian estimator that minimizes the posterior expected loss. It is given by:

$$E\,(f|x) = \int_R f p(f|x) \mathrm{d}f \tag{45}$$

$$= \frac{\int_R f p(f) \Pr(x|f) \mathrm{d}f}{\int_R p(f) \Pr(x|f) \mathrm{d}f} \tag{46}$$

$$= \frac{\int_R f \int_\Omega \exp\left\{-\frac{g(x^*)}{2}\right\} \mathrm{d}x^* \mathrm{d}f}{\int_R \int_\Omega \exp\left\{-\frac{g(x^*)}{2}\right\} \mathrm{d}x^* \mathrm{d}f} \tag{47}$$

$$= \frac{\int_\Omega \int_R f \exp\left\{-\frac{g(x^*)}{2}\right\} \mathrm{d}f \mathrm{d}x^*}{\int_\Omega \int_R \exp\left\{-\frac{g(x^*)}{2}\right\} \mathrm{d}f \mathrm{d}x^*} \tag{48}$$

$$= \frac{\int_\Omega \exp\left\{-\frac{x^{*\prime} A x^*}{2}\right\} \int_R f \exp\left\{-\frac{\left[f - \frac{1}{B}(\lambda' \psi^{-1} x^*)\right]^2}{2}\right\} \mathrm{d}f \mathrm{d}x^*}{\int_\Omega \exp\left\{-\frac{x^{*\prime} A x^*}{2}\right\} \int_R \exp\left\{-\frac{\left[f - \frac{1}{B}(\lambda' \psi^{-1} x^*)\right]^2}{2}\right\} \mathrm{d}f \mathrm{d}x^*}. \tag{49}$$

Without loss of generality, moving the mean of f from 0 to $\frac{1}{B}\lambda' \psi^{-1} x^*$, it follows from the properties of the normal density function that:

$$\int_R \exp\left\{-\frac{\left[f - \frac{1}{B}(\lambda' \psi^{-1} x^*)\right]^2}{2}\right\} \mathrm{d}f = 1 \quad \text{and} \tag{50}$$

$$\int_R f \exp\left\{-\frac{\left[f - \frac{1}{B}(\lambda'\psi^{-1}x^*)\right]^2}{2}\right\} \mathrm{d}f = \frac{1}{B}\lambda'\psi^{-1}x^*. \tag{51}$$

This implies that

$$X_i = \widehat{f_B} = E\,(f|x) = \frac{\int_\Omega \frac{1}{B}\lambda'\psi^{-1}x^* \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\} \mathrm{d}x^*}{\int_\Omega \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\} \mathrm{d}x^*} = \frac{1}{B}\lambda'\psi^{-1}x_W^*, \tag{52}$$

with

$$x_W^* = \frac{\int_\Omega x^* \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\} \mathrm{d}x^*}{\int_\Omega \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\} \mathrm{d}x^*}. \tag{53}$$

Noting that $\exp\left\{x^{*\prime}Ax^*/2\right\}$ is proportional to the density function of the distribution $N(0, A^{-1})$, Shi and Lee (1997) suggest a simple Monte Carlo method by which L random vectors $u_1, \ldots, u_L$ are generated, where each vector is generated from a uniform distribution on Ω. Assuming that we have to estimate the integral $\int_\Omega Q(x^*)\mathrm{d}x^*$, we have

$$V(\Omega)\,[Q(u_1) + \cdots + Q(u_L)]\,/L \rightarrow \int_\Omega Q(x^*)\mathrm{d}x^* \ \text{ if } \ L \rightarrow \infty \tag{54}$$

where $V(\Omega)$ denotes the volume of Ω. By applying this result to x_W^*, we then find that

$$\frac{D(u_1) + \cdots + D(u_L)}{d(u_1) + \cdots + d(u_L)} \rightarrow x_W^*, \ \text{ if } \ L \rightarrow \infty \tag{55}$$

with

$$D(x^*) = x^* \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\} \ \text{ and } \ d(x^*) = \exp\left\{-\frac{x^{*\prime}Ax^*}{2}\right\}. \tag{56}$$

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Part II
Impact Evaluation

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Free Primary Education in Kenya: An Impact Evaluation Using Propensity Score Methods

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Abstract This chapter attempts to evaluate the impact of the free primary education programme in Kenya, which is based on the premise that government intervention can lead to enhanced access to education especially by children from poor parental backgrounds. Primary education system in Kenya has been characterized by high wastage in form of low enrolment, high drop-out rates, grade repetition as well as poor transition from primary to secondary schools. This scenario was attributed to high cost of primary education. To reverse these poor trends in educational achievements, the government initiated free primary education programme in January 2003. This chapter therefore analyzes the impact of the FPE programme using panel data. Results indicate primary school enrolment rate has improved especially for children hailing from higher income categories; an indication that factors that prevent children from poor backgrounds from attending primary school go beyond the inability to pay school fees. Grade progression in primary schools has slightly dwindled. The results also indicate that there still exist constraints hindering children from poorer households from transiting to secondary school. The free primary education programme was found to be progressive, with the relatively poorer households drawing more benefits from the subsidy.

Keywords Primary education · Programme evaluation · Propensity score · Benefit incidence analysis · Kenya

JEL Classifications I20, I21, I22

1 Introduction

The government of Kenya has committed itself to expanding its state education system to enable greater participation. This has been in response to a number of concerns, the main one being the desire to combat ignorance, disease, and poverty as

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outlined in the *Sessional Paper No.10 of 1965 on African Socialism and its Application to Planning in Kenya* (Republic of Kenya, 1965). Consequently, every Kenyan child has the right of access to basic welfare provisions, including education, and the government has the obligation to provide its citizens with the opportunity to take part in the country's socio-economic and political development, and to attain a decent standard of living.

Free primary education (FPE) was first introduced in Kenya in the late 1970s. However, the programme was later abolished in 1988 under the Structural Adjustment Programs (SAPs) to ease the financial burden on the public education system. These meant that parents had to contribute more towards education of their children through a cost-sharing programme. Parents were responsible for buying school uniforms, textbooks, and other instructional materials for their children, as well as constructing buildings and providing other equipment to schools. The government retained the role of recruiting and paying teachers for their services.

The cost-sharing system somewhat led to high wastage within the primary education system in the form of low enrolment, high drop-outs, grade repetition, low completion, and poor primary to secondary transition rates (Bedi et al., 2002; Kimalu et al., 2001). The gross enrolment rate (GER) dropped from 115% in 1987 to 95% in 1990 and further to 91% in 2002 (Republic of Kenya, 1988, 1991, 2003a). Primary school GER declined from 98% in 1989 to 89% in 2002, while secondary school enrolment rate dropped from 29 to 23% during the same period. The GER for girls remained relatively lower than that for boys. In 2001, for example, the primary school GER was recorded at 90 and 91% for girls and boys, respectively. This scenario was attributed to the high cost of education, which had a negative impact on access, retention, equity, and quality (Republic of Kenya, 2001). It is imperative to note that these trends were observed despite Kenya being among the highest spenders on education in Sub-Saharan Africa (Vos et al., 2004). However, over 75% of the education budget was spent for paying teachers' salaries.

To reverse poor trends in educational achievements, the government initiated a free primary education (FPE) programme beginning January 2003. This policy was congruent with the 2001 Student's Act that calls for affordability of and equitable access to education in Kenya. The Act states that the government should provide free and compulsory primary education. The FPE policy was also in line with other international declarations such as the World Conference on Education for All (EFA), held in Jomtien, Thailand, in 1990, which underscored the importance of basic education and recognized that the cost of schooling was a major stumbling block to universal primary education in Sub-Saharan Africa among poor households (UNESCO, 1990), and the Millennium Development Goals (MDG) in which the world leaders made the achievement of universal primary education by the year 2015 as one of the goals.

2 Free Primary Education Programme in Kenya

The free primary education programme in Kenya was reintroduced by the National Rainbow Coalition (NARC) government elected into office in December 2002. Top-level dynamic political initiatives triggered FPE implementation, driven by a social contract with the electorate (Avenstrup et al., 2004). There was little time for consultations with the stakeholders. The FPE's thrust was an 'equity and socio economic agenda' essentially aimed at narrowing the gaps of inequality in the country (Republic of Kenya, 2004). The premise of the FPE programme was that the main barriers to schooling come from income constraints and direct schooling costs. Before the beginning of 2003, parents offset a significant proportion of operational and development costs averaging 35% of the total costs in primary schools (Republic of Kenya, 2003b), and were also responsible for supplying instructional materials to the schools. The FPE programme's primary objective was to provide enrolment opportunities for those children who were out of primary school due to schooling cost constraints.

The programme, however, does not single out only the poor in its implementation. Its implementation involves capitation payment to all public primary schools amounting to KSh.1020 (about US $14.57) per child per annum, with the amount disbursed based on the number of pupils enrolled in each school. About 36% of the payment goes to a General Purpose Account, which is used for the wages of supporting staff, repairs and maintenance, utility bills, postage, and general expenses. The remaining 64% of the payment goes to an Instructional Materials Account, which is used to purchase instructional materials. The funds are strictly allocated to the two accounts. In addition, within each account the funds are set aside for various expenditure items, and transfers between the expenditure items are prohibited. The FPE programme funds are managed by School Management Committees (SMC) comprised of the following individuals and their designations:

- Head teacher-chair person
- Deputy head teacher-secretary
- The chair person of the parents teachers association (PTA)
- Two parents (non-members of the PTA) elected by parents
- One teacher each to represent each grade

The FPE programme does not require parents and communities to build new schools, but to refurbish and use existing facilities such as community and religious buildings. However, the SMCs have argued that the programme's payment allocation for repairs and maintenance is not adequate (UNESCO, 2005). If parents wished to charge additional levies, school heads and committees would have to obtain approval from the Ministry of Education, Science and Technology. The request to charge any levy has to be sent to the District Education Board by the Area Education Officer, after a consensus among parents expressed through the Provincial Director of Education, a process that primary school heads consider bureaucratic and tedious.

The immediate effect of the FPE was an improvement in primary school enrolment. The GER increased from 92% in 2002 to 104% in 2003 of the school age population (Republic of Kenya, 2007). The enrolment of girls rose by 17% from 3 million in 2002 to 3.5 million in 2003, while that of boys rose by 18% from 3.1 to 3.7 million in the same period. By 2006, total enrolment in primary schools was 7.63 million, up from 7.59 million in 2005. It is also important to note that some of the students enrolling were adults (Annex).

The dramatic rise in enrolment rates in schools presented a number of challenges. There was overcrowding in classrooms as most schools did not have adequate classrooms to accommodate the large number of pupils that enrolled under the FPE (UNESCO, 2005). The pupil–teacher ratio increased from 35:1 in 2000 to 43:1 in 2004 (Republic of Kenya, 2006). In many schools, the classroom sizes, especially in the lower classes, rose from an average of 40–120 pupils, resulting in overburdened teachers. Some pupils were forced to study under trees or in the open. There were also shortages of desks, equipment and supplies. The quality of education offered under these circumstances remains questionable.

Besides these logistical problems, another pertinent question lingers: is the programme sustainable? In the 2003/04 financial year, the government increased its education budget by 17%. The donor community, which received the FPE policy with high enthusiasm, was quick to support the initiative. A discussion with the Ministry of Education officials revealed that the World Bank gave a grant of KSh. 3.7 billion, while the British government – through the Department for International Development – gave KSh. 1.6 billion towards the programme. Other donors included the Organization of Petroleum Exporting Countries (OPEC), the Swedish government, and UNICEF. This may mean that the current cost of education would be unaffordable if the country was to rely solely on domestic sources of funds to finance education.

3 Justification and Objectives of the Study

Education is critical to breaking the cycle of poverty. For poor parents, the opportunity to obtain primary education for their offspring is the first empowering step in their long journey out of poverty (Holyfield, 2002). Missed schooling opportunities or poor performance in schools are 'irreversible disinvestments' (Voth et al., 2000). Children born into poor families often have poor educational outcomes. Studies exist pointing at parental poverty as the main reason for poor performance in schools (Cross and Lewis, 1998; Glewwe and Jacoby, 1994; Wambugu, 2002). However, poverty is not only about income; it is also about inequitable access to services, lack of opportunities, reduced outcomes, and reduced hopes and expectations. The poverty experienced by the youth is often linked to childhood multidimensional deprivation and parental poverty: that in one way or another, the 'older' generation is unable to provide the assets required by the 'younger' generation to prepare it to effectively meet challenges faced during their youth (Moore, 2004). Parental poverty has always been associated with escalating rates of school drop-outs, as pupils from poor parental backgrounds go to school on empty stomachs and dressed in tatters, making it difficult for them to concentrate on their lessons or participate in school activities (Center for Public Policy Priorities, 1999).

Government intervention can lead to enhanced access to education, effectively affording the younger generation from poor households an equitable chance to escape from poverty in the future. Several studies have been conducted elsewhere to evaluate the impact of educational programmes on schooling outcomes. Shapiro et al. (2004) evaluated the effectiveness of a compensatory education programme in Mexico in improving student test scores and lowering repetition and failure rates. Study results showed that the programme improved short-term learning results for disadvantaged students, although the improvement varied by the subject of instruction and the demographic characteristics of students taught.

A study by Raymond and Sadoulet (2003) assessed the effectiveness of educational grants in raising schooling attainment of poor children in Mexico's rural areas. Results showed that the per grade gains in reducing drop-outs combined for an additional half a year in total schooling. Progressive impacts were found along three dimensions: degree of poverty, parents' education, and distance to school. The children of uneducated fathers living far from school gained twice as much as their counterparts with an educated father or residing close to a school. The authors concluded that the educational grants successfully closed the schooling gap along the wealth dimension but fell short of achieving the same in the other dimensions of parents' education and school distance.

Newman et al. (2002) evaluated the impact of small-scale rural infrastructure projects in health, water, and education in Bolivia using an experimental design and propensity score matching methods. Results indicated that although education projects improved school infrastructure, they had little impact on education outcomes. Interventions in health clinics, on the other hand, raised utilization rates and were associated with substantial declines in under-age-five mortality rates. Investments in small community water systems had no major impact on water quality until this was combined with community-level training, though they did increase the access to and the quantity of water.

Results from the above studies indicate that directing education expenditures to the poor holds a promise for breaking the intergenerational transmission of poverty. This study specifically analyses trends in key primary education outcome indicators (school enrolment rates, grade progression and transition from primary to secondary schools) before and after FPE implementation; identifies the correlates of these outcome indicators; and examines the pro-poorness of the FPE transfer. The thrust of the study is how government intervention can stem parental poverty and its effects from extending into the future generation through children's low educational attainment. Results from this study will aid in perfecting the FPE programme design and the recently introduced subsidized secondary education programme.

4 Data and Variables

The analysis uses panel data of children in the school-going age drawn from about 1,500 rural households. The data was collected as part of the Tegemeo Agricultural Monitoring and Policy Analysis project between Tegemeo Institute (Egerton University, Kenya) and the Department of Agricultural, Food and Resources Economics (Michigan State University, USA). The households were interviewed before the FPE programme was introduced in 1997, 2000, and after the programme had been implemented, in 2004 and 2007. Being panel data, the same households were interviewed in these four waves. All the districts were classified into seven agro-regional zones, as these zones bring together areas with similar broad climatic conditions and thus, rural livelihoods. Using standard proportional sampling aided by the national census data, households were sampled for interviews. Administratively, the households span 24 districts, 39 divisions, and 120 villages. The questionnaire used to elicit information remained relatively stable over the years.

While the interviews extracted comprehensive information on both economic and social indicators of the households in all the four waves, data on members' schooling was only well captured in the 2000, 2004, and 2007 waves. Schooling information relates to the household members' number of years spent in school prior to the survey and whether children in the school-going age were attending school in the past year before the survey. The data, however, did not discriminate between attendance in private and public schools. In most cases in Kenya, private schools are found in urban centres. We made a bold assumption that the schooling information provided by the households relates to public schooling. A summary of variables is presented in Table 1.

To measure the impact of the FPE programme in Kenya, we construct three main outcome indicators: (i) primary school enrolment; (ii) primary school grade progression; and (iii) secondary school enrolment. The choice of these indicators was dictated by data availability.

Primary school enrolment is a dichotomous variable measuring whether a child in the school-going age was in or out of school during the year of the survey. A child generally enters grade 1 of primary school at age 6 and is expected to exit grade 8 of primary school at age 13. School enrolment was estimated for year 2000, 2004, and 2007. To estimate the FPE programme's impact on school enrolment, we compare enrolment in the period before (2000) and after (2004 and 2007) the programme.

Primary school grade progression is the average time (in number of years) spent by a pupil in one grade over a period of time (between two survey periods). A pupil is expected to advance one grade every subsequent year. The normal progression through schooling in Kenya includes between 1 and 3 years of pre-primary school, followed by 8 years of primary school, and then 4 years of secondary school. Progression was measured as a difference between grades achieved in 2000 and 2004 and between 2004 and 2007. A continuous grade progression variable (index) bound between $0 \leq GP \leq 1$ was constructed. If the index was 0, it meant perfect retardation: the child was not making progress at all. If the index was 1, it indicated perfect progression from one grade to the next without repetition. To estimate the programme's impact on grade progression, we compare the average grade progression index of 2000–2004 and that of 2004–2007. It is assumed that since the FPE programme started in 2003, it had not made a significant difference in progression rates in 2004. While the incidence of an extra age among pupils could also be used to measure grade progression, in this case it was not appropriate since many over-age persons enrolled in public primary schools after FPE was implemented.

Table 1 Overview of the sample characteristics

Variable	Year 2000	2004	2007
School-going children sample size	4,011	3,640	3,148
Age of child (mean-years)	12.48	12.54	12.55
	(3.71)	(3.72)	(3.67)
Gender of child (%)			
Boy-child	51.03	51.07	50.29
	(0.50)	(0.50)	(0.50)
Girl-child	48.97	48.93	49.71
	(0.50)	(0.50)	(0.50)
Caregiver (%)			
Parent	73.75	64.09	60.64
	(0.44)	(0.48)	(0.49)
Other relative	23.24	33.65	38.53
	(0.42)	(0.47)	(0.49)
Unrelated	3.02	2.25	0.83
	(0.17)	(0.15)	(0.09)
Mean age of the household head (mean-years)	52.47	54.38	56.08
	(12.44)	(12.82)	(13.15)
Household head education attainment (mean-years)	6.45	6.97	7.97
	(4.42)	(5.41)	(5.78)
Dependency ratio[a]	1.03	1.03	0.90
	(0.84)	(0.87)	(0.89)
Household size (mean)	9.85	8.51	6.96
	(3.26)	(3.44)	(3.02)
Annual per capita mean income (KSh '000)	17.53	22.27	31.07
	(19.44)	(25.70)	(33.73)
Distance to the nearest school (mean-Kms)	3.54	2.95	3.33
	(4.02)	(3.18)	(4.01)
Gender of household head (%)			
Male	90.05	83.27	80.78
	(0.30)	(0.37)	(0.39)
Female-headed	9.95	16.73	19.22
	(0.30)	(0.37)	(0.39)

[a]Dependency ratio is measured as the number of individuals aged below 15 or above 64 divided by the number of individuals aged 15–64. Standard deviations are reported in the parentheses.

Secondary school enrolment is a dichotomous variable. It measures whether a child in the secondary school-going age was in or out of school during the year of the survey. Here we are concerned about children who had completed primary education and were in the secondary school-going age (14–18 years). The variable takes a value '1' if a child who had completed primary education had been enrolled in secondary school and value '0' if otherwise. The main aim was to examine whether secondary school enrolment improved/declined with the FPE. This was meant to indicate whether primary–secondary school transition improved/declined with the FPE programme. It is important to note that there were no measures put in place in the FPE programme to boost transition rate, so that any effect of the programme on secondary school enrolment must be considered indirect.

The following variables were used as explanatory in programme impact modelling:

Child-level: Age of child; gender of child; the relationship to caregiver; and a child's health. On health, data on whether any household member had been chronically ill for more than three consecutive months in the last 12 months preceding the survey thus making it impossible for him/her to work or attend school was elicited.

Household-level: Age of household head; gender of the household head; household size; highest educational attainment of household head; health; dependency ratio (measured by dividing the number of individuals aged below 15 or above 64 by the number of individuals aged 15–64); distance to the nearest school; and per capita household income.

Spatial variables: indicate the region where the household is situated to control for regional inequalities in incomes and opportunities.

5 Methodology

Even though the main goal of this study is to assess whether the FPE programme in Kenya has had an 'impact' on primary schooling outcomes, we first start by identifying the correlates of primary schooling performance indicators. Next, we evaluate the FPE programme using propensity score matching methods, and finish with benefit incidence analysis of the programme.

5.1 Correlates of Primary Schooling Performance Indicators

To examine the correlates of primary schooling outcome, the following pooled model is estimated:

$$y_i = \alpha + \lambda t_i + \beta_1 c_i + \beta_2 h_i + \beta_3 r_i + \varepsilon_i \quad (1)$$

where y_i represents the outcome of interest (primary school enrolment rate, grade progression or secondary enrolment rate) variable for individual i. t_i is a step dummy variable used to capture whether there was structural change with the FPE programme. Year 2004 is used as the reference year. To test whether there was intercept shift with the FPE programme we test the null hypothesis $\lambda = 0$ against $\lambda \neq 0$. The coefficient indicates whether there was an increase or decrease in the probability of enrolment for a given year relative to the base year (2000), controlling for other observable factors. However, it must be noted that this might not be the appropriate way to test for the programme impact owing to functional form imposition and endogeneity problems. c_i, h_i, and r_i are vectors representing child-level, household-level, and regional-level background characteristics, respectively, for member i. Coefficients on the other independent variables represent the relative impact of those variables on the probability of the outcome of interest.

The estimation strategy of equation (1) depends on the nature of primary education outcome of interest. For dichotomous dependent variables, i.e. primary and secondary school enrolment rates, we use a probit model. The probit model with White's heteroscedasticity-robust standard errors returns consistent parameter estimates (Wooldridge, 2002). Using OLS to estimate fractional dependent variables like primary school grade progression is unlikely to yield consistent parameter estimates. To estimate the grade progression model, we use the quasi-maximum likelihood estimation (QMLE) method proposed by Papke and Wooldridge (1996). This method yields robust estimators of the conditional mean parameters with satisfactory efficiency properties.

5.2 Propensity Score Matching Methods

Evaluating program effectiveness without a randomized control is a frequent necessity in most public programmes. Analysts typically use statistical modelling to estimate program impact. In recent years, propensity score matching (PSM) has gained attention as a potential method for estimating the impact of public policy programmes in the absence of experimental evaluations (Rosenbaum and Rubin, 1983). PSM is a semi-parametric technique used to estimate the average treatment effect of a binary treatment on a continuous scalar outcome. Although the technique was developed in the 1980s (Rosenbaum and Rubin, 1983) and has its roots in a conceptual framework which dates back even further (Rubin, 1974), its use in programme evaluation only became established in the late 1990s (Dehijia and Wahba, 1999; Smith and Todd, 2005; Heckman et al., 1998; Agodini and Dynarski, 2001; Dehijia and Wahba, 2002; Trevino and Shapiro, 2004; Jalan and Glinskaya, 2005; Ravallion and Jalan, 2000; and Esquivel and Alejandra, 2006).

In order to estimate the FPE's average treatment effect on the programme's participants, we would ideally want to estimate the following:

$$ATT = E(Y_{i1}|D = 1) - E(Y_{i0}|D = 1) \tag{2}$$

where *ATT* is the average effect of the programme on its participants, $D = 1$ when an individual i participates in the programme and $D = 0$ when an individual i does not participate in the programme. $E(Y_{i0}|D = 1)$ is the outcome for the ith individual that would have been observed had the individual not participated in the programme, while $E(Y_{i1}|D = 1)$ is the actual outcome for the ith individual participating in the programme. The challenge is that $E(Y_{i0}|D = 1)$ cannot be observed, that is we cannot observe the outcome for the ith individual had the individual not participated in the programme. This creates a need for establishing a counterfactual of what can be observed. To approximate the counterfactual, we undertake propensity score matching.

We are interested in comparing the difference between Y_0 and Y_1 for the same individual, that is

$$\phi(X) = E(Y_1|D = 1) - E(Y_0|D = 1, X) \tag{3}$$

where X is a multidimensional vector of characteristics that influences participation in the programme. The component $E(Y_0|D = 1, X)$ is impossible to observe. When $E(Y_0|D = 0, X)$ is used to approximate $E(Y_0|D = 1, X)$ we run a risk of bias selection. The mean selection bias which occurs because of the use of non-participants to approximate participant outcomes conditional on X is given by:

$$B(X) = E(Y_0|D = 1, X) - E(Y_0|D = 0, X) \tag{4}$$

The PSM relies on the key assumption that conditional on observable characteristics X, participation must be independent of outcomes, that is $(Y_{1,} Y_0) \perp D|X$, (the conditional independence assumption, or CIA). Ideally, one would match a participant with a non-participant using the entire dimension of X (simple matching). But matching on every covariate is difficult to implement when the set of covariates is large. To overcome this curse of dimensionality, propensity scores ($P(X)$) – the probabilities of participating that are conditional on X – are used. Rosenbaum and Rubin (1983) show that if matching on covariates is valid, so is matching on propensity score. This allows matching on a single index rather than on the multidimensional X vector.

Because the FPE programme is mandatory,[1] we focus on estimating the average treatment effect of the programme over time. The only untreated pool from which the comparison sample may be drawn is the eligible population from the period *before* the programme implementation, to give a before–after design.[2] Bryson et al. (2002) and Friedlander and Robins (1995) discuss non-experimental evaluation strategies, especially with respect to comparing the behaviour of persons in a particular area covered by a policy change to the behaviour of individuals in the same area before the change in policy. They conclude that in practice, despite the strategies, there is an obvious shortcoming with regard to the inherent difficulty in controlling for changes over time; these strategies are often the only ones available to the analyst as a result of data limitations or opposition to randomized experiments on ethical grounds. The conditional independence assumption (CIA) now becomes $(Y_{1,} Y_0) \perp T|X$ where (T) indicates the time period ($T = 1$ period when the programme is implemented and $T = 0$ period before programme implementation).

It should be noted that when evaluating voluntary programmes, the conditional independence assumption (CIA) implies that X needs to be chosen such that X is correlated with the decision to participate in the programme and the outcome. For mandatory government programmes, there is no decision whether to participate and X might need to be chosen based on different criteria (Lee, 2006). Matching here is an attempt to eliminate period bias rather than self-selection bias. In this

[1] Programmes introduced nationally without piloting.

[2] Exact control group is non-existent since the programme is implemented in all public primary schools throughout the country. Private schools normally attract enrolment from relatively well-off members of the society and thus could not be used as a control group.

case, propensity score matching controls for differences in the profiles of the two groups (before and after) but will not automatically allow for programme effects to be differentiated from temporal effects. The propensity scores help in matching persons who are similar (that is, both before and after programme implementation) according to a set of some conditioning variables (X). It is important to note that in the special case of schooling, and moreover schooling performance, unobservable factors such as child ability may be important in conducting propensity score matching. Unavailability of data on such important but unobservable attributes might seem to invalidate the choice of our methodological strategy. However, the propensity score method is the only technique available to us in this case where experimental data is absent.

We performed the matching process in two steps. In the first step, we used a standard logistic regression to generate propensity scores for each observation in the treatment and the non-treatment samples. The choice of conditioning (explanatory) variables used in predicting propensity scores was informed by review of literature on determinants of primary education outcomes and data availability. In the second step, we conducted one-to-one matching without replacement[3] (also referred to as 'single nearest-neighbour matching without replacement' in the literature) type of propensity score balancing.[4] Recent literature suggests that other methods of propensity score matching might not make that much difference (Zhao, 2004; Michalopoulos et al., 2004). This approach chooses for each treatment group member the comparison group member with the closest estimated propensity score. For each treatment group member (observations in 2004 and 2007 taken separately), the comparison group member (observation in 2000) was chosen as the one that had the closest estimated propensity score. If several comparison group members matched a given treatment group member equally well, then one group was chosen randomly. Comparison group members were dropped from the analysis if they were not a best match for any treatment group member.

Traditionally, applications of nearest neighbour matching do not impose any support condition (Smith and Todd, 2005). However, following recent advice from the literature, we imposed a common support by setting a trimming level of 2% (i.e. dropping observations at which the propensity score density is very low), the level that was used in Heckman et al. (1997), Smith and Todd (2005) and Lee (2006). The difference in outcomes for each matched pair and the mean across all pairs represent the average effect of treatment on the treated. The advantage of the propensity score matching is that a model or structure does not need to be imposed.

[3] For nearest neighbour matching, literature suggests the use of non-replacement to reduce the bias (D'Agostino, R.B. 1998). Matching without replacement involves a trade-off between less bias and a better potential match. However, Zhao (2004) has shown that in practice, the difference between the two approaches is often small.

[4] Matching was performed using PSMATCH2 STATA routine developed by Leuven, E. and B. Sianesi (2003).

5.3 FPE Programme Benefit Incidence Analysis

Education is understood to be a basic service that is essential in any fight against poverty. Government intervention in education should be seen to promote less inequality and reduced poverty (Manasan et al., 2007). To meet these objectives, the FPE programme in Kenya adopted *broad targeting*. The broad targeting approach does not target the poor directly as individuals; rather, the poor are reached by targeting services or commodities consumed heavily by the poor, such as primary education and primary health care.

Examining the extent to which the poorest strata benefit from the FPE programme in Kenya is imperative. In the literature, two broad approaches have been pursued to measure the value of government programmes to its beneficiaries. The first, based on Aaron and McGuire (1970), considers an individual's own valuation of a programme; that is, the demand, or virtual, price. The difficulties inherent in estimating these prices led to the development of a less-demanding approach known as benefit incidence analysis. Benefit incidence combines the cost of providing public services with information on their use to show how the benefits of government spending are distributed across the population (van de Walle, 2003; Castro-Leal et al., 1997).

Though there are many ways to approach benefit incidence, a fairly standard method has emerged, mainly based on the work of Demery (1997), van de Walle and Nead (1995) and Selden and Wasylenko (1992). This method takes 'across the population' to mean 'across the expenditure (or income) distribution' – an approach consistent with the overall concern about poverty. It then estimates the distribution of benefits based on some variant of the average participation rate in a public programme among people in different expenditure (or income) brackets.

In this study, we are interested in a general description of the FPE programme beneficiaries in terms of which income group draws more benefits. Therefore, we examine the average benefit incidence of the FPE programme per capita transfers across income quintiles. Income quintiles are defined on the basis of household incomes (not including the FPE transfers) to examine among which group the FPE transfer is concentrated. Income quintiles are formed by ranking the sample by household per adult equivalent income in 2004 and 2007. Quintiles are defined with equal numbers of people in each. So the poorest quintile refers to the poorest 20% in terms of income per adult equivalent.

As mentioned earlier, the FPE programme comprises an allocation equivalent to Ksh. 1,020 (about US $14.57) per child per annum. The total transfer per quintile depends on the total number of primary school enrolment of children whose households fall into the respective income quintiles. If lowest income groups have more children attending primary school than households in the higher income groups, then the lower income groups receive a larger share of the benefits from government spending than the higher income groups. If this scenario prevails, then the FPE programme can be judged as pro-poor.

According to Demery (2000), the amount of the education subsidy (X_j) that benefits group j is defined as

$$X_j = \sum_{i=1}^{n} E_{ij} \frac{S_i}{E_j} = \sum_{i=1}^{n} \frac{E_{ij}}{E_j} S_i \quad (5)$$

where X_j is the benefit incidence of spending on a service (say education) to group j, E_{ij} is the number of enrolments from group j at education level i, E_j is the total number of enrolments at level i, S_i is the government's net spending on education at level i, and (S_i/E_i) is the *mean* unit subsidy of an enrolment at education level i.

The *share* of total education spending to group j (X_j) is:

$$X_j = \sum_{i=1}^{n} \frac{E_{ij}}{E_i} \left[\frac{S_i}{S} \right] = \sum_{i=1}^{n} e_{ij} s_i \quad (6)$$

It can be seen that this depends on two major components: First, e_{ij}'s which are the shares of the group in total service use (in this case, enrolments). These reflect *household behaviour*. Secondly, the s_i, that is, the shares of spending across the different types of service, reflects *government behaviour*.

6 Results and Discussions

The study results are presented and discussed in this section. First, summary descriptive statistics on the data are presented. Next, correlates of primary schooling outcomes are shown followed by the FPE programme impact evaluation results using the propensity score matching technique. Results from FPE programme benefit incidence analysis conclude the section.

6.1 Summary Descriptive Statistics of the Variables

Overview of the summary statistics on the variables used in the analysis is presented in Table 1. The number of school-going children in the sample declined from 4,011 in 2000 to 3,148 in 2007. The mean age in the contrary increased from 12.48 years in 2000 to 12.55 years in 2007. Among these children, approximately 51% were boys while 49% were girls in 2000. In 2007, the proportion of girls and boys stood at approximately 50%. The majority of school-going children were under the care of parents (74%), but this declined to 61% in 2007.

The mean age of the household head increased from 52% in 2000 to 56% in 2007. This increase is expected as these are panel households. Over 80% of the households were headed by males. However, the proportion of female-headed households nearly doubled between 2000 and 2007. The household head's education attainment averaged between 6 and 8 years of schooling. The mean dependency ratio declined from 1.03 in 2000 to 0.9 in 2007. The mean household size likewise declined from 10 to 7 between 2000 and 2007. Annual per capita mean income increased from KSh. 175,300 in 2000 to KSh. 310,700 in 2007. The distance from the household to the nearest school declined from 3.5 km in 2000 to 3.3 km in 2007.

6.2 Correlates of the Selected Primary Education Performance Indicators

6.2.1 Primary School Enrolment

Results from a probit regression used to predict primary school enrolment is presented in Table 2. Considering the likelihood ratio chi-square vis-à-vis the p-value, the model is statistically significant. The results also show that there was an increase in the probability of primary enrolment in the year 2007 relative to the base year (2004), controlling for other observable factors. Compared to the base year 2004, 1 year into the FPE programme, there was a lower probability of primary school enrolment in 2000.

At the child-level, the gender of the child, age, chronic sickness, and relationship to the caregiver were found to be significant correlates of primary school enrolment. Compared to the boy-child, the girl-child has a higher probability of being out of school. As a child advances in age, the probability of being out of school increases. Perhaps this could be explained by the increased opportunity cost of being in school, as elder children are capable of getting jobs to augment household incomes. Children who were chronically ill had a lower probability of attending school. The results also indicate that children under the care of non-relatives are more likely to be out of school compared to children under the care of either their own parents or other relatives. Whereas chronic sickness by household head affected school enrolment negatively, the variable was not significant.

At the household level, gender and education level of the household head and household income are significant predictors of primary school enrolment. Children hailing from households headed by females have a higher chance of being in school. Children from households headed by persons with lower educational attainment had a higher probability of being out of school.

As expected, children from low-income households are more likely to be out of school. Income quintiles are formed by ranking the sampled households based on per adult equivalent incomes. The first quintile represents the poorest 20% of households in terms of per adult equivalent income. Households belonging to quintile 3 are used as the reference group. On the other hand, children hailing from the first two wealthiest income quintiles are less likely to be out of school. Similarly, school enrolment varies across agro-ecological regions. The central highlands region was used as the base region. Children hailing from other regions are more likely to be out of school compared to children from the central highlands region. However, this relationship was only significant for the western transitional, western lowlands, and coastal lowland dummies.

Table 2 Probit regression of determinants of primary school enrolment

School enrolment (1 = in school; 0 = dropped out)	Coef.	dF/dx	Robust Std. Err.
Year (base year = 2004)			
2000 = 1	−0.188[a]	−0.043	0.038
2007 = 1	0.117[a]	0.025	0.045
Child-level variables			
Gender of child (1 = boy-child; 0 = girl-child)	0.075[b]	0.017	0.032
Child age	−0.027[a]	−0.006	0.005
Child sick (yes = 1; 0 = otherwise)	−0.378[b]	−0.101	0.166
Relationship to caregiver (base = non-relative)			
Parent	2.380[a]	0.677	0.121
Other relative	2.133[a]	0.321	0.125
Household-level variables			
Age of household head (years)	0.002	0.000	0.002
Gender-household head (1 = male; 0 = female)	−0.096[c]	−0.021	0.050
Education attainment of household head (years)	0.017[a]	0.004	0.005
Dependency ratio	−0.001	0.000	0.019
Household head sick (yes = 1; 0 = otherwise)	−0.042	−0.009	0.080
Distance to the nearest school (km)	0.006	0.001	0.004
Income per capita quintiles (base: 3rd quintile)			
Quintile 1-lowest	−0.111[b]	−0.026	0.051
Quintile 2	−0.006	−0.001	0.051
Quintile 4	0.123[b]	0.026	0.052
Quintile 5-highest	0.116[b]	0.025	0.053
Spatial variables (base region: central highlands)			
Western highlands (wh)	−0.059	−0.013	0.074
High potential maize zone (hpm)	−0.047	−0.011	0.059
Western transitional (wt)	−0.312[a]	−0.078	0.065
Western lowlands (wl)	−0.161[b]	−0.038	0.071
Eastern lowlands (el)	−0.015	−0.003	0.071
Coastal lowlands (cl)	−0.690[a]	−0.201	0.072
Constant	−0.890[a]		0.200
Log likelihood	−4,078.41		
Number of obs	10,007		
LR $chi^2(22)$	548.88		
Prob > chi^2	0.00		
Pseudo R^2	0.06		

[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

6.2.2 Primary School Grade Progression

Next, results from QMLE of primary school grade progression for periods 2000–2004 (before FPE programme) and 2004–2007 (after the FPE programme) are presented in Table 3. The overall model is statistically significant. The coefficient of the programme dummy was negative and statistically significant at 1% level. This means that there was a decrease in grade progression in the period 2004–2007 relative to the base period 2000–2004, controlling for other observable factors.

Table 3 QMLE of the factors influencing primary school grade progression

Progression index	Coef.	Robust Std. Err.
Year (2004–07 = 1, 2000–04 = 0)	−0.090[a]	0.013
Child-level variables		
Age of the child	0.014[a]	0.002
Gender of child (1 = boy-child; 0 = girl-child)	−0.002	0.009
Relationship to caregiver (1 = parent; 0 = other)	−0.001	0.014
Child sick (yes = 1; 0 = otherwise)	−0.076[b]	0.039
Household-level variables		
Age of household head (years)	0.001	0.000
Gender-household head (1 = male; 0 = female)	−0.013	0.015
Education attainment of household head (years)	0.004[a]	0.001
Dependency ratio	−0.003	0.006
Household head sick (yes = 1; 0 = otherwise)	0.020	0.017
Distance to the nearest school (km)	0.001	0.001
Income per capita quintiles (base: 3rd quintile)		
Quintile1-lowest	−0.006	0.015
Quintile2	−0.006	0.015
Quintile4	0.000	0.014
Quintile5-highest	0.043[a]	0.014
Spatial variables (base region: central highlands)		
Western highlands (wh)	−0.014	0.018
High potential maize zone (hpm)	−0.065[a]	0.014
Western transitional (wt)	−0.076[a]	0.016
Western lowlands (wl)	−0.048[b]	0.020
Eastern lowlands (el)	−0.023	0.016
Coastal lowlands (cl)	−0.063[a]	0.022
Constant	0.496[a]	0.041
Number of obs	2,300	
$F(21, 2278)$	6.53	
Prob $> F$	0.00	
R^2	0.06	

[a] Significant at 1%.
[b] Significant at 5%.

While school grade progression is more or less a function of a child's ability, there were some child- and household-level factors explaining grade progression. At the child level, age of the child and whether a child was sick for 3 months consecutively in the last 12 months preceding the survey were found to be significant predicators of grade progression. The age of the child positively influences grade progression. Also, children who had been sick for at least 3 months consecutively progressed less than children who had not been sick.

Educational attainment by the household head and household income were the most important predictors of grade progression at the household level. Children from households headed by members with high educational attainment progressed more than their counterparts from households headed by members with low educational attainment. While children from poorer households (20% poorest) progressed less than their counterparts in the higher income groups, the results are not statistically significant. Income quintile three is used as the base. However, children from the wealthiest quintile (20% wealthiest) were found less likely to repeat grades than children in income quintile three.

Just as in the case of primary school enrolment, primary school grade progression also varies across agro-ecological regions. The central highlands region is again used as the base region. Children from other regions are more likely to repeat grades compared to children from the central highlands region. This relationship is significant for the high potential maize zone, western transitional, western lowlands, and coastal lowland dummies.

6.2.3 Secondary School Enrolment

Results from probit regression of secondary school enrolment are presented in Table 4. As mentioned earlier, the dependent variable takes the value 1 if a child that had finished primary school and still in the secondary school-going age was enrolled in secondary school, and 0 if otherwise. Dummy variables were used to capture changes in transition rates in the years in consideration. Year 2004 is used as the base year. The results indicate that before the FPE programme (year 2000), the probability of a child having completed primary education being in secondary school was lower compared to 2004. However, the finding was not statistically significant. After the FPE programme was introduced, the scenario changed. The probability of a child being in secondary school after having completed primary education was higher in 2007. Among the most important child-level correlates of primary–secondary transition include age of child and relationship to the caregiver. As a child advances in age, the probability of not transitioning to secondary school increases. Children under the care of their parents have a higher probability of being in secondary school compared to their counterparts under the care of other relatives or non-relatives.

Educational attainment of household head, dependency ratio, and household income are the most significant predictors of primary to secondary school transition. Children from families headed by people with low educational attainment are less likely to enrol in secondary school compared to children from families headed by highly educated persons. This could be explained by the fact that highly educated parents are likely to be earning higher incomes and thus can afford the cost of secondary school education. Also, highly educated parents serve as role models to their offspring.

Children hailing from highly burdened households are less likely to continue with secondary education. Families with high dependency ratios are less likely to afford secondary school education. Similarly, the probability of children from relatively poor families proceeding with secondary education is lower compared to their counterparts from wealthier households. Children from the poorest 20% of households are less likely to continue with secondary education after completing primary education.

From the regional perspective, children hailing from most of the regions were less likely to proceed to secondary schools compared to those from the central highlands region. However, the relationship was only significant for the coastal lowlands dummy.

Table 4 Probit regression of determinants of secondary school enrolment

Enrolment (1 = in school; 0 = out of school)	Coef.	dF/dx	Robust Std. Err.
Year (base year = 2004)			
2000 = 1	−0.004	−0.001	0.096
2007 = 1	0.219[a]	0.076	0.114
Child-level variables			
Gender of child (1 = boy-child; 0 = girl-child)	0.087	0.031	0.080
Child age	−0.096[b]	−0.034	0.037
Child sick (yes = 1; 0 = otherwise)	0.437	0.137	0.663
Relationship to caregiver (1 = parent; 0 = other)	0.605[b]	0.226	0.099
Household-level variables			
Age of household head (years)	0.006	0.002	0.004
Gender-household head (1 = male; 0 = female)	0.047	0.017	0.138
Education attainment of household head (years)	0.033[b]	0.012	0.010
Dependency ratio	−0.140[a]	−0.050	0.072
Household head sick (yes = 1; 0 = otherwise)	0.408	0.130	0.254
Income per capita quintiles (base: 3rd quintile)			
Quintile 1-lowest	−0.235[c]	−0.086	0.132
Quintile 2	−0.111	−0.040	0.128
Quintile 4	0.054	0.019	0.127
Quintile 5-highest	0.069	0.024	0.128
Spatial variables (base region: central highlands)			
Western highlands (wh)	−0.179	−0.066	0.157
High potential maize zone (hpm)	0.073	0.026	0.116
Western transitional (wt)	−0.201	−0.074	0.152
Western lowlands (wl)	−0.104	−0.038	0.147
Eastern lowlands (el)	−0.024	−0.009	0.142
Coastal lowlands (cl)	−0.692[b]	−0.267	0.209
Constant	1.084		0.731
Log likelihood	−667.17		
Number of obs	1,155		
LR $chi^2(21)$	134.61		
Prob > chi^2	0.00		
Pseudo R^2	0.09		

[a] Significant at 5%.
[b] Significant at 1%.
[c] Significant at 10%.

6.3 FPE Programme Impact Evaluation Using PSM Results

6.3.1 Primary School Enrolment Rates

The results from primary school enrolment analysis using propensity score matching methods are presented in Table 5. In general, primary school enrolment has improved with the FPE programme introduction. Enrolment increased significantly from 82% in 2000, to 86% in 2004, to 89% in 2007; this is a 7% increase between 2000 and 2007.

Generally, primary school enrolment increased after the introduction of the FPE programme across all income groups. Two very important points stand out from

Table 5 Primary school enrolment by income groups

Income group	2007	2004	2000	Increase/decrease 2000–2007	2004–2007	2000–2004
Quintile 1 (lowest)	0.83	0.82	0.82	0.01	0.01	0
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Quintile 2	0.88	0.88	0.83	0.05[a]	0.01	0.05
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Quintile 3	0.90	0.88	0.83	0.07[a]	0.03[a]	0.05[a]
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Quintile 4	0.91	0.86	0.81	0.10[a]	0.04[b]	0.05[a]
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Quintile 5 (highest)	0.91	0.85	0.82	0.09[a]	0.06[a]	0.03[a]
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Overall	0.89	0.86	0.82	0.07[a]	0.03[a]	0.04[a]
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

[a] Significant at 1%.
[b] significant at 5%.
Standard errors in parentheses.

this analysis. First, higher income groups experienced a relatively higher increase in primary school enrolment in the period between 2000 and 2007. Secondly, the increase in primary school enrolment for children belonging to the poorest 20% of households was not statistically significant. This finding probably indicates that factors that prevent children from poor backgrounds from attending primary school go beyond the inability to pay school fees. They could possibly include the opportunity cost of schooling and the ability to meet other basic needs such as clothing. A poor household may cherish free primary education, but rationally may be obliged to seek meeting immediate basic needs, thus prompting the household to send a child to work rather than to school.

In 2000, primary school enrolment for the girl-child was relatively lower than that for the boy-child; 82 and 83%, respectively (Table 6). In 2004, enrolment for the girl-child rose to 86%, overtaking that for the boy-child (85%). But this was reversed in 2007, when the boy-child's enrolment rose to 90% as against 88% for the girl-child. Difference of means tests for primary school enrolment between 2000 and 2004 and between 2000 and 2007 indicated that the increment in enrolment for both the boy- and the girl-child was statistically significant, signifying FPE's role in enhancing primary school enrolment. Between 2004 and 2007, however, the difference in enrolment was significant only for the boy-child.

The increase in primary enrolment rates also varies by pupils' region of origin (Table 7). While some regions experienced marked improvement in enrolment rates, in other regions primary enrolment declined. Five years after the introduction of FPE (2007), a dramatic increase in enrolment rates is witnessed across all regions except the Eastern lowlands. Between 2000 and 2007, the coastal lowlands experienced the largest and significant increase in enrolment of about 32% , followed by the Western transition with 12%. Compared to 2000, enrolment rates in 2004 and 2007 declined, albeit insignificantly, in the Eastern province by three and 4%, respectively.

Table 6 Primary school enrolment by gender

	Boy-child		Girl-child	
Year	Mean	Std. Err.	Mean	Std. Err.
2007	0.90	0.01	0.88	0.01
2000	0.83	0.01	0.82	0.01
Difference	*0.07*[a]	*0.01*	*0.06*[a]	*0.01*
2007	0.90	0.01	0.88	0.01
2004	0.85	0.01	0.86	0.01
Difference	*0.05*[a]	*0.01*	*0.01*	*0.01*
2004	0.85	0.01	0.86	0.01
2000	0.80	0.01	0.82	0.01
Difference	*0.05*[a]	*0.01*	*0.04*[a]	*0.01*

[a] Significant at 1%.

Table 7 Primary school enrolment by region

				Increase/decrease		
Region	2007	2004	2000	2000–2007	2004–2007	2000–2004
Coastal lowlands	0.86	0.78	0.54	0.32[a]	0.08[a]	0.24[a]
	(0.02)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Eastern lowlands	0.89	0.88	0.92	−0.03	0.01	−0.04
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Western lowlands	0.90	0.83	0.82	0.08[a]	0.07[b]	0.01
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Western transitional	0.89	0.84	0.77	0.12[a]	0.05[b]	0.07[a]
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
High potential maize zone	0.87	0.88	0.86	0.01	−0.01	0.02[a]
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Western highlands	0.89	0.85	0.83	0.06[b]	0.04[b]	−0.02
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Central highlands	0.90	0.88	0.86	0.04[b]	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)

[a] Significant at 1%.
[b] Significant at 5%.
Standard errors in parentheses.

6.3.2 Primary School Grade Progression

Next, primary school grade progression trends are examined. As alluded to earlier, grade progression is measured as a difference between grades achieved between 2000 and 2004 and between 2004 and 2007. It is a continuous variable bound between 0 and 1. If the index is 0, it means no progression was made from one grade to the next (perfect retardation) during the period in focus. If the index is 1, then the child was advancing one grade each year without repetition during the period under consideration. To estimate the impact of FPE programme on grade progression, we compare the average grade progression index of 2000–2004 and that of 2004–2007.

Grade progression rates have slightly declined in the period under review (Table 8). The grade progression index dropped from 0.62 in the 2000–2004 period to 0.58 in the 2004–2007 period. The decline is statistically significant at 1% level. While appreciating that grade progression is more or less a function of a pupil's ability, changes in grade progression after the introduction FPE programme vary across income groups (Table 9). The decline in grade progression rates was more pronounced and significant among children hailing from the 60% poorest households. The decline in grade progression among the 40% wealthiest households was not statistically significant.

Table 8 Primary school grade progression

Variable	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
2004–2007	0.5827	0.0070	0.2286	[0.5689–0.5965]
2000–2004	0.6194	0.0062	0.2022	[0.6072–0.6316]
Difference	−0.0367[a]	0.0094	0.3052	[(−0.0552) – (−0.0182)]

[a] Significant at 1%.

Table 9 Primary school grade progression by income groups

	Mean				
Variable	2004–2007	2000–2004	Difference	Std. Err.	Std. Dev.
Quintile 1 (lowest)	0.6078	0.6445	−0.0367[a]	0.0216	0.3135
Quintile 2	0.5524	0.6067	−0.0543[b]	0.0202	0.2926
Quintile 3	0.5660	0.6142	−0.0481[b]	0.0200	0.2915
Quintile 4	0.5861	0.6153	−0.0292	0.0229	0.3305
Quintile 5 (highest)	0.6012	0.6162	−0.0150	0.0205	0.2973

[a] Significant at 5%.
[b] Significant at 1%.
post-FPE = 2007–2004; pre-FPE = 2004–2000.

Even though grade progression declined for both the boy- and girl-child after the introduction of FPE, grade progression for the boy-child remained relatively higher than that of the girl-child (Table 10). In the period 2000–2004, grade progression for both the boy- and girl-child stood at 0.62. However, in the FPE programme period (2004–2007) grade progression for the boy- and the girl-child significantly declined to 0.59 and 0.57, respectively.

Next, we analyse grade progression across agro-ecological zones (Table 11). After the introduction of FPE programme, primary grade progression declined in virtually all regions except in Central region where grade progression slightly increased, albeit insignificantly. The decline in grade progression was statistically significant only in Coastal lowlands, Eastern lowlands, and High potential maize zone.

Table 10 Primary school grade progression by gender

Boy-child	Mean	Std. Err.	Std. Dev.
2004–2007	0.5932	0.0098	0.2289
2000–2004	0.6227	0.0087	0.2034
Difference	−0.0294[a]	0.0130	0.3039
Girl-child	Mean	Std. Err.	Std. Dev.
2004–2007	0.5713	0.0101	0.2279
2000–2004	0.6158	0.0089	0.2010
Difference	−0.0446[a]	0.0136	0.3066

[a] Significant at 1%.

Table 11 Primary school grade progression by region

	Mean				
Variable	2004–2007	2000–2004	Difference	Std. Err.	Std. Dev.
Coastal lowlands	0.5484	0.6290	−0.0806[a]	0.0403	0.3174
Eastern lowlands	0.6000	0.6369	−0.0369[b]	0.0262	0.2983
Western lowlands	0.6296	0.6500	−0.0204	0.0299	0.3103
Western transitional	0.5650	0.5919	−0.0269	0.0241	0.3165
High potential maize zone	0.5414	0.6065	−0.0651[c]	0.0170	0.3126
Western highlands	0.6203	0.6264	−0.0061	0.0303	0.3121
Central highlands	0.6407	0.6356	0.0052	0.0220	0.2558

[a] Significant at 5%.
[b] Significant at 10%.
[c] Significant at 1%.
post-FPE = 2007–2004; pre-FPE = 2004–2000.

6.3.3 Secondary School Enrolment

The success of education in stopping intergenerational poverty transfer hinges on primary graduates proceeding to secondary schools. First, we look at general cohort transition rates from the panel data. From the cohort that was in primary school in the 2000 survey and was expected to have joined secondary schools in 2004, only 37% transitioned. Similarly, only 33% of the cohort that was in primary school in 2004 and was expected to have proceeded to secondary school in 2007 actually did so. Therefore, only about one child out of every three children finishing primary education proceeds to secondary school, both before and after the introduction of the FPE period.

While transition rates among children from different household income levels were on average one-to-three (one child joining secondary education for every three children completing primary education), transition rates for children from poorer families have worsened after the FPE programme was introduced; out of every four children completing primary education, only one transitions to secondary school among the children hailing from the poorest 20% of households. Transition ratios of children from the wealthiest 20% of households were one for every three children finishing primary education.

Table 12 Secondary school enrolment by income groups

Income group	2007	2004	2000	Increase/decrease 2000–2007	2004–2007	2000–2004
Quintile 1 (lowest)	0.67	0.57	0.58	0.08	0.09	−0.01
	(0.07)	(0.07)	(0.06)	(0.11)	(0.09)	(0.11)
Quintile 2	0.65	0.62	0.70	−0.05	0.03	−0.07
	(0.07)	(0.07)	(0.06)	(0.12)	(0.08)	(0.08)
Quintile 3	0.76	0.66	0.76	0.00	0.08	−0.10
	(0.06)	(0.06)	(0.06)	(0.10)	(0.09)	(0.08)
Quintile 4	0.86	0.68	0.74	0.12[a]	0.18[a]	−0.06
	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)	(0.08)
Quintile 5 (highest)	0.77	0.72	0.62	0.15[b]	0.05	0.10
	(0.06)	(0.06)	(0.06)	(0.10)	(0.09)	(0.07)
Overall	0.74	0.66	0.68	0.06[b]	0.08[b]	−0.02
	(0.04)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)

[a] Significant at 5%.
[b] Significant at 10%.
Standard errors in parentheses.

The results from secondary school enrolment analysis using propensity score matching methods are presented in Table 12. Generally, secondary school enrolment improved between 2000 and 2007. Enrolment rates increased from a mean of 68% in 2000 to 74% in 2007. However, a test of significance in the difference of the two means was only significant at the 10% level. Between 2000 and 2004, the enrolment rate declined from 68 to 66%. This decline was not significant, however. In relation to household income levels, results indicate that children from wealthier households had higher enrolment rates. Secondary enrolment rate for the children from the 20% poorest households was 58% while that for their counterparts from the 20% wealthiest households stood at 62% in 2000. In 2004, 1 year into the FPE programme, the enrolment for the children from the wealthiest group increased by 7% to 72%. This improvement in enrolment was, however, not significant.

On the other hand, enrolment rates among children from the poorest income group declined, albeit insignificantly, by 1% to 57%. Between 2000 and 2007, secondary school enrolment rate for the two wealthiest income groups improved significantly. For the other income groups the change was not significant. These results indicate that there still exist constraints hindering children from poorer households from transitioning to secondary school after primary education.

There exist gender disparities in secondary enrolment rates (Table 13). The secondary school enrolment for the girl-child was relatively higher compared to that of the boy-child in 2000 – 67 and 65%, respectively. In 2004, the enrolment for the boy-child increased to 68% while that for the girl-child declined to 63%. These changes were, however, not significant. Comparing 2000 and 2007, secondary school enrolment rate for the boy-child rose by 19% to 84%. This increment was statistically significant at the 5% level. On the other hand, secondary school enrolment for the girl-child between the two periods slightly declined by 1% to 66%. However, the decline was not statistically significant.

Table 13 Secondary school enrolment by gender

Year	Boy-child Mean	Boy-child Std. Err.	Girl-child Mean	Girl-child Std. Err.
2007	0.84	0.04	0.66	0.05
2000	0.65	0.05	0.67	0.05
Difference	*0.19*[a]	*0.06*	*−0.01*	*0.06*
2007	0.84	0.04	0.66	0.05
2004	0.68	0.04	0.63	0.04
Difference	*0.16*	*0.05*	*0.03*	*0.06*
2004	0.68	0.04	0.63	0.04
2000	0.65	0.05	0.67	0.05
Difference	*0.03*	*0.06*	*−0.04*	*0.05*

[a] Significant at 1%.

Secondary school enrolment rates also vary across regions (Table 14). In 2000, the High Potential Maize zone led in secondary school enrolment (75%). Western lowlands and highlands had the least secondary school enrolment rates (10%). In 2004 and 2007, while some regions experienced improvement in enrolment rates, others witnessed declines. Secondary school enrolment decreased significantly in the Coastal lowlands region by 23% between 2000 and 2007. In the High Potential Maize zone, the enrolment rate significantly improved by 12% between 2004 and 2007. The changes in enrolment in the other regions were not statistically significant.

Table 14 Secondary school enrolment by region

				Increase/decrease		
Region	2007	2004	2000	2000–07	2004–07	2000–04
Coastal lowlands	0.34	0.54	0.57	−0.23[a]	−0.19	−0.03
	(0.44)	(0.11)	(0.10)	(0.20)	(0.24)	(0.14)
Eastern lowlands	0.60	0.65	0.63	−0.04	−0.05	0.02
	(0.07)	(0.07)	(0.07)	(0.12)	(0.10)	(0.10)
Western lowlands	0.78	0.56	0.46	0.32	0.22	0.10
	(0.07)	(0.08)	(0.08)	(0.13)	(0.12)	(0.12)
Western transitional	0.81	0.72	0.68	0.12	0.09	0.04
	(0.08)	(0.09)	(0.10)	(0.12)	(0.08)	(0.08)
High potential maize zone	0.79	0.68	0.75	0.05	0.12[b]	−0.07
	(0.05)	(0.05)	(0.05)	(0.08)	(0.06)	(0.07)
Western highlands	0.72	0.63	0.60	0.12	0.09	0.03
	(0.08)	(0.10)	(0.10)	(0.13)	(0.14)	(0.13)
Central highlands	0.81	0.70	0.71	0.10	0.11	−0.01
	(0.05)	(0.06)	(0.06)	(0.11)	(0.09)	(0.08)

[a] Significant at 5%.
[b] Significant at 1%.
Standard errors in parentheses.

6.4 Benefit Incidence Analysis Results

Table 15 presents the distribution of primary school enrolment using income quintiles. The results are presented for 2004 and 2007. The first column in each year presents sample results while the second presents the population results. It should be noted that during sample selection, sampling weights were not taken into consideration. Nevertheless, an effort was made to construct probability weights to represent the probability that a case was selected into the sample from a population. These weights are calculated by taking the inverse of the sampling fraction. It can be observed from the results that immediately after the FPE programme introduction in 2004, the households in the second and the third quintiles had relatively more children enrolled in primary school compared to households in the first (20% poorest) and fifth (20% wealthiest) households. However, in 2007 there was a substantial shift in distribution of primary school enrolment across income quintiles. The primary school enrolment rates vary inversely with household income per adult equivalent. Poorer households have comparably more children attending primary school than their wealthier counterparts. Actually, the number of children enrolled in primary school from the households in the poorest 20% quintile is more than double the number from the wealthiest 20% income group.

Table 15 Number of children enrolled in primary school

	2004		2007	
	Sample	Population	Sample	Population
1 lowest	576	1,282,274	637	1,856,865
2	575	1,653,357	571	1,575,693
3	516	1,358,191	484	1,077,927
4	389	1,159,307	373	856,351
5 highest	277	709,174	268	779,403

As mentioned earlier, the FPE programme comprises a uniform allocation per enrolled child across the country. The allocation was KSh.1020 in 2004/05 and 2007/08 financial years. This implicitly means that benefit incidence is more or less a function of household behaviour rather than government behaviour.

In the first year after the introduction of FPE programme (2004), households in the second and third quintile captured most of the primary education subsidy (Table 16). However, with changes in enrolment across quintiles in 2007, the scenario changed. Government spending on FPE programme became pro-poor. The poorest 20% of households captured more than twice the government's expenditure on FPE than their counterparts in the wealthiest 20% income group. This can be attributed to the fact that poorer households tend to have more children, and when schooling constraints are eased the same households are bound to have more children enrolled.

In Fig. 1, the estimates of children in the school-going age but are out of school, even though they have not completed primary education, are presented for 2004 and 2007. The results show that poorer households have more children out of school

Table 16 FPE programme expenditure estimates across income quintiles

	2004			2007		
Income quintile	Ksh	US$	%	Ksh	US$	%
1 lowest	1,307,919,480	20,121,838	20.8	1,986,845,550	30,566,855	30.2
2	1,686,424,140	25,944,987	26.8	1,685,991,510	25,938,331	25.6
3	1,385,354,820	21,313,151	22.0	1,153,381,890	17,744,337	17.5
4	1,182,493,140	18,192,202	18.8	916,295,570	14,096,855	13.9
5 highest	723,357,480	11,128,577	11.5	833,961,210	12,830,172	12.7

1US$ = KSh.65

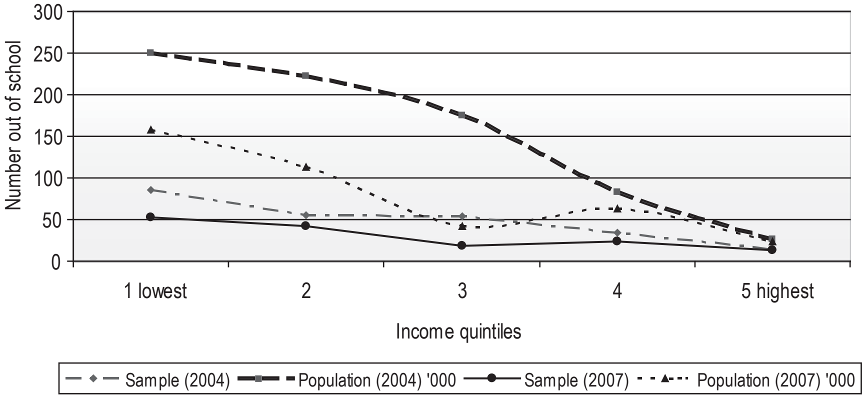

Fig. 1 Number of children out of school but in the school-going age

compared to the relatively wealthy households. Two important points stand out. First, the poorer households would benefit a lot more from the FPE programme if their children out of school could be enrolled. Second, as mentioned earlier, the reasons that scaled down enrolment rates in primary school before the introduction of the FPE programme go beyond direct schooling costs.

7 Summary and Conclusion

This study set out to evaluate the impact of the FPE programme in Kenya, to assess whether the programme is succeeding in reversing poor education trends. The FPE programme's impact was evaluated using the propensity score matching method.

Results have shown that while primary and secondary school enrolment rates have significantly improved in the period after the introduction of the FPE programme, grade progression has worsened. The improvement in primary school enrolment rates can largely be attributed to the FPE programme and the primary education sensitization campaign that accompanied it. Increased secondary school enrolment could be attributed to the increase in primary school enrolment, as well as several secondary school bursary schemes that were introduced alongside the

FPE programme. Declining grade progression could indicate declining quality of primary education as a result of congestion, inadequate teachers, and inadequate primary school infrastructure resulting from increased enrolment.

There is a need to improve primary school infrastructure and recruit more teachers. Secondary school enrolment rates remain low, especially among children hailing from poorer households and in some regions. This indicates a need for government intervention at the secondary school level. The recently introduced subsidized secondary education initiative is a step in the right direction and should be sustained.

Government spending on the FPE programme was found to be pro-poor. Despite lower enrolment rates, the poorest 20% of households capture more than twice the benefits of their counterparts in the wealthiest 20% income group, as poorer households tend to have more children. However, under this programme, primary school enrolment rates increased most among children from the wealthier households. This finding suggests that the factors that prevent poorer children from attending primary school go beyond the inability to pay school fees. This indicates a need for pragmatic interventions to combat other factors beyond direct schooling costs that keep children from enrolling in school. Such interventions would definitely require an inquiry into the relevant hindrances to primary school enrolment, before these interventions can be instituted.

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Annex: Kenya's Oldest Schoolboy

The provision of free primary schooling in Kenya has been widely welcomed as a success since the newly elected government introduced it.[5] The policy has had some unexpected consequences though – not least, the enrolment of the country's oldest schoolboy. Wearing a faded blue blazer, shorts, and long socks, Mzee Kimani Nganga Maruge walks to school with his classmates dressed much like any other new boy – except that he also carries a walking stick, has grey beard and weathered face, and happens to be 84 years old. He says he decided to enrol when he heard that the new government was providing free primary education. He had hoped to go to school before, but had never had the opportunity. Mr. Maruge, not the least bit embarrassed to be in the same school with two of his grandchildren, dismisses his

[5] The *New York Times*, Monday, April 5, 2005 and BBC, Nairobi Wednesday, 14 January, 2004

critics with a wave of his cane, 'Let them who want to make fun of me do it,' he said, 'I will continue to learn.'

Maruge joined classes at Kapkenduiywa Primary School in the western town of Eldoret in early January. He is the world's oldest pupil, according to the *Guinness Book of World Records*, and Kenya's most famous primary school pupil.

Mr. Maruge is a widower who has fathered 15 children, 5 of whom survived. He is a great-grandfather who never spent a day in school. His own father had insisted that he look after the family's herd of livestock.

Mr. Maruge took part in the *Mau Mau* rebellion against the British. He says one of his main aims is to learn to count the money he expects to receive in compensation from the authorities for fighting against the British in the 1950s. He also hopes to learn to read the Bible – because he does not trust the version he hears each week in church.

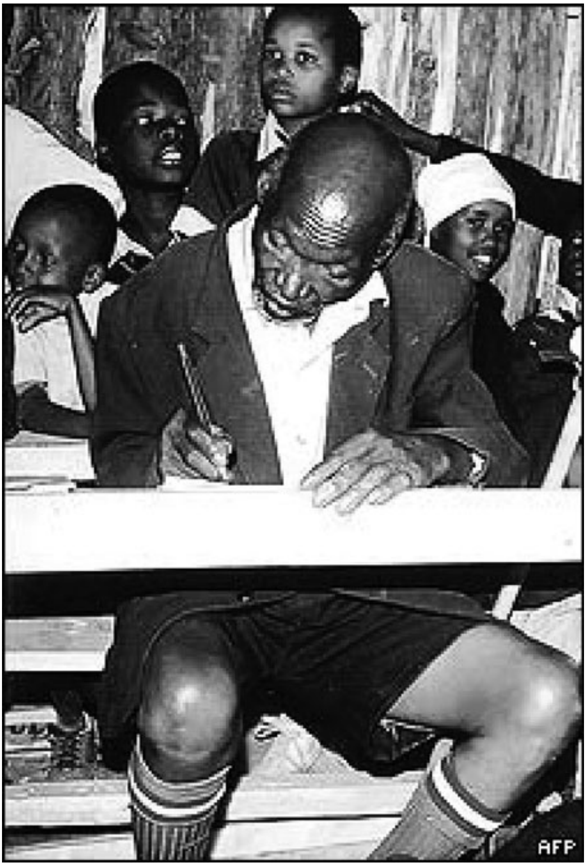

Photo 1: Mzee Kimani Nganga Maruge

While there is general support for the Kenyan Government's policy of providing free schooling, some parents have complained that standards have dropped and classes have become overcrowded.

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Productive Safety Net Program and Children's Time Use Between Work and Schooling in Ethiopia

Tassew Woldehanna

Abstract Government, non-government, and donor organizations have developed a social assistance program known as Productive Safety Net Program (PSNP) which has two sub-programs namely public work program (PWP) and Direct Support Program (DSP). PSNP is designed to reduce the vulnerability of poor people to drought and it targets household and in most cases without considering ex ante the issue of intra-household resource distribution. This paper assesses, using Young Lives Survey data, the impacts of the Productive Safety Net Program (PSNP) and the Agricultural Extension Program (AEP) on time use between work and schooling as well as highest grade completed by 12-year-old children in rural and urban Ethiopia. Empirically the study used propensity score matching techniques to estimate the impact of PSNP and AEP on child welfare measured by time use in various types of work, schooling, and studying. We found that PWP in rural areas increases child work for pay, reduces children's time spent on child care and household chores and total hours of time children spent on work all kind of work combined, and increases girls spending on study. The DSP in rural and urban areas reduces time children spent on paid and unpaid work, and increases the highest grade completed by boys in urban areas. On the other hand, AEP in rural areas was effective in reducing child work for pay and total work, increasing time girls spent on schooling and highest grade completed by girls.

Keywords Social protection · Child welfare · Impact evaluation · Productive safety net · Ethiopia

Abbreviations

AEP	Agricultural Extension Program
CFW	Cash for Work Program
DSP	Direct Support Program
EGS	Employment Generation Scheme

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FFW	Food-for-Work Program
PASDEP	Program for Accelerated and Sustained Development to End Poverty
PSNP	Productive Safety Net Program
PWP	Public Work Program
SP	Social Protection
YL	Young Lives

1 Introduction

Child labor/work and its potential causes has been a subject of study in the economic literature in the past decade. Theoretically, children's time allocation between work and education is the result of household decisions shaped by the availability of assets, inputs, credit and insurance, the effectiveness of labor and credit markets, and parental education levels. They call this model a household production model (Becker and Tomes, 1976). Using this model, various hypotheses exist as to what explains the incidence and intensity of child labor in the developing countries. The often mentioned cause of child labor is poverty in the sense that raising household income enables parents not to send their children to the labor market. (Basu and Van, 1998; López-Calva, 2001). Without this income, parents use child labor to trade off higher current income against lower future child income as it reduces children's human capital development[1]. Poverty is, however, not sufficient for this relation to hold. It has to be associated with non-positive bequests and financial market imperfections that prevent parents from trading-off old-age income with current resources, leading them to produce too much child labor relative to the first best optimum that would hold with positive bequests or perfect financial markets (Baland and Robinson, 2000).

Although the poverty hypothesis suggests that there could be a positive correlation between expenditure/wealth and child schooling, liquidity constraints and imperfect labor markets may result in the opposite relationship (Bhalotra and Heady, 2003; Nielsen, 1998). Wealth paradox (Bhalotra and Heady, 2003; Nielsen, 1998) sates that in the absence of perfect access to credit and the imperfect substitution of hired labor for family labor, livestock ownership and the cultivation of larger land holdings (or the use of more labor-intensive technologies in the same land size) may in fact lead to greater demands for child labor than schooling (Coulombe, 1998). They call this wealth paradox (Bhalotra and Heady, 2003; Nielsen, 1998).

Recent literature of Guarcello et al. (2003), Duryea et al. (2003), Beegle et al. (2006), Jacoby and Skoufias (1997), and Jensen (2000) point out that child labor may vary depending on households' ability to respond to unexpected income shocks. Lack of access to credit and insurance markets can increase the intensity of child labor to buffer the effects of negative economic shocks, very much like they can do with sales of assets, running down savings and informal social networks

[1] This is known as poverty hypothesis in child labor/education literature.

of transfers and loans. Child labor allows households to partially offset income loss directly through child wage income or indirectly by freeing up adult labor from household work or chores. According to this hypothesis, all else being equal, increases in child labor incidence and/or intensity should be associated with households that have experienced such negative economic shocks.

To reduce the negative impact of economic shocks on children, government and non-government organizations including donor groups develop social protection programs such conditional and unconditional cash transfer to the poor (Farrington and Slater, 2006). There are studies that evaluates whether such transfers achieve the stated objectives especially for conditional cash transfer programs (Cardoso and Souza, 2004; de Janvry et al., 2006). For example, de Janvry et al. (2006) assess the long-run effect of economic shocks on school attendance in Mexico and evaluate the effectiveness of conditional cash transfer (CCT) program of Mexico's known as Progressa program. Using panel data from the *Progresa* experience with randomized treatment, they show that short-term shocks that take children out of school will consequently have long-term consequences on their educational achievements. Idiosyncratic and covariate shocks pushed parents to take children out of school and to use child labor as risk-coping instruments. Consequently they show that the conditional cash transfer helps protect children from these shocks. However, the effect of unconditional cash transfer or social assistance (one form of protection programs) on child welfare is not clearly known.

A prime concern of governments and donor organizations in developing countries including Ethiopia is to mitigate poverty. To address extreme poverty, governments, in collaboration with donors and non-governmental organizations, are developing various social protection strategies. Among such strategies, the Ethiopian government has introduced a public work and direct support program popularly known as *Productive Safety Net Program* (PSNP) in 2005 to strengthen the emergency relief-based employment generation scheme (EGS) in order to better address poverty and vulnerability in both rural and urban Ethiopia.

However, all of these social protection policies target the household as a whole, without focusing on the issue of intra-household resource distribution. Especially the child welfare effect of social protection programs is not considered by practitioners and policy-makers (at least for the programs considered in this paper, namely PSNP, EGS and AEP). This is partly based on the assumption that child welfare will improve when household poverty is reduced. Social protection programs, if carefully applied, may reduce household poverty, but it may be at the expense of child welfare. For example, provision of agricultural extension support may encourage households buy fertilizer, livestock, other purchased inputs, and capital in order to intensify farming. Moreover, provision of public work program may increase the demand for labor. While these kinds of support programs increase household income and hence improve child welfare in terms of nutrition, they would also increase the demand for labor. If the demand for labor cannot be met via adult family and hired labor, children may be subjected to heavy work both at home and outside home, which would compete with schooling and studying time. Therefore, unintentionally, the social protection programs, which are originally designed to improve household welfare, can be damaging to children. Children, instead of going to school and/or using their free time for studying and entertainment, may be forced to spend more for short-term benefits such as earning income from child labor.

Ethiopia (as indicated in the recent poverty reduction strategy known as PASDEP) has intensified the use of public work, credit, and agricultural extension support programs in rural Ethiopia, and micro- and small-scale enterprises in urban areas (MoFED, 2006). As argued above, such polices may have detrimental effects on child welfare. The underlying assumption behind such programs is that labor is relatively more abundant than capital, leading to the conclusion that new livelihood opportunities should be labor-intensive and agriculture based. However, given imperfect labor and credit markets, the demand for labor may in the short term be met by involving children in either paid or non-paid work.

Public work and agricultural extension programs implemented in rural Ethiopia require households to supply labor in order to obtain payment. Hence, we expect public work (PSNP) and agricultural extension support programs to have both substitution effect and income effect. The substitution effect comes in that these programs increase the demand for labor and may create an incentive to intensively use children's time and/or substitute child time for adult time in household chores, child care, and works outside home. Because these support programs bring additional resource to the households, they have income effects in the sense that participation in these programs increases child schooling and reduce child work.

The direct support program component of the productive safety net program (cash/food and education support) has been implemented in both rural and urban areas. These programs do not require household to supply labor to obtain the support. Hence we expect these programs have only income effect, not substitution effects. Therefore their effect on child labor and education would be expected to be different from that of public work and agricultural extension programs. If the programs are effective we expect that involvement of households in cash/food aid and education support program will reduce child work and increase schooling and studying time.

The hypothesis of this study, therefore, is that the provision of public work and agricultural extension support programs via the promotion of labor-intensive activities, while augmenting aggregate economic development, could be detrimental to child well-being when pursued without precautionary management measures. In order to create a win-win situation where both national economic development and children's rights (socioeconomic, civic and cultural) are realized, it is crucial to have a deep understanding of the relationship between support programs and children's time use.

Although studies investigate the effect of support programs on household welfare, studies are scarce regarding the child welfare effect of support programs that target households instead of children. Specifically the effectiveness of social assistance programs designed to improve household income is not assessed well at least in the Ethiopian context.

This paper, therefore tries to assess the impact of social protection programs on child welfare measured by child work and education. Specifically, the objective of this paper is the following.

1. To investigate if participation of households in public work programs and agricultural extension programs affects children time use between work on the one hand and schooling and study at home on the other hand.
2. To see the effectiveness of direct support (cash and food aid) programs in reducing child work and increase child schooling.
3. Asses the differential impact of the support programs between boys and girls.

The study uses propensity score matching techniques in order to estimate the impact of support programs. Data of Young Lives Survey from the older cohort sample collected in the last quarters of 2002 and 2006 were used for the study.

The rest of the paper is organized as follows. Section 2 presents brief literature review of concepts and empirical studies. Descriptions of the support programs considered in the paper are presented in Section 3. Section 4 outlines theoretical framework and method of estimating program impacts as well as description of data used in the paper. Section 5 presents the result and a discussion. The summary, conclusion and policy implications are highlighted in Section 6.

2 Literature Review in Brief

2.1 Definition of child labor

The literature differentiates between "Child Work" and "Child Labor." The first is mainly described as work which is not particularly harmful for the child and does not damage educational opportunities. On the contrary, "Child Labor" is used for work which is likely to damage children's health, physical and psychological development as well as their chances of fulfilling other rights, mainly the right to education.

According to the International Labor Organization (ILO), Child Labor has been defined as (a) All economic activities done by children until age 11; (b) all economic activities done by children aged 12–14, excluding permitted "light work" in the sense of Convention 138; (c) all economic activity carried out under "hazardous conditions" by children aged 15–17; and (d) "The worst forms of "Child Labor" carried out under age 18.

ILO's definition of child labor does not include activities done by the children inside the house (all forms of domestic work and family care) on the ground that these kinds of work do not harm children's education, health and physical and psychological development. However, evidences show that these kinds of activities also contribute to harm the children's development and their learning process, especially in the case of girls (see Knaul Felicia, 1999; Lavinas L, Barbosa M. L. et al., 2001; Levinson Deborah, Knaul Felicia et al., 2001; Yap et al., 2001, cited in Anker (2000)).

In this paper, we use the term child work and labor interchangeably because we do not want to engage in the controversy of including children's activity at home in to the definition of child labor. Furthermore, we found that it is difficult to apply

ILO's definition of child labor as we are using data from children of 5–17 years old and ILO definition requires different intensities of child work for different age categories.

2.2 Theoretical Models of Child Labor

The analysis of children's time use between work and education is done by employing models of household behavior. Modeling of household behavior in mainstream economics started with Becker (1965), known in literature as household production model (Becker and Tomes, 1976). According to the review made by Dar et al. (2002) there are two basic types of household models often used by economists: bargaining models and altruistic models. In bargaining models household behavior is outcome of internal bargains and power struggle (Browning et al. 1994). Bargaining models may be of two distinct kinds, depending on who the agents involved in the bargaining are. Intra-household bargaining models assume that the bargaining occurs within the family between parents and the child (children). Solutions to these models usually specify that a child's labor supply depends on the adult wages and child wages that prevail on the market. In the extra-household approach, it is assumed that children have negligible bargaining power in households, and are basically an instrument for the parents' maximization of utility. These models usually treat employers and parents of the children as the two main factors involved in the bargaining process (Dar et al., 2002).

These models sharply contrast with altruist models of child labor, in which the parents are altruistically concerned with the child's welfare. Furthermore, the altruistic classes of models are differentiated from bargaining models, as they assume multiple equilibria (Dar et al., 2002). Foremost among the altruistic models is presented in Basu and Van (1998), which provides a framework for investigating how child labor and adult labor are interdependent in economic activity and under what conditions child labor emerges in the labor market. The main findings in their paper are essentially derived from two axioms referred to as the "Luxury" and "Substitution" axioms, respectively. Luxury Axiom states that a family sends the children to the labor market only if the family's income from non-child labor sources drops below the subsistence level; and Substitution Axiom asserts that child labor and adult labor are substitutes from a firm's point of view (Dar et al., 2002).

Basu and Van (1998), in a multiple equilibria model, stress an alternative mechanism in which child labor is both a cause and a consequence of poverty: in a "good" equilibrium, when market wages are high, parents choose not to send their children to work; whereas in a "bad" equilibrium, when wages are low and families are poor, parents send their children into the labor force (Kruger et al., 2007). Dessy (2000) finds that there is a critical level of adult wages below which child labor is supplied. Ranjan (2001) also shows that credit constraints lead to inefficiently high levels of child labor, which, in turn, are related to greater income inequality.

Other models exploring multiple equilibria have looked at the relationship between child labor and social norms, and also at the question of income redistribution. The redistribution question is examined by Swinnerton and Rogers (1999), who stated that while the two crucial assumptions implied by Basu and Van's "Luxury" and "Substitution" axioms are related to the micro-behavior of households and firms, in addition there also exists an essential assumption linked to the macro-behavior. They denote this as "Distribution Axiom," which states that income and/or wealth from non-labor sources must be sufficiently concentrated within only a few of the agents to generate child labor. In particular, Swinnerton and Rogers demonstrate that with sufficient equality in the distribution of non-labor income, market equilibrium with child labor cannot exist in the Basu and Van model. This observation points toward the importance of inequality and/or bargaining power at the macro- as well as the individual level as a potential important determinant of child labor (Dar et al., 2002).

Within the class of altruistic household model, Baland and Robinson (2000) have looked at dynamic consequences of child labor. They demonstrate various channels through which inefficiently high levels of child labor may persist in equilibrium, even when parents are altruistic. First, lack of access to credit markets may force parents to let their children engage in child labor to an extent that is Pareto inferior to what they would have chosen with sufficient access to credit. Second, since children cannot write credible and enforceable contracts with their parents to transfer resources to them in the future, this too may generate an inefficient level of child labor in equilibrium. Parents are unable to capture the full returns from their investment in children's education and therefore will underinvest, relative to what would otherwise be (Pareto) optimal.

2.3 Concept of Social Protection

Social protection is becoming a broader concept which goes beyond social policies and social welfare. According Farrington and Slater (2006), social protection encompasses a subset of public actions that address risk, vulnerability and chronic poverty, while World Bank relates social protection program with social risk management and goes beyond the traditional area of social protection (as labor market interventions, social insurance and social safety nets) to redefine its strategies to deal with risk (Holzmann and Jorgensen, 2000). The three strategies of World Bank's' Social Risk Management are prevention, mitigation, and coping which can be provided via informal mechanisms (storing in the form wealth, trees, and transfer of cash within the household), market based (insurance) and publicly mandated (such as social insurance, transferred payment of various kinds and public work). Conway and Norton (2002) argue that social protection includes the link between social assistance and wider economic objectives such as growth by assisting the poor so as to make poor contribute for growth, which closely resembles the World Bank's social risk management. The idea is to link social protection with the productive sector by making markets work better for the poor. As a result, provision of credit and subsidized or free inputs are considered as component of social protection (Farrington et al., 2004). The UNICEF view of social protection focuses on vulnerable groups of children and views access of vulnerable groups to social protection as a basic human right in that governments have the obligation to provide both economic and social support to the most vulnerable segment of the population (Kamerman and Gabel, 2006). The most inclusive definition is the one developed by Devereux and Sabates-Wheeler (2004) which is beyond raising income and reducing poverty. Devereux and Sabates-Wheeler (2004) state that social protection must enhance social equity and social rights of the poor, vulnerable, and marginalized population:

> Social protection is the set of all initiatives, both formal and informal that provide: social assistance to extremely poor individuals and households; social services to groups who need special care or would otherwise be denied access to basic services; social insurance to protect people against the risks and consequences of livelihood shocks; and social equity to protect people against social risks such as discrimination or abuse Devereux and Sabates-Wheeler (2004).

In general, there exists a broad range of social protection programs. One form of social protection is s*ocial assistance* which involves non-contributory transfers to those deemed eligible by society on the basis of their vulnerability or poverty (Farrington and Slater, 2006). It includes food transfers (food stamps, food rations, food price subsidies), cash transfers (grants, non-contributory pensions, family allowance programs), service subsidies (social housing programs, utility subsidies, and child care centers), and conditional cash transfers (conditional on child and maternal health care practices, school attendance, and nutritional standards, or on use of welfare programs). Social assistance may also include livelihood support payments targeted at households below the poverty line, which they are free to spend as they wish; 'cash for work'-type payments, i.e., made to those belonging to targeted categories who carry out public works under supervision; 'matching funds' which supplement the contributions that people themselves make to, for example, savings schemes, health and life insurance, and so on; and payments made as part of emergency relief, or to facilitate post-emergency transitions.

Another form of social protection is *social insurance* which involves individuals pooling resources by paying contributions to the state or a private provider so that, if they suffer a shock or a permanent change in their circumstances, they are able to receive financial support. Social insurance is, in general, more appropriate for better-off individuals, although it can have an important role in preventing them from dropping into poverty (Farrington and Slater, 2006).

This paper follows concepts of social protection as defined by Devereux and Sabates-Wheeler (2004) because it is broader, inclusive of all providers of social protection (formal and informal), and all dimensions of poverty including all initiatives that helps protect the rights of children. Although social protection encompasses both public and private initiatives that address household vulnerability to shocks, what we consider in this paper are social assistance programs provided by government and non-governmental organizations namely safety net programs (public work and cash/food aid) designed to help poor, vulnerable, and drought stricken people and agricultural extension support program designed for farmers to get subsidized inputs, credit, and market information.

2.4 Social Protection and Its Relation with Child Work and Education

There are sufficient evidences that conditional cash transfer programs helps households send their children school and to some extent reduce child labor (Tabatabai, 2006; Rawlings, 2005), while evidence on the effectiveness of unconditional cash transfer on child schooling is weak. Adapting a model proposed by Hyslop (1999) that represents labor market participation decisions when there are search costs, de Janvry et al. (2006) develop a simple dynamic model of school enrollment decision under uncertainty in which re-entry to school after a discontinuity requires additional effort and cost on the part of the student. This model generates an enrollment decision that depends on the past enrollment state and current level of human capital. Using panel data for villages from the Mexican *Progresa* program with randomized treatment, they have shown that shocks are highly prevalent, that many children have irregular periods of school enrollment, and that child labor is very frequent. They also showed that there is strong state dependence in the enrollment decision. Children taken out of school are less likely to subsequently return, implying long-term consequences from short-term decisions.

By observing control villages after they became incorporated in the treatment, de Janvry et al. (2006) also show that children that did not benefit from transfers during the experiment are harder to bring back to school, implying as well that short-term actions are difficult to reverse. Shocks have strong effects in taking children out of school. This applies to unemployment of the household head, illness of the household head, and natural disasters in the community. In poor rural communities, children are indeed used as risk-coping instruments in responding to these shocks. Strong state dependence implies that short-run consumption smoothing gains for the household result in long-term losses in human capital for children. The *Progresa* transfers, however, largely or completely compensate for these shocks. CCTs thus have an important safety net role to play, protecting child education from a range of idiosyncratic and covariate shocks. Shocks also induce children to work, particularly girls and children of farm workers when their parents are affected by unemployment. *Progresa* transfers also fully shelter them from being sent to work. The conditionality on school attendance is thus effective in preventing use of their time as a risk-coping instrument.

Dubois et al. (2003) study the effects of a conditional transfers program on school enrollment and performance using the Mexican social program *Progresa*. They estimate empirically the different incentive effects and average treatment effects on enrollment and performance at school and find that *Progresa* always had a positive impact on school continuation whereas for performance it had a positive impact at primary school but negative at secondary school, due to the program termination after the third year of secondary school.

Applying propensity score matching methods on household level data of the 2000 Census of Brazil, Cardoso and Souza (2004) estimate the impact of income transfers on child labor and school attendance. They find that income transfer programs had no significant effect on child labor but a positive and significant impact on school attendance implying that the programs were not effective in fighting child labor in Brazil because of the preference to combine school and labor, considering that the transfers are too small to provide an incentive to forgo labor income (Cardoso and Souza, 2004).

Attanasio et al. (2006) studied the effects of a conditional cash transfer program implemented in rural areas in Colombia in 2002 (*Familias en Acción*), on school enrolment and child labor. Using a quasi-experimental approach, their results show that the program increased school participation of 14–17-year-old children quite substantially, by between 5 and 7 percentage points, and had lower, but non-negligible effects on enrolment of younger children of between around 1.5 and 2.5 percentage points. In terms of work, the effects are generally largest for younger children whose participation in domestic work decreased by around 10–12 percentage points after the program but whose participation in income-generating work remained largely unaffected by the program. The authors also found evidence of school and work time not being fully substitutable, suggesting that some, but not all, of the increased time at school may be drawn from children's leisure time.

Schady and Araujo (2006) used a randomized study design to analyze the impact of the *Bono de Desarrollo Humano* (BDH), a cash transfer program, on enrollment and child work among poor children in Ecuador. The objective was to determine whether or not program effects are larger when transfers are "conditioned" on certain behaviors, such as a requirement that households enroll their children in school. The authors found out that first, the cash transfer program had a large, positive impact on school enrollment, about 10 percentage points, and a large, negative impact on child work, about 17 percentage points; and second, the fact that some households believed that there was a school enrollment requirement attached to the transfers, even though such a requirement was never enforced or monitored in Ecuador, helps explain the magnitude of program effects.

The study conducted by Edmonds (2006) found out that anticipated large cash transfers to the elderly in South Africa appear to be associated with increase in schooling and decline in hours worked. The average rural South African child living with an elder that is not yet pension eligible spends almost 3 h per day working. In the data, pension income to an elder male is associated with over an hour less work per day. These declines in hours worked occur simultaneously with increases in school attendance. In turn, these declines in time spent working and increases in school attendance are also associated with increasing schooling attainment and primary school completion rates, especially for boys, in the length of time that the child has lived with a pension-eligible male. These changes in hours worked and schooling with male pension eligibility lead to levels of work and schooling that are similar to what the data report for nearly eligible elder women. Hence, the results herein would follow from a model where men are credit constrained to a greater degree than women are. There is some suggestive evidence that these credit constraints influence schooling because of an inability to afford schooling.

Baland and Robinson (2000) show that if a family faces liquidity constraints, then child labor is inefficiently high (from the family's perspective), because child labor supply is determined by the marginal utility of consumption rather than the relative return to educational investments. The inability to borrow against future income forces households to underinvest in education. Therefore, receiving large cash transfers weaken this cash constraint, and hence children work less and attend school more.

Cash transfers may enable households to make previously unattainable investments in income-generating activities. Gertler (2004) used a controlled randomized experiment to identify the extent to which beneficiary households from Mexico's *OPORTUNIDADES* program invested cash transfers and the extent to which those investments increased long-term household consumption. They found that transfers from the program result in increased investments in micro-enterprises and agricultural production, which have a lasting effect on the household's ability to generate income and thereby increase living standards.

Yap et al. (2002) evaluated the impact a program in Brazil known as the Programa de Erradicacao do Trabalho Infantil (PETI) which was implemented in poor rural states of Northeast Brazil in 1996. The PETI provided income transfers to poor households in exchange for an agreement that the child would attend school at least 80% of the time. In addition, the child had to attend an after-school program that effectively doubled the length of the school day. The study used experimental approach on a cross-section of 3,564 households with 6,772 children between ages 7–14. It assessed the impact PETI on child schooling, labor supply, academic performance, and hazardous work. The treatment group was composed of three municipalities which were in the PETI program. The control group included three municipalities of like socioeconomic status that were not in the PETI program The study found that PETI was able to increase time in school, reduce labor force participation and hazardous work, and increase academic success for children who had participated in the program.

This review of literature reveals that while cash transfer conditional on children school attendance is effective in ensuring child schooling and reducing child work/labor, the evidence on the child welfare effect (schooling and labor) of unconditional assistance program such as public employment and food aid is not yet sufficiently available. Moreover, many of the studies that assessed the impact of conditional cash transfer on child welfare, especially on child labor, are conducted on Latin American and Caribbean countries where child labor is less extensive than in Africa (Tabatabai, 2006). Therefore, this paper contributes to fill the information gap on the relationship between child welfare (measured by education and work) and social assistance program that target households only.

3 Description of Public Employment and Agricultural Extension Support Programs in Ethiopia

3.1 Public Employment Programs

The food-for-work program in Ethiopia started in 1980 under the program of Rehabilitation and Development of Rural Lands and Infrastructure. Since its start, the program is divided into several phases. The first and the second phases were implanted from 1980 to 1994, while the third phase of food-for-work program was conducted from 1995 to 1998. The food-for-work program that was carried out from 1999 to 2003 is the fourth phase. In 1997, a similar program namely employment generation scheme started as a temporary employment scheme designed in order to combine relief efforts with development activities. EGS was considered as a direct contribution to the rebuilding of household assets, contributing to reduce Ethiopia's chronic food insecurity. This program passed through three phases. The first phase (run from May 1997 to Decemeber1998) was a pilot program conducted in two drought-prone areas in Amhara Regional State, Belesa *Woreda* and Tigray Regional State, Saesi Tsaeda Emba *Woreda*. In this program, part of the relief is given to conduct development activities in the area, such as soil and water conservation, rural road building, and other efforts that build community assets. Those who are not able to work are given free, but those who are able to work are given 2.5 kg/of grain per working day[2]. The second and third phases of EGS started in September 2001 and ran until the launch of Productive Safety Net Program (PSNP) in 2005.

Gratuitous relief (GR) distribution and general free food distribution (GFFD) were other programs (before PSNP) designed to support people who are not able to work including pregnant, lactating mothers, disabled people, and children. The principle was that GR distribution should not be given to able person in order to discourage dependency. If a person is able to work, he has to participate in EGS in order to get food aid. If however, there is no shelf project for EGS implementation and the area is affected by a sudden onset disaster, free food can be distributed to an able person temporarily until an EGS is implemented. They named this type of food aid as General Free Food Distribution (GFFD).[3]

Geographical and household level target was used to select beneficiaries of the above-mentioned public work programs (EGS and FFW). First, geographical areas (sites) that are drought prone are selected. Then from each site, households are selected using vulnerability ranking criteria such as household asset and level of poverty. According to the National Food Aid Targeting Guidelines (Disaster Prevention and Preparedness Commission, DPPC, 2000), the household level targeting

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[2] The original plan was to provide 3 kg of grain per person, but because there is a shortage of relief resources, beneficiaries actually obtain 2.5 kg of grain per person.

[3] GFFD requires special authorization in which district/*Woreda* Disaster and Preparedness Committee (WDPPC) raises the idea and RDPPC approves. The emergency operation was provided by WFP, EU, and other non-governmental organizations such as SCUK.

criteria for FFW and EGS programs took two parts namely self-targeting and individual targeting. Cash or in kind payment below the market wage rate was made to participants in the program. Everybody living in the village was able to join the program if there was sufficient resource. If there was no sufficient resource for all participants, individual level targeting was applied. The major individual criteria for inclusion in the EGS and FFP were ownership of productive (land and livestock holding) and personal assets (such as jewelry and food stock), production failure, level of income from non-agricultural activities, family size, and number of dependents.

After the 2002/03 severe droughts (which brought extreme hunger upon almost one quarter of the population), it became clear that a well-planned employment-generation scheme with more resources was needed to make people's livelihoods more secure in case disaster struck again. As a result of successive discussions between donors and government bodies, the Productive Safety Net Program (PSNP) was launched by the Ethiopian government in 2005 and backed by donors including DFID, World Bank, Ireland, Canada, Sweden, and the United States. PSNP has two components: public work program (PWP) and direct support (DSP). The public work program was planned to provide *public works* which are labor-intensive community-based activities designed in order to provide employment for chronically food insecure people who have "able-bodied" labor. The program pays daily wages for unskilled labor (either in cash or in kind) for the able-bodied chronically food insecure beneficiaries of the Safety Net. People get money and food in exchange for work focusing on improving public facilities such as roads, water points, and health and education posts. With the cash people receive, the most susceptible households to food shortages can buy assets that may turn into lasting sources of income. By providing enough food to meet participants' needs, the program is expected to make households less likely to resort to desperate measures when famine threatens.

According to the revised PSNP program implementation manual (MoARD, 2006), a combination of administrative and community targeting is used to identify able-bodied food insecure households who can participate in the program. Food Security Task Force established in each community is responsible to select beneficiaries (households) of the program. In principle, the task force pre-identifies beneficiaries (MoARD, 2006, pp. 23)as those (1) who are chronically food insecure households (those facing continuous food shortages) in the last 3 years and who have received food assistance prior to the commencement of the PSNP program, (2) who suddenly become more food insecure as a result of a severe loss of assets and are unable to support themselves (last 1–2 years); and (3) who do not have any family support and other means of social protection and support. The task force has to further refine the selection by looking at (1) status of household assets such as land holding, quality of land and food stock, (2) income from non-agricultural activities and alternative employment, and (3) support/remittances from relatives or community. According to baseline survey of Ethiopian food security program (Gilligan et al., 2007), the actual selection criteria used by communities are not fully consistent with the guidelines. For example, beneficiary selection criteria used in Tigray, Amahara, Oromia and SNNP in 2006 were based on poverty, small area of land, small number of livestock holdings, and healthy poor. In these regions, nearly 78% of the communities put poverty among the top five eligibility criteria for public work. Contrary to the guideline, household food insecurity is used only by 7% of the communities because (1) it was found difficult to judge food insecurity of households and (2) poverty is considered as a good proxy for food insecurity. Moreover, about 12–17% of the communities used disability as criteria for eligibility for public work in Tigray, Oromia and SNNP regions, while people with disability should have been covered by direct support program.

The PSNP program has also a "Direct Support (DSP)" component in order to deliver assistance to households who are labor-poor and do not have reliable support. Specifically, the Direct Support component should targets only two groups of individuals: the first group is individuals who (i) do not have labor to participate in public works, (ii) do not have sufficient and reliable support from sons/daughters, or remittances from relatives away from the village; and (iii) cannot participate or contribute to other community-based activities/initiatives, which includes disabled people. The second group includes individuals who do not have labor to participate in public works, but can participate or contribute in other community activities (e.g., managing day care facilities). Such individuals include lactating mothers (in the first 10 months after birth), pregnant women, and orphaned teenagers. The actual main eligibility criteria used by community for the direct support in 2006 were age and disability in Tigray, Amhara, Oromia and SNNP (Gilligan et al., 2007).

Basically, the PSNP and food and cash for work are similar in nature in that beneficiaries have to provide labor in order to get support in cash or in kind. The only differences between the previous (EGS) and the current (PSNP) are in resource availability, institutional arrangement, and planning. While EGS is based on the resource obtained from the annual emergency relief aid, PSNP is based on external resources provided on a multi-annual basis through the Safety Net Budget line of the government, which ensures availability of resources from the start of the year allowing public works to be undertaken at the most appropriate time. The capital input and administrative cost were very limited for EGS while, in case of PSNP, districts are given appropriate budget for capital inputs into public works and other supporting activities, which improve the quality of public work, assets created, and, where appropriate, allow for more technically complex projects. In the Safety Net Program, public work programs are overseen by the Food Security line offices and are designed in line with districts' development plan. On the other hand there was no clear institutional responsibility to plan and follow up EGS activities. Therefore, we expect PSNP would be more effective than EGS in protecting households from shocks and falling into poverty as it has more resources with better planning and institutional setup for implementation and monitoring.

All Young Lives sample sites are located within the food security *districts* and hence all our sites are beneficiaries of productive safety net food program, employment generation scheme or GFFD. The productive safety net program (PSNP) started in 2005. Our Young Lives survey captures involvement of households in the PSNP and the amount of income beneficiary households obtained in the 12 months prior to the survey in the income module of our survey data. Since we have asked households their involvement in food and cash for work as well as other support programs since 2002 (via our program support module), we have captured in-depth cash/food-for-work programs under the EGS and agricultural extension program. Therefore, we were able to assess not only the impact the productive safety net program, but also the cash/food-for-work program that existed under the employment generation schemes and agricultural extension program.

3.2 Agricultural Extension Program

In addition to the PSNP and EGS, farmers in rural areas get the agricultural extension support program which enables farmers to obtain technical advice on the use of modern cultural practices (such as plowing, drainage, weeding and harvesting), better marketing information and outlets, purchased capital inputs (such as fertilizer and improved seeds), and credit to purchase farm inputs and livestock for animal husbandry. The agricultural extension support program has been in place since the Imperial Era, and went through successive reforms during the *Derge* and post-*Derge* Regime. In 1995/96, Participatory Demonstration and Training Extension System (PADETES) started to remedy the drawback of the previous systems (Kassa, 2008). According to the review made by Kassa (2008), the stated objectives of the this new agricultural extension system are increasing the supply of food, industrial and export crops, improving productivity and income, ensuring rehabilitation and conservation of natural resources base, and empowering farmers. To achieve these objectives the extension system used a package approach including distribution of farm input to farmers on credit. In short, the main three elements of PADETS are providing package of technologies, complement the delivery of the packages by credit, and sufficient communication between actors in the extension system to ensure participation of beneficiaries.

Although initially the program focused on food crops, it later entered into the implementation of provision of package of technologies for high value crops (oil crops and vegetables), livestock (dairy poultry, beekeeping, and fattening) and natural resource (forestry and soil and water conservation). As a result, credit availability and the distribution of fertilizers and improved varieties of crops and livestock increased (Kassa, 2008). Recently, the extension system was linked to food security in certain a region (for example, in Amhara and Tigray Regions) in order to provide subsidized credit via micro-finance for the purchase of farm inputs such as fertilizers, improved seeds, and oxen and other farming activities such as fattening, bee keeping, and water pumps (Borchgrevink et al., 2005).

All farmers are free to be part of this program and there is no restriction imposed on the farmers to participate in the program. Even farmers who do not own land may involve in livestock programs such as fattening, beekeeping, and poultry. Young Lives sample households in rural areas main occupation is farming and hence all sample households are free to be beneficiaries of the agricultural extension support program.

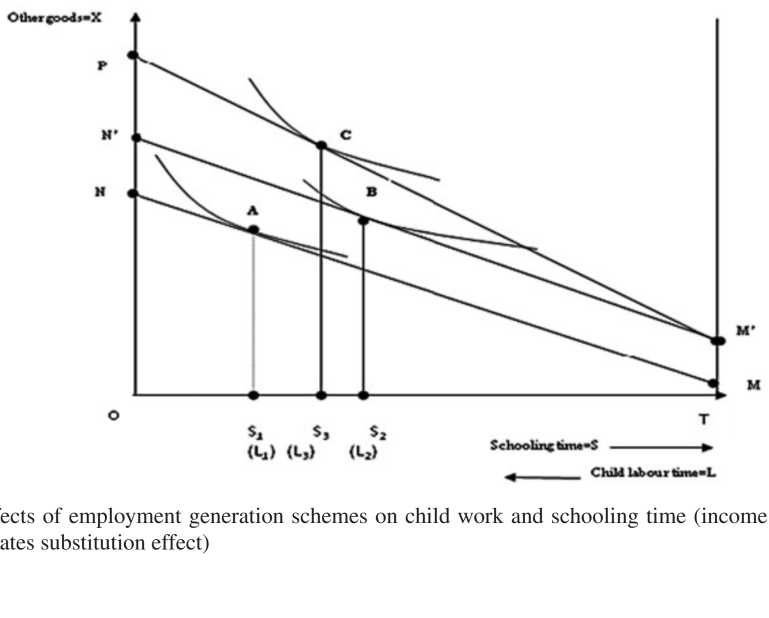
4 Theoretical Framework, Method of Estimating Impact and Data Set Description

4.1 Theoretical Framework

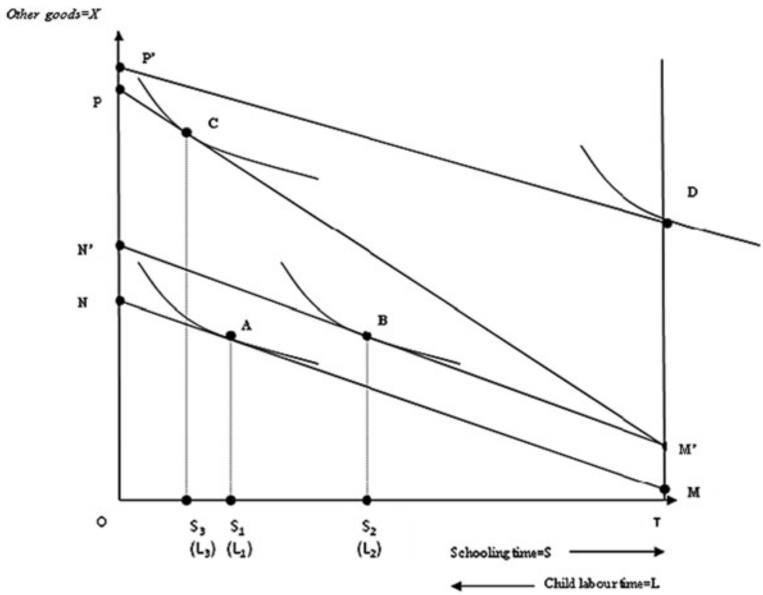
Participation of households in employment generation schemes (EGS) may affect time children spent on working, schooling, and study via the substitution and income effect. Employment generation programs may reduce or increase child work (increase or decrease children spent on schooling and study) depending on whether the substitution effect dominates the income effect. The relative strengths of substitution and income effects depends on the preference of household (indifference curve) for other goods and schooling given their budget constraint, opportunity cost of children and other household members' time, and substitutability of adult labor by child labor or vice versa. If substitution effect dominates the income effect, involvement in EGS will increase child work and reduce schooling (including study time). If the income effect is large enough to be dominated by the substitution effect, EGS will reduce child work and increase the time for schooling and study.

To see how income and substitution effects of EGS operates, let us consider Figs. 1 and 2, with vertical axis representing the quantity of other goods (denoted by X) available for consumption in the household and horizontal axis representing time spent on schooling, study and leisure (S). Assume that M is the total amount of budget available for the household for spending on X and S given by

$$P_x X + P_s S = M,$$



1 Effects of employment generation schemes on child work and schooling time (income effect dominates substitution effect)



2 Effect of employment generation programs on child work and schooling time (substitution effect outweighs income effect) Point **D** shows the level of transfer required for households to voluntarily allocate child's full time for schooling and studying

where P_x is price of other goods and P_s is the cost of children time including direct cost of schooling and P_s/P_x the slope of the line. The total time available for children is line OT which can be used for working (W) and schooling, study and leisure (S). Child work is measured by T-S. Line NN' is the original budget line given by

$$X = \frac{M}{P_x} - \frac{P_s}{P_x}S.$$

At a point where S=T, a child devotes his full time for schooling (including studying at home). When a child spent his time both working and schooling, the household faces a budget line with negative slope representing children wage equals P_s/P_x indicating a trade-off between consumption of other goods and schooling (or work). The initial optimal allocation of children's time between work and schooling will be determined by the tangency of indifference curve and budget line, that is, at point A, where OS_1 unit of time is allocated for schooling and studying and TL_1 units of time is allocated for work.

To demonstrate a case where income effect dominates the substitution effect, let us consider Fig. 1. Initially the household is at point A, where the indifference curve is tangent to the budget line. When a household participates in EGS, the budget available for the household increases from M to M'. Assuming the opportunity cost of time does not change, the equilibrium point moves from point A to point B, where child work decline from TL_1 to TL_2 and schooling time increases from OL_1 to OL_2

due to income effect. However, the household faces steeper budget line (line M'P) indicating an increase in the opportunity cost of using child time for schooling. As a result the final optimal allocation of child's time is at point C, where child work increases to TL_3 and schooling time decreases to OS_1 duet to substitution effect. Since the income effect dominates the substitution effect, child work decline from TL_1 to $TL_3$and schooling time increases from OS_1 to OS_2.

Another scenario is a case where substitution effect dominates income effect (Fig. 2). Assuming the household budget constraint before participation in EGS is line *MN*, the initial equilibrium will be at point A, where the indifference curve is tangent to the budget line. When a household is involved in EGS, the household's budget constraint tilts upward and the new budget constraint is line PP'. Following the same argument as above, due to income effect, child work declines from OL_1 to OL_2, and schooling increases from OS_1 to OS_2. Due to the substitution effect, child work increases from OL_2 to OL_3, and schooling time declines from OS_2 to OS_3. Since the substitution effect dominates the income effect, the net effect is that child work increases from OL_1 to OL_3, and schooling time declines from OS_1 to OS_3 at the final optimal point, C.

4.2 Estimating Impact of EGS on Child Work and Schooling and Study Time

One possible way to measure the impact of safety net on child welfare is to compare child welfare outcome (measured by child work) between parents who have participated and those who have not participated in employment generation schemes (EGS). Let y_1 denote the child labor outcome with treatment and y_0 the child labor outcome without treatment. Let the variable w be a binary treatment (participation in safety net programs) indicator where $w = 1$ denotes participation in the programs and $w = 0$ denotes non-participation.

Let us assume that treatment w, is independent of the outcomes (y_0 and y_1) after conditioning with x: $y_1, y_0 \perp w|x$. We can also deal with the more weaker version of conditional independence of participation and y_0: $y_0 \perp D|x$. This assumption is named as ignorability assumption (Rubin, 1980; Wooldridge, 2001).

Assuming that $E(y|x, w)$ is linear, the outcome-participation equation is given by

$$y = x'\beta + \alpha w + u, \tag{1}$$

where $E[u|w] = E[y - x'\beta - \alpha w|w] = 0$. In this case w is treated as exogenous. In order to identify some population measure of impact, overlap or matching assumption is required. Matching assumption is stated as

$$0 < \Pr[w = 1|x] < 1). \tag{2}$$

This assumption ensures that for each treated individual, there is another matched untreated individual with a similar x. When treatment participation depends stochastically on a vector of observables x, the concept of propensity score is useful. Propensity score is a conditional probability measure of treatment participation given x, denoted as

$$p(x) = \Pr[w = 1|X = x]. \tag{3}$$

Another condition that plays an important role in treatment evaluation is the balancing condition which states that $w \perp x | p(x)$. This means that for individual with the same propensity score, the assignment of treatment is random and should look identical in terms of their x vector. This balancing condition is testable hypothesis. Conditional mean independent assumption which states that

$$E(y_0|w = 1, x) = E(y_0|w = 0, x) = E(y_0|x).$$

This implies that y_0 does not determine participation. Due to Rosenbaum and Rubin (1983), the conditional independent assumption given x implies conditional independent assumption given $p(x)$. That is,

$$y_1, y_0 \perp w|x \Rightarrow y_1, y_0 \perp w|p(x).$$

Often $p(x)$ is a particular function of x and is computed given the data (w_i, x_i) by logit or porbit regression.

From the assumptions above, the outcome-participation equation can be written as

$$y = x'\beta + \alpha p(x) + u = x'\beta + \alpha \hat{p}(x) + [u + \alpha(p(x) - \hat{p}(x))]. \tag{4}$$

Since the unknown $p(x)$ is replaced by a sample estimate, the error term, $u + \alpha(p(x) - \hat{p}(x))$, includes additional sampling error, $\alpha(p(x) - \hat{p}(x))$.

Selection bias can arise when the treatment is correlated with the error term in the outcome equation. Selection bias can arise due to two reasons: selection on observables and selection on unobservables. Selection on observables arises when there are incorrectly omitted variables that partly determine w and y. In this case, the error term will be correlated with the participation variable, w. This can be easily corrected by included all relevant variables in the outcome equation. The second source of selection (selection on unobservables) arises when there are unobservable factors that partly determine both w and y, which makes the error term in the outcome equation to be correlated with the participation variable, w. In this case we have to deal with endogenous treatment effect or use of IV estimation method.

4.3 Description of Data

This paper uses Young Lives survey data of the older cohort using time use module for the index children (12 years old). Specifically we used information collected using sections 1A (page 3) and 1B (page 13) of the "Child Questionnaire" of the older cohort. The outcome variables are hours spent on various activities in a typical day and the highest grade completed by the children. The activities include paid work outside home, unpaid work outside home, child care and household chores, schooling, and studying at home. For the economic shock variables, we use data obtained via question 6.3 and economic shocks that are the most important events (question 6.3.5). Households' involvement in social assistance program is obtained from question 3.17 of the household questionnaire while household income from (and also involvement in) PSNP (PWP and DSP) are obtained from the income module (Section 3D, p. 39 and Section 3E, p. 43, respectively).

Location and gender. The total number of observations used in this paper is 980 households of which 584 (60%) reside in rural area while 396 (40%) are urban dwellers. We used data of index children around the age of 12 years taken from the older cohort sample. Overall, 51% of the children are boys while the remaining 49% are girls. The average age of household heads (76% of whom are male) is 43 with a range of 15–85 years of age. Average education level of the mothers' is grade two during both rounds of survey while that of fathers is grade two in the first round and grade four during the second round (see Table 16 in the appendix).

Household composition. The descriptive statistics reported in Tables 16 has also documented a wide range of household compositions that include the number of household members disaggregated by age and sex, the birth order of index children, as well as the number of economically dependent household members. The Young Lives older cohort sample children are on average the fourth child of their family having an average of three older siblings. Each household is also found to have at least 1.2 economically dependent members with some households having up to five. An average household has fairly similar number of male and female members (1.2 and 1.3 respectively, on average) whose age range falls in the labor force (17–65).

Household wealth. Household wealth measured by wealth and asset indices increased substantially between 2002 and 2006: wealth index grew by 31% and asset index increased by 17% (Table 1). In both rounds wealth index is higher in urban areas than in rural areas while asset index is higher in rural areas than in

Table 1 Level of wealth and asset indices and change in indices between Round 1 and Round 2

	Urban	Rural	Total
Round 2 Wealth index	0.379	0.137	0.235
Round 1 wealth index	0.319	0.084	0.179
Change in wealth index (%)	0.187	0.635	0.312
Round 2 asset index	0.161	0.280	0.232
Round 1 asset index	0.129	0.245	0.198
Change in asset index (%)	0.255	0.141	0.171

urban areas. This partly because wealth index better measures urban wealth while asset index looks suitable to measure rural wealth as the asset index is composed of farm-related assets, while wealth index is mainly composed of household durables and access to services. Rural wealth index starts from lower value has higher growth, while urban asset index starts from a very low base registering higher growth.

Shocks. In terms of shocks, 46% of the households have suffered from either illness or death of a household member during the last 4 years (Table 2). Another 14% have encountered theft, while 30% were affected by increased input prices as 32% were hurt by reduced output prices during the same period. Death of livestock (26%), drought, crop failure or pests (48%), and natural disaster (43%) are also some of the major shocks inflicting adverse impacts on households. The most common type of shock suffered by most rural households is drought, crop failure, and pests affecting 72% of households followed by natural disasters (65%), death or illness of household members (46%), and adverse prices (40%). In urban areas, on the other hand, it is death or illness of a household member that affects most of the survey subjects (46%) followed by adverse prices and loss of jobs or shutdown of place of employment with each shock affecting close to 20% of the total households.

Table 2 Percent of households affected by various shocks since 4 years ago: older cohort

Type of shocks	Urban	Rural	Total
Dummy for illness of household members	35.10	37.16	36.33
Dummy for death or illness of household members	46.46	45.89	46.12
Dummy for theft	13.13	13.87	13.57
Increase in input price dummy	19.19	37.67	30.20
Dummy for decrease in output price	20.45	39.90	32.04
Dummy for death of livestock dummy	8.08	37.67	25.71
Dummy for place employment shutdown or job lose	17.93	5.31	10.41
Dummy for drought	6.57	46.92	30.61
Dummy for drought crop failure and pests and diseases	12.37	72.26	48.06
Dummy for divorce or separation of family	3.03	1.71	2.24
Dummy for any dispute	3.79	5.31	4.69
Dummy for confiscation of asset and abandoned credit sources	1.77	2.40	2.14
Dummy for having to pay for school	10.10	9.59	9.80
Dummy for new household member or birth	8.84	21.23	16.22
Dummy for migration	0.51	0.34	0.41
Dummy for natural disaster and drought combined	10.35	65.07	42.96

Support programs. Based on the information we obtained from the support program module, we compared the distribution of support programs provided since 2002 by location. We found out that rural areas benefit more from support than urban areas. Ninety-nine percent of agricultural extension support and 85–90% of the EGS (85% of cash for work, and 90% of food-for-work) were provided to rural areas. Similarly 83% of health extension services, 77% of credit support, and 61% of family planning services were rendered to rural households. Water well development support, cash/food aid (unconditional transfers), irrigation development support (though small) are all biased toward rural areas. Likewise there are also a few support programs that were provided mainly to urban households: 97% of education support and 88% of support programs for the prevention of mother-to-child HIV/AIDS transmission were offered to urban areas.

The perceived impact of participating in different support programs since 2002 on the well-being of children was assessed in the survey (Tables 3, 4, and 5). Beneficiaries perceived that agricultural support allowed households to have more food with better quality at their disposal, thereby benefiting children. Productive safety net and credit support programs were perceived as instruments to have better quality food as well as more food. Educational support programs were considered as a means obtain more resources for educational purposes.

Information on households' participation in productive safety net program is taken from the income module of the household questionnaire. PSNP started in 2005, and the level of income household obtained over 12 months from PSNP was recorded in the income module of the survey data collected in the last quarter of 2006. Public work program (PWP) is one of the components of productive safety

Table 3 Perceived benefits YL child obtain from the programs (%) in rural areas

Perceived benefits	Agricultural extension	Cash for work	Food-for-work	Credit	Food aid
Better quality food	26.85	21.64	49.51	27.56	44.03
More food	55.7	61.99	46.6	51.24	46.27
More resources for educational purposes	4.7	9.36	1.46	8.83	3.73
More time to study				0.35	
Less time on work activities	2.68	1.17	0.49	1.06	1.49
Less time on household chores		1.75			1.49
Other	0.67	1.17	0.49	6.01	

Table 4 Perceived benefits YL child obtain from the programs (%) in urban areas

Perceived benefits	Food aid	Education support
Better quality food	30	4.29
More food	52.5	8.57
More advice on caring practices	0	0
More resources for educational purposes	12.5	81.43
More health care treatment	0	1.43
More time to study	0	0
Less time on work activities	0	0
Less time on household chores	5	2.86
Other	0	1.43

net program that is specifically designed for rural areas[4]. About 46% of the sample households in rural areas were involved in public work program (see Table 5). The average income a rural household obtained from the public work was found to be 368 Birr per year. When we consider the participants of PWP only, the average income a rural household obtained from PWP was about 795 Birr per year, which is about 11% of the total consumption expenditure.

Table 5 Involvement in and income (Birr per year) from productive safety net programs: Public work and direct support in last 12 months from the survey time

Program type	Rural	Urban	Total
Percentage of participation in PSNP: pubic work program	46.2	9.1	31.2
Percentage of direct support received from PSNP	18.7	32.8	24.4
Mean income from public work, PSNP	367.76	48.30	238.67
Mean income direct support, PSNP	158.34	130.35	147.03

PSNP = productive safety net

The second component of PSNP is direct support program (DSP) which provides cash/food handouts to households who cannot supply labor. In our sample about 24% of the sample households (33% from urban areas and 19% in rural areas) received cash/food aid support for 12 months. The average income a household obtained from direct support program component of PSNP was Birr 147 per year. In urban areas the average income from the cash/food aid was 130 Birr while it was Birr 158 for rural households. When considering the cash/food aid recipients only, the average income from direct support is Birr 848 per year, which is about 11% of the total household consumption expenditure. In rural areas, the income households obtained from cash/food aid program is slightly higher than the income obtained from public work program. In our survey (data) 18% of the rural households are also involved in the agricultural extension program and these households perceived that the program has benefited them to get better quality and quantity of food (Table 5).

Child schooling and work. The enrollment and average grade completed by 12-year-old children is presented in Tables 6 and 7. About 95% of the children are enrolled in school and the mean highest grade completed by the children is grade four with urban figures (4.9) slightly higher than that of rural (3.4). School enrollment rate of the index children during round 1 survey was 66% and it has increased to 95% in round 2. Disaggregating by rural urban category, rural enrollment rate was 55% and grew to 93% in round 2, while enrollment rate in urban areas grow from 83% in round 1 to 96% in round 2. Enrollment by gender indicates that girls have slightly higher enrolment rate than that of boys, the mean grade looks slightly higher for female for round 2 in rural areas. In general boys did not show higher enrollment and higher average years of schooling than that of girls.

[4] Although PSNP is designed officially for rural areas only, about 63% of the households in one of our urban site (Fereweini, Senkata Town, Tigray) were found to be beneficiaries of PWP component of the PSNP. No meaningful participation in PWP is reported in all other urban sites.

Table 6 Time spent working on various activities in hours in a typical day last week by children 12 years old

Type of child outcome variables	Rural	Urban	Girls	Boys	Total
Highest grade completed	3.44	4.86	4.10	3.92	4.01
Hours index child spent on child care	0.62	0.60	0.77	0.46	0.61
Hours index child spent on domestic work	2.28	2.16	2.83	1.66	2.23
Hours index child spent on unpaid work outside home	2.33	0.57	1.03	2.18	1.62
Hours index child spent on paid work outside home	2.17	0.42	0.90	2.01	1.47
Hours index child work outside home paid and unpaid	0.16	0.15	0.13	0.17	0.15
Hours child spent on child care and domestic activities	2.90	2.76	3.59	2.12	2.84
Total hours index child spent all types of work	5.23	3.33	4.63	4.31	4.46
Total hours child spent on schooling	5.12	5.87	5.49	5.36	5.42
Total hours child spent on studying at home	1.59	1.94	1.71	1.75	1.73

Table 7 Participation rate (%) of children (12 years old) on various activities in a typical day last week

	Rural				Urban		All
Participation (%)	Girls	Boys	Total	Girls	Boys	Total	Total
Enrollment in school	94.3	91.4	92.8	98.0	97.0	97.5	94.7
Child care	44.5	29.6	36.8	39.1	29.1	34.1	35.7
Domestic work	96.1	76.7	86.1	94.4	83.4	88.9	87.2
Unpaid work outside home	47.3	81.7	65.1	9.6	21.1	15.4	45.0
Paid work outside home	4.9	5.6	5.3	2.0	4.5	3.3	4.5
Child work outside home paid and unpaid	50.2	83.7	67.5	11.7	23.6	17.7	47.3
Child care and domestic activities	96.5	80.4	88.2	95.9	87.9	91.9	89.7
All types of activities	100.0	99.7	99.8	97.0	91.5	94.2	97.6

The dropout rate of children from school between round 1 and round 2 surveys was very low: about 3% for rural and 2% for urban children (Table 16). The index children were asked during round 2 if they have missed class for a whole week over the last 12 months. Only 14.3% of them responded yes with urban figure (14.7%) slightly higher than that of rural (13.8%). Missing classes for whole week mainly occurred from the month of October to January when agricultural work (such as harvesting) is very intensive and children have to go to school (see Tables 16 and 17 in the Appendix). The main reasons for missing classes are that children had to do paid work (58%) and were required for domestic and agricultural work (18%) (see Table 18). In urban areas, 74% of the children missed school for a whole week due the need to work for pay.

Only very small proportion of the 12-year-old children (9.6%) responded that they did not have enough time to study, with slightly higher figure for rural areas (11%). The reason why they did not have time to study was because they were responsible for too many chores (49.4% overall and 53% for rural areas) and lack of adequate lighting (15.2% with 17.3% for rural children). In order to allow more time for studying, children wished that they could reduce work load (61.5% with 63% for rural children), have adequate lighting (24.4% with 27.5% for rural children), and allow study time at school (12.8% with 10% for rural children). However, relatively more proportion of children (about 20% of the children, less at 17% for rural children) responded that their home environment is not convenient to study. Of those children whose home environment is not convenient to study (180 children, 94 for rural areas), 73% of them (12% for rural children) have enough time. Hence for urban areas it is not work load only that prohibits children, but inconvenient home environment. For rural areas, heavy work load and lack of proper lighting are the main reasons for not having enough time to study.

The amount of time spent by the children in different activities and participation rate are summarized in Tables 6 and 7. The number of hours children spend doing domestic chores (including child care) and paid and unpaid works outside home revealed that a child spends an average of 4.5 h on a typical day engaged in work activities. The rural records (5.2 h) are higher than the urban numbers (3.3 h). The average time students need to travel to get to their respective schools is around half an hour (23 min for urban dwellers and almost 36 min for rural students) (Tables 8, 9 and 10).

Table 8 Enrolment rate of index children (12 years old) by gender

	Rural		Urban		Total	
Sex of the child	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
Girls	54.1	94.3	82.7	98.0	65.8	95.8
Boys	56.1	91.4	82.4	97.0	66.6	93.6
Total	55.1	92.8	82.6	97.5	66.2	94.7

Table 9 Average grade completed of 12 years old children in Round 1 (R1) and Round 2 (R2)

	Rural		Urban		Total		Change between rounds		
Sex of the child	R1	R2	R1	R2	R1	R2	Rural	Urban	Total
Girls	0.5	3.6	0.9	4.9	0.7	4.1	3.1	4.0	3.4
Boys	0.5	3.3	0.9	4.9	0.6	3.9	2.8	4.0	3.3
Total	0.5	3.4	0.9	4.9	0.6	4.0	2.9	4.0	3.4

Table 10 Percentage of households who have support from various programs since 2002: older cohort

Support type	Variable name	Urban	Rural	Total
Agricultural extension	agextr2	0.3	17.8	10.7
Cash for work	cfwr2	5.1	13.4	10.0
Food-for-work	ffwr2	3.5	14.6	10.1
Cash and food-for-work combines	cffwr2	8.6	27.9	20.1
Credit support	creditr2	6.6	9.9	8.6
Support from health extension agent	hlthextr2	0.5	2.9	1.9
Health support	hlthr2	2.0	2.9	2.6
Education support	edur2	14.4	0.2	5.9
Food aid	faidr2	7.8	11.3	9.9

5 Estimation Results and Discussions

Following Wooldridge (2001) and Cameron and Trivedi (2005), we implement exercise of estimating impact of support programs on children's allocation of time for work and schooling/studying. First we estimated a logit model of propensity score (i.e., logit model of w on a set of x variables). The x variables are chosen to be round one household composition, wealth index and asset index, dummy variables for a household being affected by crop failure, death of cattle, death and illness of family members since 5 years before the survey as well as the square and interaction of the variables. These variables are consistent with the selection criteria used by the communities to select beneficiaries of EGS and PSNP programs (see Section 3 of the paper). We used Ramsey Reset test to see if there are omitted variables from the model and we found there is not omitted variable bias. We use stata "*psmatch2*" command (Leuven and Sianesi, 2003) and kernel smoothing to match treatment and comparison observations and estimate the treatment effect on the treated group. The standard errors are computed using bootstrap method. Unlike that of nearest neighborhood matching, using bootstrap method to estimate standard error after kernel matching gives valid estimators (Gilligan et al., 2007).

We used different specification of logit models to estimate propensity score (Dehejia and Wahba, 1999, 2002) in order to ensure balancing condition. When we get many unbalanced strata (after testing the balancing property), logit model is re-estimated with improved specification that includes interactions and higher order terms among the regressors, x.

Since the AEP and cash/food-for-work for both PWP and EGS are specifically designed for rural areas, we limit the sample to rural areas when we assess the impact of PWP, EGS and AEP. The impact of food aid is estimated for both rural and urban areas. In urban areas, we found many of the cash/food handouts are provided not only as food aid, but also as education support.

5.1 Propensity Score Matching Regression

Logit model of propensity score is estimated for three kinds of programs: (1) rural public work programs such as cash and food-for-work support programs; (2) agricultural extension support program in rural areas and (3) for direct support program which includes cash and food handouts as aid and education support for both rural and urban areas. Since the first two support programs have differences between rural and urban areas, we run separate logistic regression (propensity score) for rural and urban areas. Public work (cash/food-for-work) and agricultural extension support programs (AEP) are observed only in rural areas and they are not captured in urban areas in our survey data. The direct support program component of the productive safety net program (cash/food and education support) has been implemented in both rural and urban areas. Therefore, for rural areas, we estimated the impact public work and agricultural extension programs on hours spent by children on various activities and education, while we estimated the impact of direct support (cash/food aid and education support programs) for both rural and urban areas.

The results of the first stage regression and descriptive statistics of the variables used for the three programs are provided in Tables 19, 20, 21, 22, 23, 24, 25, and 26. As there is no guideline on how to choose conditioning variables, x (Smith and Todd, 2005), we select x variables intuitively that affect both the outcome and the participation in programs. We mainly use initial condition (household composition, human capital, and physical wealth) and shocks observed before the first round survey and shocks that occurred between first and second round survey. We have also included site dummies in the set of conditioning variables, which we found very helpful to meet the balancing property. The standard errors are computed using bootstrap method.

Although the model of propensity score need not to be accurate (Cameron and Trivedi, 2005), the models fit quite for some of the propensity score models. The Pseudo R^2 is 36.5% for public work program in rural areas (Tables 19 and 20) and 22% for direct support program (cash/food aid and education support) run for both rural and urban areas combined (Tables 23 and 24). The Pseudo R^2 for logistic regression of participation in agricultural extension program in rural areas is 40.6% (Tables 21 and 22). Balancing conditions for all the three propensity score models was obtained. In total we have 955 observations with 352 from urban areas and 584 of them are from rural areas. We also estimated the treatment effect for boys and girls separately for the all support programs considered above.

5.2 Treatment Effect of Support Programs in Rural and Urban Areas

We have analyzed treatment of the support programs on the highest grade completed and hours per day children spent for various activities including work, schooling, and studying at home. The types of child work and other activities we consider are (1) paid and unpaid work outside home, (2) unpaid work outside home, (3) paid work outside home, (4) child care and domestic work, (5) All types of work including paid and unpaid as well as at home and outside home, (6) schooling, and (7) studying at home. We analyzed the treatment effect separately for rural and urban areas as well as for boys and girls.

Public work program (a component of PSNP) in rural areas. As pointed out above, the public work program (PWP) in Ethiopia requires households to supply labor in return to daily unskilled wage. Hence PWP has both substitution and income effects on children's time use for various activities namely paid and unpaid work, schooling, and studying at home as well as on the highest grade completed. Depending on the net effect of the two (substitution and income effects), PWP may increase or decrease children's time spent on work, schooling and study and grade completed. The treatment effect estimated provides the net effects.

Treatment effects of PWP on schooling and various child activities/work of rural children are provided in Table 11. We found out that PWP has positive effect on

Table 11 Impact of public work program (PWP) of the productive safety net program (PSNP) on hours spent in a typical day on work, schooling, and studying and on grade completed by children 12 years old in rural areas (Kernel matching)

Outcomes	ATTk	SE	T-stat
All children ($N = 584$)			
Paid and unpaid work outside home	0.325	0.207	1.570
Unpaid work outside home	0.191	0.200	0.960
Paid work outside home	0.134	0.070	**1.920**
Child care and household chores	−0.567	0.172	**−3.300**
Total work	−0.269	0.199	−1.350
Schooling	0.146	0.163	0.900
Studying	0.133	0.089	1.490
Grade completed	0.249	0.166	1.500
Girls ($N = 283$)			
Paid and unpaid work outside home	0.400	0.254	1.570
Unpaid work outside home	0.146	0.239	0.610
Paid work outside home	0.254	0.092	**2.760**
Child care and household chores	−0.501	0.235	**−2.140**
Total work	−0.115	0.271	−0.420
Schooling	0.250	0.230	1.090
Studying	0.255	0.123	**2.070**
Grade completed	0.184	0.233	0.790
Boys ($N = 301$)			
Paid and unpaid work outside home	0.194	0.284	0.680
Unpaid work outside home	0.173	0.278	0.620
Paid work outside home	0.021	0.105	0.200
Child care and household chores	−0.571	0.205	**−2.780**
Total work	−0.416	0.290	−1.430
Schooling	0.056	0.231	0.240
Studying	0.020	0.129	0.160
Grade completed	0.323	0.233	1.390

For two tail test and for $n>120$, T values for 1%, 5%, and 10% level of significance are 2.576, 1.96, and 1.645, respectively; ATTk = average treatment effect of the treated using kernel matching
SE = standard error
Bolded figures are those statistically significant at least at 10% level.

paid work and unpaid work; combined and negative effect on child care and household chores and total work. However, the treatment effect is statistically significant on the hours of time spent on paid work (which is positive) and child care and household chores (which is negative). On the other hand PWP has positive effect on time children spent on schooling, studying, and children's highest grade completed although these effects are not statistically significant. Consequently, we found that PWP increases paid work outside home by 0.13 h per day and reduces child care and household chores by 0.57 h per day implying that the income effect dominates the substitution effect for child care and household chores and substitution effect dominates the income effect for paid work. The increase in paid work outside home could be due to direct involvement of children in public work or substitution of children for adults when adults go to public work. Although further investigation is required; our qualitative assessment in 2008 indicated that children are involved to some extent in paid work around their community and in public work programs despite the regulation that boys are not officially allowed to participate in PWP.

When we analyzed the effect of PWP by gender, for girls we found a statistically significant effect of PWP on paid work outside home, child care and household chores, studying at home. The effect is positive on paid work (0.25 h more per day), negative on child care and household chores (0.50 h less per day), and positive on studying time. with a net effect of reducing child work and increasing studying time as a whole. For boys a positive and statistically significant effect is found only child care and household chores (0.57 h less per day). No significant effect on grade completed by girls and boys is found.

There are 75 observations/households who have participated in both PWP and agricultural extension programs. To check the sensitivity of the result, we estimated the impact of PWP excluding the 75 households who have participated in both programs. There is no change in the estimated impact of PWP on girls' use of time on work and schooling. However, the effect of PWP on child care and household chores for boys turned out insignificant.

We have also estimated the impact of the employment generation schemes (EGS) that existed before 2005 (Table 12). Similar to that of PWP, We found impact of EGS on girls' and boys' use of time on paid work and girls' use of time on studying are positive. However, contrary to the impact of PWP (PSNP), the impact of EGS on boys' and girls' hours of work per day on child care and household chores is not statistical significant. Moreover the positive impact of EGS on child work for pay (0.26 h per day) is twice that of PWP of the PSNP (0.13 h per day). These imply that in terms of child welfare outcome, PWP of the PSNP is much better than that of its predecessor EGS.

Agricultural Extension Program (AEP) in rural areas. Many farmers are part of agricultural extension support programs in which farmers are encouraged to adopt labor and land augmenting technologies like fertilizers, improved seeds, and new cultural practices. In our survey (data) about 18% of the rural households are involved in the agricultural extension program. The program may have both substitution and income effect with regard to the use of children's time for work and education. What we found is that the income effect is high enough to be dominated

Table 12 Impact of employment generation scheme (EGS) on hours spent in a typical day on work, schooling, and studying and on grade completed by children 12 years old in rural areas (Kernel matching)

Variable	ATTk	SE	T-stat
Boys and Girls ($N = 538$)			
Paid and unpaid work outside home	0.309	0.200	1.540
Unpaid work outside home	0.043	0.192	0.230
Paid work outside home	0.266	0.078	**3.400**
Child care and household chores	−0.310	0.160	**−1.940**
Total work	−0.009	0.190	−0.050
Schooling	−0.355	0.158	**−2.250**
Studying	−0.018	0.086	−0.210
Grade completed	0.042	0.160	0.260
Girls ($N = 255$)			
Paid and unpaid work outside home	−0.004	0.254	−0.020
Unpaid work outside home	−0.263	0.239	−1.100
Paid work outside home	0.259	0.115	**2.250**
Child care and household chores	−0.149	0.224	−0.670
Total work	−0.136	0.243	−0.560
Schooling	−0.246	0.228	−1.080
Studying	0.208	0.127	**1.630**
Grade completed	0.198	0.232	0.850
Boys ($N = 277$)			
Paid and unpaid work outside home	0.055	0.269	0.210
Unpaid work outside home	−0.120	0.261	−0.460
Paid work outside home	0.176	0.100	**1.760**
Child care and household chores	−0.013	0.196	−0.070
Total work	0.012	0.275	0.040
Schooling	−0.360	0.221	**−1.630**
Studying	−0.182	0.123	−1.480
Grade completed	0.017	0.225	0.070

For two tail test and for n > 120, T values for 1%, 5%, and 10% level of significance are 2.576, 1.96, and 1.645, respectively; ATTk = average treatment effect of the treated using kernel matching SE = standard error
Bolded figures are those statistically significant at least at 10% level.

by the substitution effect and the net effect of agricultural extension support programs is negative for child work and positive for schooling and study time, which is stronger that the effect of PWP on child work and schooling and study time. Among the activities, statistically significant negative impact is found on time spent on paid work, and total work (Table 13). The impact of agricultural extension support program is −0.50 h for total work, −0.23 h for paid work in a typical day. However, although negative, we could find statistically significant effect on unpaid work which constitutes farm work and cattle herding. This might be due the fact that children are required to work on the farm and to heard cattle which traditionally the duty of children. Regarding education, we found positive and statistically significant effect on schooling and studying time. Although not statistically significant at 10%, the effect on grades completed by children is positive and statistically significant at 15% level.

Table 13 Impact of agricultural extension support program on hours spent in a typical day on work, schooling, and studying and on grade completed 12-year-old children in rural areas (Kernel matching)

Outcome	ATTk	SE	T-stat
Girls+boys ($N = 584$)			
Paid and unpaid work outside home	−0.294	0.245	−1.200
Unpaid work outside home	−0.056	0.242	−0.230
Paid work outside home	−0.238	0.053	**−4.480**
Child care and household chores	−0.190	0.195	−0.980
Total work	−0.503	0.218	**−2.310**
Schooling	0.717	0.180	**3.970**
Studying	0.202	0.111	**1.810**
Grade completed	0.314	0.200	1.570
Girls ($N = 283$)		Girls	
Paid and unpaid work outside home	−0.186	0.276	−0.670
Unpaid work outside home	0.078	0.266	0.290
Paid work outside home	−0.264	0.079	**−3.320**
Child care and household chores	−0.418	0.224	**−1.860**
Total work	−0.614	0.285	**−2.150**
Schooling	0.927	0.217	**4.270**
Studying	0.134	0.138	0.970
Grade completed	0.534	0.241	**2.220**
Boys ($N = 301$)		Boys	
Paid and unpaid work outside home	0.317	0.363	0.870
Unpaid work outside home	0.535	0.361	1.480
Paid work outside home	−0.218	0.072	**−3.040**
Child care and household chores	−0.618	0.290	**−2.130**
Total work	−0.326	0.334	−0.980
Schooling	0.321	0.319	1.000
Studying	0.290	0.196	1.480
Grade completed	−0.095	0.346	−0.270

For two tail test and for $n > 120$, T values for 1%, 5%, and 10% level of significance are 2.576, 1.96, and 1.645, respectively; ATTk = average treatment effect of the treated using kernel matching SE = standard error
Bolded figures are those statistically significant at least at 10% level.

When decomposed by gender of the child, we obtained slightly different result in favor of girls. While the result is the same for boys, for girls we found agricultural extension program significantly reduces girls spending of time on paid work, child care and household chores, and total work. The effect of agricultural extension program on hours per day girls' spend on studying (0.92 more hours per day) and girls' highest grade completed is positive (0.53 years more) and statistically significant implying that AEP is more in favor of girls than boys. The difference in the magnitude of the effect on child work between girls and boys is also remarkable. While the effect of AEP on paid work, child care and household chores, and total work for girls are −0.26, −0.42, and −0.61 h per day, respectively, for boys this figures are −0.22, −0.61, and −0.32 h per day. Moreover, the effect on studying time is 0.93 h (55 min) per day and on highest grade completed is 0.53 year.

To sum up, the income effect dominates the substitution effect for AEP. The main reasons for agricultural extension program to perform better than PWP in terms of improving child welfare is that the return from the agricultural support program is very high and farmers can hire labor for farming activities, while it is difficult to hire labor to substitute child labor in case of employment generation scheme. As a result, agricultural support program is not encouraging households to use child time for work.

Although the PWP is not found to be effective in increasing children's attainment of grades and the time boys spend on studying at home, it is not encouraging children to be highly involved in work. Compared to EGS (its predecessor), PWP is more effective in reducing child work. Specifically, PWP helps households to reduce children's spending on child care and household chores. However, compared to AEP, the performance of PWP is lower when viewed in terms of increasing the time children spent on schooling, studying time and girls' highest grade completed. The possible reasons for lower performance of PWP in reducing child labor and improving studying and attainment in school are that the return is very low for public work programs to have significant income effect on the household. The total amount of income households obtain from PSNP was around 11% of the total consumption expenditure. Hence possible action to reduce the negative welfare impact of PWP are (1) to increase the wage rate households receive when participating in PWP so as to make the income effect sufficiently higher than the substitution effect; (2) to keep sending children to school as a conditionality for households to be beneficiary of PWP; and (3) design a special program that targets children instead of household head only, for example, schooling feeding programs. Putting effective control system to implement government regulation of banning child work in public work program might also be one possible way to reduce children's involvement in paid work.

Direct support program in rural and urban areas. Direct support program is one component of productive safety net program in Ethiopia. We have observed cash/food aid in both rural and urban areas and the cash handouts in urban areas were also given to support children's education. For both rural and urban areas we have assessed the impact of direct support component of the safety net program including cash/food aid and education support programs on child work, time spent on schooling and studying and highest grade completed by 12 years old children. The result is provided in Table 14. Since the direct support program does not require households to supply labor as condition to obtain payment from the program, we expected to have income effect only in the sense that it reduces child work and increases child schooling and studying time and highest grade completed by children if the program is effective.

Our findings suggest that the direct support program is effective in reducing child work and increasing children's schooling and studying at home as well as limited effect on the highest grade completed by children.

It seems that child total work declines by 0.65 h per typical day (0.54 and 0.77 h less per day for girls and boys, respectively) as a result of households' participation in the direct support programs, which is statistically significant for both boys and

Table 14 Impact of direct support program on children's time use in hours per typical day in on work, schooling, and studying and on grade completed by children 12 years old in rural and urban areas (Kernel matching)

	Rural+Urban			Rural			Urban		
Outcome	ATTk	SE	T-stat	ATTk	SE	T-stat	ATTk	SE	T-stat
Girls + Boys		($N = 955$)			($N = 565$)			($N = 390$)	
Paid and unpaid work outside home	−0.796	0.139	**−5.71**	−0.643	0.223	**−2.88**	−0.316	0.144	**−2.19**
Unpaid work outside home	−0.697	0.128	**−5.45**	−0.59	0.2	**−2.95**	−0.164	0.12	−1.36
Paid work outside home	−0.1	0.052	**−1.93**	−0.053	0.084	−0.63	−0.152	0.079	**−1.93**
Child care and household chores	0.129	0.146	0.88	0.587	0.202	**2.9**	−0.259	0.208	−1.24
Total work	−0.652	0.181	**−3.59**	−0.018	0.24	−0.07	−0.577	0.236	**−2.44**
Schooling	−0.063	0.139	−0.45	−0.544	0.197	**−2.76**	0.119	0.184	0.65
Studying	0.049	0.081	0.61	−0.126	0.104	−1.21	0.099	0.12	0.82
Grade completed	0.492	0.14	**3.5**	0.178	0.206	0.86	0.276	0.167	**1.66**
Girls		($N = 464$)			($N = 271$)			($N = 194$)	
Paid and unpaid work outside home	−0.531	0.151	**−3.53**	−0.536	0.247	**−2.17**	−0.042	0.15	−0.28
Unpaid work outside home	−0.373	0.143	**−2.61**	−0.379	0.24	−1.58	0.107	0.122	0.88
Paid work outside home	−0.159	0.047	**−3.34**	−0.157	0.056	**−2.8**	−0.149	0.09	**−1.65**
Child care and household chores	−0.001	0.212	0	0.343	0.287	1.2	−0.183	0.314	−0.58
Total work	−0.538	0.241	**−2.23**	−0.2	0.332	−0.6	−0.229	0.329	−0.7
Schooling	−0.265	0.211	−1.26	−1.013	0.298	**−3.4**	0.132	0.277	0.48
Studying	−0.034	0.106	−0.32	−0.215	0.151	−1.43	0.017	0.15	0.12
Grade completed	0.316	0.2	1.58	−0.047	0.3	−0.16	0.094	0.244	0.38
Boys		($N = 490$)			($N = 294$)			($N = 196$)	
Paid and unpaid work outside home	−0.972	0.227	**−4.28**	−0.737	0.335	**−2.2**	−0.539	0.241	**−2.24**
Unpaid work outside home	−0.936	0.204	**−4.6**	−0.78	0.286	**−2.73**	−0.399	0.202	**−1.97**
Paid work outside home	−0.036	0.094	−0.38	0.044	0.154	0.29	−0.14	0.131	−1.07
Child care and household chores	0.163	0.169	0.96	0.806	0.248	**3.25**	−0.536	0.218	**−2.46**
Total work	−0.77	0.27	**−2.85**	0.151	0.349	0.43	−1.075	0.308	**−3.49**
Schooling	0.114	0.18	0.63	−0.11	0.255	−0.43	0.101	0.239	0.42
Studying	0.136	0.123	1.1	−0.044	0.145	−0.3	0.209	0.194	1.08
Grade completed	0.665	0.198	**3.35**	0.385	0.287	1.34	0.484	0.222	**2.18**

SE = standard error
Bolded figures are those statistically significant at least at 10% level.

girls. The direct support is also found to have negative and statistically significant effect on child work for paid and unpaid work outside home and positive effect on schooling and highest grade completed by children. However, the effect of direct support on schooling and highest grade completed by children is only limited for urban boys only.

The result seems not contrary to households perceive regarding the impact of these programs on household and child welfare. Many households responded that the food aid and education support programs have helped them to have more quantity and quality food, but not to increase the time children spent in schooling and studying and to reduce time spent on working.

6 Conclusion and Policy Implications

Ethiopia public employment program started in the 1980s associated with the rehabilitation program known as food-for-work program. From 1997 to 2004, the government introduced relief-based cash and food-for-work programs known as Employment Generation Scheme (EGS). Associated with these two programs, there were Free Food Aid Programs that provided food aid to people affected by drought. In 2005, a new public employment program popularly known as Productive Safety Net Program (PSNP) started in order to support households in absolute poverty and protect households from being falling into poverty. The PSNP has two components namely public work program (PWP) and Direct Support Program (DSP). While beneficiaries have to supply labor in return for daily unskilled wage to be part of the PWP, poor people unable to supply labor are entitled to be part of the DSP in order to get free cash and/or food aid. Complementary to PSNP is agricultural extension support program designed to help households involved in agriculture proper. The paper tries to identify the effect of households' involvement in PWP, DSP and agricultural extension program on the time allocation of children including in work, schooling, and studying at home. Child work considered is total child work, and paid work and unpaid work separately. The effect on time allocation is also disaggregated for by gender of the children: girls and boys.

The public work program component of PSNP increased both girls' and boys' spending of time on paid work by 0.13 h per day, but it reduces girls spending on child care and household chores by half an our per day. The net effect is that children's time spent on total hours on work reduced. Moreover, PWP also increases girls spent on studying by 0.25 h per day. In terms of better child welfare outcome, PWP of the PSNP is much better than that of its predecessor EGS. The positive impact of PWP of the PSNP (0.13 h per day) on child work for pay (0.13 h per day) is half of that of EGS (0.26 h per day). Moreover EGS was not able to reduce the time boys and girls spent on child care and household chores. Rather EGS reduces boys' time spent on schooling (0.36 h less per day).

Direct support (second component of PSNP) was found to be effective in reducing child work in paid and unpaid activities and increasing grades completed by boys for rural and urban areas combined. In rural areas, boys' hours of unpaid work outside home and girls' hours of child care and household chores declined. For urban areas, girls' hours of paid work and boys' hours of paid and unpaid work and total work declined significantly. We also found that boys' grade completed in urban areas increased by half year.

Substantial number of households have participated in agricultural extension programs in order to get expert advices on the use of modern inputs and improved cultural practices such as modern hoeing, weeding, harvesting, and irrigation practices. Such practices potentially have the ability to increase farm income and labor use and hence children from households who obtain agricultural extension support may work less and spend more time in schooling and studying at home and less time on work if households get richer as a result of the support program. On the other hand, if households cannot meet the increased demand for labor by using adult family and/or hired labor, children may increase the time they spent on working while reducing their time in schooling and studying at home. In our Young Lives sample households, we found the latter effect (substitution effect) is dominated by the former (income effect), and as a result, participation of households in agricultural support program reduces hours of time spent on paid work (0.23 h less per day) and child care and household chores for girls and boys (0.41 and 0.61 h less per day, respectively) and increases hours of schooling time spent by 0.92 h per day.

To conclude, although the productive safety net program (PSNP) targets households, it has been instrumental in improving child well-being in terms of reducing total time child spent on working, child care, and household chores and increasing girls' time spent on studying, which has strong implication for the quality of education. However, the PWP part of the PSNP is still not effective enough to reduce children's involvement in paid work, highest grade completed, and time children spent on studying at home. Since the program started only 12 months prior to survey, it is too early to capture the full impact of the program.

The following policy implications can be withdrawn from the study. In order to reduce the negative effect of PWP on children, the programs have to be flexible enough not create a pressure on households to involve children in public work and other activities at home and outside home. It would be good to consider shifting the support program from PWP to conditional on children going to school and supporting households for activities that have higher income effect than substitution effect such as like extension support. Moreover, the design of the PSNP should consider substitution effect on children and hence target children instead of households. In this regard, perhaps considering changing part of the PWP into school feeding would important. Moreover, gender impacts of labor requirements need further attention to ensure that programs do not have negative impacts for women/men and girls/boys. Households unable to provide adult labor should receive direct support. The payment made to beneficiaries in PWP was not high enough to discourage children to work for paid and unpaid work. Hence it would be good to increase the payment for public work to make it more beneficial to children. Especially, payment in real terms should be reasonably high by indexing the wage rate to inflation.

Appendix

Descriptive Statistics

Table 15 Mean values of variables at household level for rural and urban areas

	Rural	Urban	Total
Variables	Mean	Mean	Mean
Age of household head	43	41.9	42.7
Sex of household head	0.813	0.672	0.756
Mother's educational level (round one)	0.723	3.44	1.821
Father's educational level (round one)	1.414	3.74	2.353
Father's education level (round two)	2.808	5.31	3.82
Mother's education level (round two)	1.334	4.28	2.524
Distance to school	35.822	22.59	30.477
Birth order	4.014	3.55	3.827
Asset index for 8-year-olds (round 1)	0.245	0.13	0.198
Wealth index for 8-year-olds (round 1)	0.084	0.32	0.179
Asset index square (ai182)	0.067	0.03	0.052
Wealth index square (wi182)	0.013	0.12	0.057
Number dependants in the household	1.459	0.93	1.246
Number of 17–65 male family members	1.204	1.17	1.189
Number of 17–65 female family members	1.238	1.4	1.303
Death or illness dummy (Round 2)	0.459	0.46	0.461
Theft dummy (Round 2)	0.139	0.13	0.136
Increase in input price dummy (Round 2)	0.377	0.19	0.302
Increase in input price or decrease in output price dummy (Round 2)	0.399	0.2	0.32
Death of livestock dummy (Round 2)	0.377	0.08	0.257
Dummy for place employment shutdown or job lose (Round 2)	0.053	0.18	0.104
Drought dummy (Round 2)	0.469	0.07	0.306
Dummy for drought crop failure and pests and diseases (Round 2)	0.723	0.12	0.481
Having to pay for school dummy (Round 2)	0.096	0.1	0.098
New household member or birth dummy (Round 2)	0.212	0.09	0.162
Natural disaster including drought (Round 2)	0.651	0.1	0.43
Death or illness dummy (Round 1)	0.265	0.34	0.294
Theft dummy (Round 1)	0.12	0.07	0.101
Death of livestock dummy (Round 1)	0.399	0.1	0.278
Dummy for place employment shutdown or job loss (Round 1)	0.122	0.23	0.164
Dummy for drought crop failure and pests and diseases (Round 1)	0.661	0.08	0.424
Having to pay for school dummy (Round 1)	0.111	0.16	0.132
New household member or birth dummy (Round 1)	0.116	0.1	0.11
Natural disaster including drought (Round 1)	0.396	0.05	0.256
Dummy for Addis Ababa	0	0.36	0.146
Dummy for Amhara	0.245	0.12	0.196
Dummy for Oromia	0.247	0.14	0.204
Dummy for SNNP	0.252	0.24	0.249
Dummy for Tigray	0.257	0.13	0.205
Urban dummy			0.4

Table 16 Percent of children who missed class and dropouts

	Rural	Urban	Total
Percent of 12-year-old children dropped out from school	3.04	2.03	2.30%
Percent of children who missed classes more than one whole week in the last 12 months	13.8	14.7	14.3
Number of days missed in the last 12 months	6	4.4	5.3
Time (in minutes) it takes children to reach school	35.8	22.6	30.5

Table 17 Time of the year (Months) when children are most absent from school

	Rural	Urban	Total
September	2.9	1.92	2.48
October	**23.19**	9.62	17.36
November	**24.64**	23.08	23.97
December	**18.84**	11.54	15.7
January	**13.04**	17.31	14.88
February	1.45	11.54	5.79
March	5.8	3.85	4.96
April	1.45	7.69	4.13
May	5.8	7.69	6.61
June	2.9	5.77	4.13

Bolded figures are those statistically significant at least at 10% level.

Table 18 Reasons for missing schooling over the last 12 months

School	Rural	Urban	Total
Need for domestic work and/or agricultural work at home	31.1	1.8	18.3
Had to do paid work	46.0	73.7	58.0
Other reasons	23.0	24.6	23.7

Results of Propensity Score Regression

Table 19 First stage logistic regression (propensity score) of public work part of the productive safety net program in rural areas and descriptive statics

	First stage logistic regression				Before matching			After matching		
					Untreated ($N = 303$)	Treated ($N = 270$)	All ($N = 584$)	Untreated ($N = 159$)	Treated ($N = 262$)	All ($N = 421$)
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
maxedur1	−0.075	0.048	−1.590	0.113	5.122	4.458	4.814	4.805	4.458	4.589
ai18	8.702	8.537	1.020	0.308	0.268	0.218	0.245	0.256	0.218	0.233
wi18	−32.514	10.859	−2.990	0.003	0.076	0.093	0.084	0.065	0.092	0.082
ai182	−51.567	20.968	−2.460	0.014	0.076	0.056	0.067	0.070	0.056	0.061
wi182	23.064	22.797	1.010	0.312	0.011	0.014	0.013	0.008	0.014	0.012
asaw	−16.212	26.867	−0.600	0.546	0.021	0.020	0.020	0.017	0.019	0.018
depen	0.054	0.654	0.080	0.935	1.510	1.400	1.459	1.421	1.405	1.411
wdepn	0.656	1.933	0.340	0.734	0.112	0.132	0.121	0.088	0.131	0.115
asdepn	−0.069	2.398	−0.030	0.977	0.417	0.326	0.375	0.377	0.326	0.345
w7to17	5.388	2.385	2.260	0.024	0.140	0.172	0.155	0.115	0.172	0.151
w17to65m	3.821	2.497	1.530	0.126	0.095	0.110	0.102	0.076	0.111	0.097
w17to65f	3.950	3.946	1.000	0.317	0.091	0.121	0.105	0.081	0.120	0.105
wdcropfr2	7.294	4.950	1.470	0.141	0.045	0.068	0.055	0.049	0.066	0.060
wdcattler2	2.373	3.998	0.590	0.553	0.025	0.040	0.032	0.027	0.039	0.034
wddillnesr2	−2.824	3.869	−0.730	0.465	0.032	0.038	0.035	0.033	0.036	0.035
a7to17	−0.320	2.722	−0.120	0.906	0.513	0.405	0.463	0.468	0.410	0.432
a17to65m	1.298	2.658	0.490	0.625	0.347	0.277	0.315	0.318	0.279	0.294
a17to65f	−0.266	3.971	−0.070	0.947	0.328	0.274	0.303	0.319	0.275	0.292
adcattler2	4.823	4.136	1.170	0.244	0.101	0.095	0.098	0.104	0.094	0.097
addillnesr2	2.200	3.644	0.600	0.546	0.130	0.097	0.114	0.132	0.097	0.110
ch7to17	−0.273	0.730	−0.370	0.708	1.873	1.819	1.848	1.799	1.840	1.824
nbn17_65mr1	−0.323	0.747	−0.430	0.665	1.223	1.181	1.204	1.164	1.195	1.183
nbn17_65fr1	−0.055	1.141	−0.050	0.961	1.217	1.263	1.238	1.233	1.267	1.254
dcropfr2	0.610	0.670	0.910	0.363	0.672	0.781	0.723	0.786	0.779	0.781

Table 19 (continued)

	First stage logistic regression				Before matching			After matching		
					Untreated ($N = 303$)	Treated ($N = 270$)	All ($N = 584$)	Untreated ($N = 159$)	Treated ($N = 262$)	All ($N = 421$)
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
ddillnesr2	−0.566	0.987	−0.570	0.567	0.481	0.433	0.459	0.516	0.431	0.463
dtheftr2	0.505	0.384	1.310	0.189	0.137	0.141	0.139	0.157	0.141	0.147
dinputpr2	0.691	0.984	0.700	0.483	0.446	0.296	0.377	0.447	0.305	0.359
dpricer2	−0.491	0.967	−0.510	0.612	0.471	0.315	0.399	0.459	0.321	0.373
dcattler2	−1.459	1.130	−1.290	0.197	0.357	0.400	0.377	0.384	0.397	0.392
dnewhhr2	−0.239	0.330	−0.720	0.470	0.185	0.244	0.212	0.220	0.248	0.238
dndisr2	−0.949	0.552	−1.720	0.086	0.631	0.674	0.651	0.736	0.672	0.696
comm_7	0.291	0.629	0.460	0.643	0.080	0.078	0.079	0.138	0.076	0.100
comm_8	0.490	0.647	0.760	0.449	0.099	0.067	0.084	0.164	0.061	0.100
comm_9	2.432	0.699	3.480	0.001	0.022	0.159	0.086	0.044	0.164	0.119
comm_10	0.051	0.635	0.080	0.935	0.108	0.056	0.084	0.145	0.057	0.090
comm_18	−0.350	0.668	−0.520	0.600	0.121	0.041	0.084	0.157	0.042	0.086
comm_19	−1.571	0.674	−2.330	0.020	0.134	0.026	0.084	0.126	0.027	0.064
comm_20	2.884	0.723	3.990	0.000	0.029	0.148	0.084	0.057	0.145	0.112
comm_21	3.149	0.789	3.990	0.000	0.013	0.170	0.086	0.025	0.172	0.116
comm_23	4.002	0.884	4.530	0.000	0.019	0.163	0.086	0.031	0.160	0.112
comm_24	−1.582	1.028	−1.540	0.124	0.025	0.007	0.017	0.013	0.008	0.010
_cons	2.454	1.860	1.320	0.187						
Number of observations	484									
LR chi2(41)	243.4									
Prob > chi2	0.000									
Pseudo R2	0.365									
Log likelihood =	−212									

See Table 24 below for the description of variables abbreviated
SE = Standard error

Table 20 Impact of PSNP on child welfare whose parents participate in public work component of PSNP

	All			All		
Variable	TTk	SE	T-stat	ATTn	SE	T-stat
work	0.325	0.207	1.570	0.968	0.436	2.220
Cnpaywrk	0.191	0.200	0.960	0.853	0.423	2.020
Cpaywork	0.134	0.070	**1.920**	0.115	0.121	0.950
Chcaredom	−0.567	0.172	**−3.300**	−0.078	0.435	−0.180
Cpayunpaidw	−0.269	0.199	−1.350	0.887	0.461	1.920
Cschool	0.146	0.163	0.900	−0.185	0.421	−0.440
cstudy	0.133	0.089	1.490	−0.121	0.218	−0.550
gradnow	0.249	0.166	1.500	−0.660	0.373	−1.770
	Girls					
work	0.400	0.254	1.570	−0.584	0.507	−1.150
cnpaywrk	0.146	0.239	0.610	−0.541	0.481	−1.120
cpaywork	0.254	0.092	**2.760**	−0.043	0.116	−0.370
chcaredom	−0.501	0.235	**−2.140**	0.473	0.600	0.790
cpayunpaidw	−0.115	0.271	−0.420	−0.112	0.625	−0.180
cschool	0.250	0.230	1.090	0.293	0.558	0.520
cstudy	0.255	0.123	**2.070**	−0.210	0.273	−0.770
gradnow	0.184	0.233	0.790	−0.237	0.546	−0.430
	Boys					
work	0.194	0.284	0.680	1.251	0.512	2.450
cnpaywrk	0.173	0.278	0.620	1.297	0.501	2.590
cpaywork	0.021	0.105	0.200	−0.046	0.269	−0.170
chcaredom	−0.571	0.205	**−2.780**	−0.261	0.452	−0.580
cpayunpaidw	−0.416	0.290	−1.430	0.980	0.564	1.740
cschool	0.056	0.231	0.240	−0.218	0.465	−0.470
cstudy	0.020	0.129	0.160	−0.163	0.262	−0.620
gradnow	0.323	0.233	1.390	−0.370	0.450	−0.820

Note: For two tail test and for n > 120, T values for 1%, 5%, and 10% level of significance are 2.576, 1.96, and 1.645, respectively
ATTk = average treatment effect of the treated using kernel matching
ATTn = average treatment effect of the treated using nearest neighborhood matching
SE = standard error
Bolded figures are those statistically significant at least at 10% level.

Table 21 First stage logistic regression (propensity score) for Employment Generation Scheme (EGS) in rural areas and descriptive statics

	First stage logistic regression				Before matching			After matching		
					Untreated ($N = 362$)	Treated ($N = 222$)	Total ($N = 584$)	Untreated ($N = 309$)	Treated ($N = 222$)	Total ($N = 531$)
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
ai18	−1.083	6.871	−0.160	0.875	0.255	0.228	0.245	0.250	0.228	0.241
wi18	−5.122	8.574	−0.600	0.550	0.087	0.078	0.084	0.092	0.078	0.086
ai182	−36.710	15.716	−2.340	0.020	0.071	0.060	0.067	0.069	0.060	0.065
wi182	9.625	17.546	0.550	0.583	0.013	0.011	0.013	0.014	0.011	0.013
asaw	−5.825	19.190	−0.300	0.761	0.022	0.017	0.020	0.022	0.017	0.020
depen	−0.430	0.467	−0.920	0.358	1.541	1.324	1.459	1.456	1.324	1.401
wdepn	−2.489	1.648	−1.510	0.131	0.134	0.100	0.121	0.132	0.100	0.119
asdepn	2.237	1.642	1.360	0.173	0.404	0.327	0.375	0.372	0.327	0.353
w7to17	−0.195	1.648	−0.120	0.906	0.162	0.143	0.155	0.169	0.143	0.158
w17to65m	3.144	1.919	1.640	0.101	0.107	0.095	0.102	0.112	0.095	0.105
w17to65f	0.698	3.132	0.220	0.824	0.108	0.099	0.105	0.115	0.099	0.109
wdcropfr2	0.887	3.457	0.260	0.798	0.057	0.052	0.055	0.060	0.052	0.057
wdcattler2	−5.386	3.324	−1.620	0.105	0.032	0.032	0.032	0.031	0.032	0.032
wddillnesr2	4.802	3.185	1.510	0.132	0.034	0.036	0.035	0.034	0.036	0.035
a7to17	4.028	1.915	2.100	0.035	0.477	0.441	0.463	0.466	0.441	0.456
a17to65m	1.938	1.824	1.060	0.288	0.325	0.297	0.315	0.316	0.297	0.308
a17to65f	−0.041	2.569	−0.020	0.987	0.313	0.286	0.303	0.312	0.286	0.301
adcropfr2	1.268	2.865	0.440	0.658	0.186	0.174	0.182	0.181	0.174	0.178
adcattler2	0.734	3.112	0.240	0.814	0.094	0.105	0.098	0.083	0.105	0.092
addillnesr2	0.333	2.656	0.130	0.900	0.117	0.111	0.114	0.110	0.111	0.110
ch7to17	−1.000	0.514	−1.950	0.052	1.843	1.856	1.848	1.848	1.856	1.851
nbn17_65mr1	−0.493	0.512	−0.960	0.336	1.215	1.185	1.204	1.204	1.185	1.196
nbn17_65fr1	−0.195	0.764	−0.250	0.799	1.235	1.243	1.238	1.256	1.243	1.250
ddillnesr2	−0.366	0.738	−0.500	0.620	0.450	0.473	0.459	0.430	0.473	0.448
dtheftr2	−0.218	0.342	−0.640	0.524	0.133	0.149	0.139	0.126	0.149	0.136
dinputpr2	0.972	0.773	1.260	0.209	0.401	0.338	0.377	0.359	0.338	0.350
dpricer2	−0.832	0.772	−1.080	0.281	0.425	0.356	0.399	0.379	0.356	0.369

Table 21 (continued)

	First stage logistic regression				Before matching			After matching		
					Untreated ($N = 362$)	Treated ($N = 222$)	Total ($N = 584$)	Untreated ($N = 309$)	Treated ($N = 222$)	Total ($N = 531$)
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
dcattler2	0.585	0.878	0.670	0.506	0.351	0.419	0.377	0.320	0.419	0.362
dcropfr2	−0.111	0.846	−0.130	0.896	0.715	0.734	0.723	0.712	0.734	0.721
dnewhhr2	0.065	0.291	0.220	0.822	0.210	0.216	0.212	0.201	0.216	0.207
dndisr2	−0.844	0.460	−1.840	0.066	0.663	0.631	0.651	0.660	0.631	0.648
comm_6	0.849	0.595	1.430	0.154	0.039	0.135	0.075	0.045	0.135	0.083
comm_7	1.013	0.533	1.900	0.057	0.050	0.126	0.079	0.058	0.126	0.087
comm_8	1.479	0.478	3.090	0.002	0.047	0.144	0.084	0.055	0.144	0.092
comm_9	2.604	0.582	4.470	0.000	0.019	0.194	0.086	0.023	0.194	0.094
comm_10	−1.219	0.586	−2.080	0.037	0.116	0.032	0.084	0.123	0.032	0.085
comm_12	−1.108	0.628	−1.760	0.078	0.094	0.041	0.074	0.110	0.041	0.081
comm_18	−1.096	0.594	−1.840	0.065	0.113	0.036	0.084	0.126	0.036	0.089
comm_19	−0.951	0.592	−1.610	0.108	0.108	0.045	0.084	0.123	0.045	0.090
comm_21	0.257	0.497	0.520	0.604	0.088	0.081	0.086	0.104	0.081	0.094
comm_23	−0.431	0.572	−0.750	0.452	0.091	0.077	0.086	0.107	0.077	0.094
comm_24	0.250	0.850	0.290	0.769	0.014	0.023	0.017	0.016	0.023	0.019
_cons	2.717	1.628	1.670	0.095						
Number of observations	538									
LR chi2(42)	167.24									
Prob > chi2	0.000									
Pseudo R2	0.229									
Log likelihood =	−281.04									

For two tail test and for n > 120, T values for 1%, 5%, and 10% level of significance are 2.576, 1.96, and 1.645, respectively; ATTk=average treatment effect of the treated using kernel matching

ATTn = average treatment effect of the treated using nearest neighborhood matching

SE = standard error

Table 22 Impact of EGS on child welfare

Variable	ATTk	SE	T-stat	ATTn	SE	T-stat
Boys and Girls ($N = 538$)						
Paid and unpaid work outside home	0.309	0.200	1.540	0.497	0.339	1.470
Unpaid work outside home	0.043	0.192	0.230	0.287	0.328	0.870
Paid work outside home	0.266	0.078	3.400	0.210	0.113	1.860
Child care and household chores	−0.310	0.160	−1.940	−0.250	0.285	−0.880
Total work	−0.009	0.190	−0.050	0.247	0.326	0.760
Schooling	−0.355	0.158	−2.250	−0.127	0.251	−0.500
Studying	−0.018	0.086	−0.210	−0.286	0.153	−1.870
Grade completed	0.042	0.160	0.260	−0.078	0.264	−0.300
Girls ($N = 255$)						
Paid and unpaid work outside home	−0.004	0.254	−0.020	0.328	0.447	0.730
Unpaid work outside home	−0.263	0.239	−1.100	0.066	0.428	0.150
Paid work outside home	0.259	0.115	2.250	0.263	0.139	1.900
Child care and household chores	−0.149	0.224	−0.670	−0.726	0.405	−1.790
Total work	−0.136	0.243	−0.560	−0.380	0.505	−0.750
Schooling	−0.246	0.228	−1.080	−0.115	0.408	−0.280
Studying	0.208	0.127	1.630	0.160	0.210	0.760
Grade completed	0.198	0.232	0.850	−0.043	0.392	−0.110
Boys ($N = 277$)						
Paid and unpaid work outside home	0.055	0.269	0.210	0.255	0.404	0.630
Unpaid work outside home	−0.120	0.261	−0.460	0.176	0.401	0.440
Paid work outside home	0.176	0.100	1.760	0.079	0.155	0.510
Child care and household chores	−0.013	0.196	−0.070	0.043	0.297	0.140
Total work	0.012	0.275	0.040	0.264	0.380	0.690
Schooling	−0.360	0.221	−1.630	−0.172	0.308	−0.560
Studying	−0.182	0.123	−1.480	−0.316	0.192	−1.650
Grade completed	0.017	0.225	0.070	0.015	0.327	0.050

SE = standard error

Table 23 First stage logistic regression (propensity score) of agricultural extension support program for rural areas

Explanatory variable	First stage logistic regression				Before matching			After matching		
					Untreated (N = 480)	Treated (N = 104)	Total (N = 584)	Untreated (N = 242)	Treated (N = 100)	Total (N = 342)
agextr2	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
maxedur1	0.15	0.06	2.64	0.008	4.778	4.980	4.814	4.851	4.980	4.889
ai18	8.17	12.50	0.65	0.513	0.249	0.229	0.245	0.248	0.228	0.242
wi18	−18.17	16.16	−1.12	0.261	0.077	0.116	0.084	0.082	0.115	0.092
ai182	28.87	30.51	0.95	0.344	0.068	0.060	0.067	0.068	0.060	0.065
wi182	−10.12	30.66	−0.33	0.741	0.011	0.018	0.013	0.012	0.017	0.014
Asaw	36.65	33.62	1.09	0.276	0.019	0.027	0.020	0.020	0.026	0.022
Depen	1.47	0.73	2	0.045	1.440	1.548	1.459	1.393	1.540	1.436
Wdepn	0.12	2.74	0.04	0.966	0.109	0.179	0.121	0.107	0.174	0.127
Asdepn	−4.95	2.52	−1.96	0.05	0.377	0.364	0.375	0.358	0.359	0.359
w7to17	−1.85	2.63	−0.7	0.482	0.141	0.217	0.155	0.155	0.217	0.173
w17to65m	1.65	3.56	0.46	0.644	0.094	0.139	0.102	0.098	0.139	0.110
w17to65f	2.80	4.78	0.59	0.557	0.094	0.153	0.105	0.104	0.151	0.118
wdcropfr2	5.00	5.38	0.93	0.353	0.047	0.095	0.055	0.051	0.095	0.064
wdcattler2	14.20	5.47	2.6	0.009	0.027	0.055	0.032	0.033	0.054	0.039
wddillnesr2	2.89	5.34	0.54	0.589	0.032	0.050	0.035	0.029	0.046	0.034
a7to17	−4.59	2.82	−1.63	0.104	0.471	0.425	0.463	0.475	0.426	0.460
a17to65m	−3.34	2.70	−1.24	0.215	0.324	0.269	0.315	0.305	0.271	0.295
a17to65f	0.19	3.42	0.06	0.955	0.306	0.287	0.303	0.307	0.285	0.301
adcropfr2	−5.28	5.39	−0.98	0.327	0.179	0.193	0.182	0.183	0.195	0.186
adcattler2	1.41	4.55	0.31	0.757	0.097	0.101	0.098	0.097	0.099	0.098
addillnesr2	−4.13	4.73	−0.87	0.382	0.117	0.102	0.114	0.104	0.098	0.102
ch7to17	1.31	0.80	1.63	0.103	1.842	1.875	1.848	1.872	1.890	1.877
nbn17_65mr1	0.09	0.77	0.12	0.906	1.213	1.163	1.204	1.161	1.180	1.167
nbn17_65fr1	−0.31	1.07	−0.29	0.769	1.227	1.288	1.238	1.227	1.290	1.246

Table 23 (continued)

Explanatory variable	First stage logistic regression				Before matching			After matching		
					Untreated (*N* = 480)	Treated (*N* = 104)	Total (*N* = 584)	Untreated (*N* = 242)	Treated (*N* = 100)	Total (*N* = 342)
agextr2	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
ddillnesr2	0.92	1.33	0.69	0.489	0.465	0.433	0.459	0.426	0.420	0.424
dtheftr2	0.33	0.56	0.59	0.558	0.148	0.096	0.139	0.116	0.100	0.111
dinputpr2	−2.03	0.93	−2.17	0.03	0.415	0.202	0.377	0.368	0.200	0.319
dpricer2	1.46	0.92	1.59	0.113	0.433	0.240	0.399	0.393	0.240	0.348
dcattler2	−1.55	1.36	−1.14	0.256	0.367	0.423	0.377	0.372	0.420	0.386
dcropfr2	1.36	1.56	0.87	0.384	0.698	0.837	0.723	0.711	0.850	0.751
dnewhhr2	−0.56	0.45	−1.26	0.207	0.206	0.240	0.212	0.190	0.240	0.205
dndisr2	0.56	0.69	0.81	0.419	0.627	0.760	0.651	0.661	0.770	0.693
comm_7	−1.15	1.40	−0.82	0.412	0.090	0.029	0.079	0.149	0.030	0.114
comm_8	−2.62	1.61	−1.62	0.105	0.100	0.010	0.084	0.087	0.010	0.064
comm_9	−2.88	1.68	−1.72	0.086	0.102	0.010	0.086	0.045	0.010	0.035
comm_10	−1.07	1.41	−0.76	0.447	0.096	0.029	0.084	0.165	0.030	0.126
comm_12	−0.64	1.49	−0.43	0.665	0.083	0.029	0.074	0.112	0.020	0.085
comm_19	0.40	1.33	0.3	0.766	0.081	0.096	0.084	0.161	0.100	0.143
comm_20	2.51	1.31	1.92	0.055	0.035	0.308	0.084	0.062	0.310	0.135
comm_21	1.85	1.32	1.41	0.16	0.048	0.260	0.086	0.091	0.270	0.143
comm_23	2.36	1.33	1.77	0.077	0.056	0.221	0.086	0.103	0.210	0.135
_cons	−5.82	2.72	−2.13	0.033						
Number of observations	426									
LR chi2(41)	188.42									
Prob > chi2	0.000									
Pseudo R2	0.4058									
Log likelihood =	−137.935									

See Table 26 below for the description of variables abbreviated
SE = standard error

Table 24 Impact of agricultural extension program

Girls+boys	Kernel matching			Nearest neighborhood method		
Outcome	Att	SE	T-stat	Att	SE	T-stat
work	−0.294	0.245	−1.200	−0.635	0.431	−1.470
cnpaywrk	−0.056	0.242	−0.230	−0.379	0.428	−0.880
cpaywork	−0.238	0.053	**−4.480**	−0.257	0.099	−2.600
chcaredom	−0.190	0.195	−0.980	0.614	0.328	1.870
cpayunpaidw	−0.503	0.218	**−2.310**	−0.067	0.403	−0.170
cschool	0.717	0.180	**3.970**	0.432	0.335	1.290
cstudy	0.202	0.111	**1.810**	−0.027	0.195	−0.140
gradnow	0.314	0.200	1.570	0.007	0.364	0.020
Girls						
work	−0.186	0.276	−0.670	−0.415	0.594	−0.700
cnpaywrk	0.078	0.266	0.290	−0.141	0.572	−0.250
cpaywork	−0.264	0.079	**−3.320**	−0.274	0.091	−3.030
chcaredom	−0.418	0.224	**−1.860**	0.685	0.536	1.280
cpayunpaidw	−0.614	0.285	**−2.150**	0.262	0.638	0.410
cschool	0.927	0.217	**4.270**	0.297	0.566	0.530
cstudy	0.134	0.138	0.970	−0.340	0.334	−1.020
gradnow	0.534	0.241	**2.220**	−0.011	0.589	−0.020
Boys						
work	0.317	0.363	0.870	−0.049	0.545	−0.090
cnpaywrk	0.535	0.361	1.480	0.195	0.553	0.350
cpaywork	−0.218	0.072	**−3.040**	−0.243	0.163	−1.500
chcaredom	−0.618	0.290	**−2.130**	0.135	0.398	0.340
cpayunpaidw	−0.326	0.334	−0.980	0.006	0.546	0.010
cschool	0.321	0.319	1.000	0.350	0.481	0.730
cstudy	0.290	0.196	1.480	0.170	0.282	0.600
gradnow	−0.095	0.346	−0.270	−0.081	0.494	−0.160

SE = standard error
Bolded figures are those statistically significant at least at 10% level.

Table 25 First stage logistic regression (propensity score) of direct support (part of the productive safety net program) for rural and urban areas

	First stage logistic regression of dummy for receiving direct support				Before matching			After matching		
					Untreated $N = 719$	Treated $N = 236$	All $N = 955$	Untreated $N = 693$	Treated $N = 236$	All $N = 929$
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
maxedur1	−0.027	0.031	−0.880	0.380	6.143	6.386	6.203	6.150	6.386	6.210
ai18	5.622	4.139	1.360	0.174	0.205	0.177	0.198	0.202	0.176	0.195
wi18	0.529	3.338	0.160	0.874	0.176	0.188	0.179	0.179	0.190	0.181
ai182	−26.180	11.436	−2.290	0.022	0.054	0.044	0.052	0.053	0.044	0.051
wi182	−3.424	3.929	−0.870	0.383	0.055	0.062	0.057	0.057	0.062	0.058
asaw	8.629	6.818	1.270	0.206	0.031	0.028	0.030	0.031	0.028	0.030
depen	0.269	0.270	1.000	0.318	1.270	1.172	1.246	1.255	1.165	1.233
wdepn	−0.906	0.641	−1.410	0.157	0.195	0.178	0.191	0.196	0.180	0.192
asdepn	−0.627	0.958	−0.650	0.513	0.291	0.243	0.279	0.283	0.240	0.272
w7to17	1.495	0.752	1.990	0.047	0.319	0.356	0.328	0.325	0.360	0.334
w17to65m	0.100	0.602	0.170	0.868	0.227	0.219	0.225	0.232	0.222	0.229
w17to65f	−1.768	0.947	−1.870	0.062	0.244	0.259	0.248	0.247	0.262	0.251
wdcropfr2	−2.913	2.008	−1.450	0.147	0.048	0.038	0.046	0.045	0.038	0.043
wdcattler2	−2.674	2.010	−1.330	0.183	0.032	0.016	0.028	0.031	0.016	0.027
wddillnesr2	2.353	1.209	1.950	0.052	0.071	0.113	0.081	0.071	0.114	0.082
a7to17	0.412	1.007	0.410	0.683	0.391	0.325	0.375	0.389	0.324	0.373
a17to65m	0.377	0.970	0.390	0.697	0.266	0.214	0.253	0.263	0.215	0.251
a17to65f	−1.326	1.486	−0.890	0.372	0.263	0.232	0.255	0.259	0.232	0.252
adcattler2	1.003	2.593	0.390	0.699	0.069	0.044	0.063	0.067	0.042	0.061
addillnesr2	−2.578	1.732	−1.490	0.137	0.094	0.093	0.094	0.094	0.094	0.094
ch7to17	−0.307	0.296	−1.040	0.301	1.864	1.812	1.851	1.882	1.818	1.865
nbn17_65mr1	−0.054	0.275	−0.200	0.845	1.216	1.105	1.189	1.229	1.110	1.199
nbn17_65fr1	0.672	0.419	1.600	0.109	1.296	1.326	1.303	1.300	1.331	1.308
dcropfr2	0.936	0.488	1.920	0.055	0.491	0.448	0.481	0.479	0.441	0.469
ddillnesr2	0.634	0.480	1.320	0.186	0.433	0.548	0.461	0.436	0.555	0.466
dtheftr2	−0.291	0.281	−1.030	0.301	0.142	0.117	0.136	0.144	0.110	0.136
dinputpr2	−1.149	0.639	−1.800	0.072	0.302	0.301	0.302	0.313	0.305	0.311
dpricer2	1.007	0.632	1.590	0.111	0.316	0.335	0.320	0.328	0.335	0.329
dcattler2	−0.232	0.728	−0.320	0.750	0.281	0.184	0.257	0.274	0.178	0.250
dnewhhr2	−0.286	0.277	−1.030	0.301	0.174	0.126	0.162	0.160	0.127	0.152

Table 25 (continued)

	First stage logistic regression of dummy for receiving direct support				Before matching			After matching		
					Untreated $N = 719$	Treated $N = 236$	All $N = 955$	Untreated $N = 693$	Treated $N = 236$	All $N = 929$
Explanatory variables	Coef.	SE	Z	P > Z	Mean	Mean	Mean	Mean	Mean	Mean
dndisr2	−0.620	0.405	−1.530	0.126	0.447	0.377	0.430	0.433	0.369	0.417
demplr2	0.298	0.275	1.080	0.279	0.085	0.163	0.104	0.087	0.165	0.107
dedupr2	0.466	0.296	1.570	0.116	0.090	0.121	0.098	0.097	0.123	0.103
comm_2	−1.688	0.535	−3.150	0.002	0.058	0.025	0.050	0.061	0.025	0.052
comm_3	−1.707	0.852	−2.000	0.045	0.019	0.008	0.016	0.020	0.008	0.017
comm_4	−0.706	0.578	−1.220	0.222	0.031	0.029	0.031	0.033	0.030	0.032
comm_5	0.839	0.414	2.030	0.043	0.028	0.117	0.050	0.029	0.119	0.052
comm_7	−0.955	0.557	−1.720	0.086	0.054	0.025	0.047	0.058	0.021	0.048
comm_8	−0.177	0.479	−0.370	0.712	0.051	0.046	0.050	0.052	0.038	0.048
comm_9	−1.473	0.599	−2.460	0.014	0.062	0.017	0.051	0.066	0.017	0.054
comm_10	1.750	0.436	4.010	0.000	0.030	0.113	0.050	0.032	0.114	0.053
comm_11	0.658	0.452	1.460	0.145	0.038	0.088	0.050	0.040	0.089	0.053
comm_12	−2.208	1.056	−2.090	0.037	0.057	0.004	0.044	0.045	0.004	0.034
comm_13	0.124	0.451	0.270	0.783	0.047	0.046	0.047	0.051	0.047	0.050
comm_14	−1.867	0.567	−3.290	0.001	0.059	0.021	0.050	0.062	0.021	0.052
comm_15	−1.474	0.606	−2.430	0.015	0.039	0.021	0.035	0.040	0.021	0.036
comm_16	−0.064	1.243	−0.050	0.959	0.004	0.004	0.004	0.004	0.004	0.004
comm_17	−0.774	0.924	−0.840	0.402	0.011	0.008	0.010	0.012	0.008	0.011
comm_18	0.987	0.430	2.290	0.022	0.043	0.071	0.050	0.046	0.072	0.053
comm_20	−2.691	1.064	−2.530	0.011	0.065	0.004	0.050	0.036	0.004	0.028
comm_21	−1.945	0.677	−2.870	0.004	0.063	0.013	0.051	0.066	0.013	0.053
comm_22	1.194	0.454	2.630	0.009	0.034	0.096	0.049	0.032	0.097	0.048
comm_23	−1.102	0.539	−2.050	0.041	0.059	0.025	0.051	0.059	0.025	0.051
comm_24	−1.174	0.795	−1.480	0.140	0.027	0.008	0.022	0.027	0.008	0.023
_cons	−1.150	0.867	−1.330	0.185						
No. of observations	955									
LR chi2(54)	234.8									
Prob > chi2	0.000									
Pseudo R2	0.220									
Log likelihood	-416.6									

SE = standard error

Table 26 Description of variables used in Tables 19, 20, 21, 22, 23, 24, 25, and 26

Variable name	Description
maxedur1	Maximum years of schooling in the household
Border	Birth order in ascending order
Dmale	Dummy for boys (1 if boy and 0 if girl)
ai18	Asset index for 8-year-olds (Round 1)
wi18	Wealth index for 8-year-olds (Round 1)
Depen	Number of family member below 7 and above 65 years old
ch7to17	Number of children between the age of 7 and 17 years
nbn17_65mr1	Number of male family members >17 and less than 65 years
nbn17_65fr1	Number of female family members >17 and less than 65 years
ddillnesr2	Dummy for death or illness since 2002
dtheftr2	Dummy for being attacked by theft since 2002
dinputpr2	Dummy for increase in input price since 2002
dpricer2	Dummy for increase in input price since 2002
dcattler2	Dummy for death of owned livestock since 2002
dcropfr2	Dummy for drought crop failure and pests and diseases since 2002
dnewhhr2	Dummy for Addition of new household member or birth since 2002
dndisr2	Dummy for natural disaster including drought since 2002
	Square and interaction variables
ai182	square of ai18
wi182	square of wi18
Asaw	ai18 X wi18
Wdepn	wi18 X depn
Asdepn	as18 X depen
w7to17	wi18 X ch7to17
w17to65m	wi18 X nbn17_65mr1
w17to65f	wi18 X nbn17_65fr1
wdcropfr2	wi18 X dcropfr2
wdcattler2	wi18 X dcattler2
wddillnesr2	wi18 X ddillnesr2
a7to17	ai182 X ch7to17
a17to65m	ai182 X nbn17_65mr1
a17to65f	ai182 X nbn17_65fr1
adcropfr2	ai182 X dcropfr2
adcattler2	ai182 X dcattler2
addillnesr2	ai182 X ddillnesr2
Comm._1 to Comm_24	Community dummies
_Cons	Constant

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Family Allowances and Child School Attendance: An Ex-ante Evaluation of Alternative Schemes in Uruguay

Verónica Amarante, Rodrigo Arim, Gioia de Melo, and Andrea Vigorito

Abstract *Asignaciones Familiares* is a child allowances programme that was incepted in Uruguay in 1942 and significantly modified in 2008. The programme is focused on children aged 0–18 and aims at alleviating poverty and promoting school attendance particularly among teenagers. This chapter presents an ex-ante evaluation on the effects of this reform on teenager school attendance, poverty, inequality and adult labour supply. Our ex-ante estimated effects indicate that teenage school attendance rates may increase by 6–8% points as a result of the new programme, and that this change in school attendance shows a progressive pattern. The programme also significantly reduces extreme poverty, and to a lesser extent, the intensity and severity of poverty. Effects on poverty incidence and inequality are of small magnitude. Finally, the transfer may influence adult labour supply, inducing a reduction of work hours for household heads and spouses.

Keywords Impact evaluation · conditional cash transfers · school attendance · poverty · inequality

JEL Classification I38, I32

1 Introduction

Asignaciones Familiares was originally created in 1942 as a universal child allowances programme for formal workers. In 1995 however, the programme became a means-tested benefit due to fiscal constraints. In 2004, after a severe economic crisis, programme coverage was expanded to incorporate households that did not include formal workers, provided their earnings did not surpass an income threshold.

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During 2005–2008, an ambitious package of reforms was introduced in Uruguay that included health care services, the tax system and social protection. In this framework, *Asignaciones Familiares* was substantially reshaped in 2008. The new design expands the non-contributory strand of the regime, significantly extending coverage of the social protection network among the lower income strata. Its main aims are alleviating poverty and fostering school attendance, particularly at secondary school, given that attendance rates in primary school are almost universal in Uruguay since the early decades of the twentieth century.

This research aims at shedding light on the effects of this renewed conditional cash transfer programme on teenage school attendance, adult labour force participation, poverty and income inequality by carrying out an ex-ante evaluation. This exercise can provide useful inputs for policy implementation and further improvement of the intervention. Our work is mainly based on the methodology developed by Bourguignon et al. (2002) to assess *Bolsa Escola* in Brazil.

In the first part of our analysis, we assess the new programme's impact on teenage schooling, poverty and inequality, assuming that *Asignaciones Familiares* only affects household well-being through its effects on child behaviour. We develop microsimulations on teenage schooling behaviour considering three possible settings of the transfer (the actual transfer and two different schemes). To analyse the impacts of the new transfer on poverty and inequality at the household level, we consider two additional extreme scenarios: one assumes that the transfer exerts no influence on attendance, and the other considers that, as a consequence of the transfer, all children attend school. Finally, we explore the new programme's effects on adult labour supply.

In what follows we provide a short description of *Asignaciones Familiares*, focusing on the programme's recent reforms (section 2). Then we present some data on the situation of children in terms of poverty and school attendance (section 3) and discuss our methodological approach (section 4). Our main results, including regression outputs for the basic equations and the estimated effects on schooling, poverty, inequality and labour force outcomes are discussed in section 5. Finally, section 6 offers some concluding remarks. Additional information is depicted in two annexes.

2 *Asignaciones Familiares*: Short History and Present Legislation

This section contains a historical background of *Asignaciones Familiares* (I.1) and the main features of the present reform (I.2). After that, we describe the main characteristics of the baseline scenario used to carry out the microsimulations presented in the following section 2.3.

2.1 Programme Background and History

As stated before, *Asignaciones Familiares* was created in 1942 as an income transfer scheme reaching formal workers with children. Following the French legislation, it became one of the pioneering programmes of this kind in Latin America. Access to child benefits depended on both contribution to the social security system and compliance with school attendance for children aged 6–17. The transfer was served for children over 15 years old only in cases when they attended secondary school.[1] The value of the benefit was fixed at 8% of the national minimum wage.

Since the creation of *Banco de Previsión Social* (BPS), the regime has been in charge of this institution. BPS is the country's social security institute, which centralizes all social security payments (pensions, unemployment benefits, maternity leave, etc.).

In 1995, the system was transformed into a means-tested regime as a result of fiscal constraints. Later on, two subsequent reforms carried out in 1999 and 2004 created a sub-programme targeted towards indigent households that removed the requirement of contributing to the social security system and fixed the value of the transfer to 16% of the national minimum wage. Although the receipt of the transfer was still conditional on school attendance, controls on compliance were loosened due to administrative difficulties, after the regime's expansion in 2004. Meanwhile, controls on the income threshold have strictly been carried out every 2 months since the end of 1990 on the basis of the social security records of formal earners and beneficiaries. However, since most of the new beneficiaries were informal workers, this control was of little value.

The effects of the previous *Asignaciones Familiares* on either poverty or inequality were not found to be significant, mainly because the monthly stipend was very low and seemed not to exert any influence on individual behaviour (Bucheli, 1995; Arim and Vigorito, 2006).

2.2 The New **Asignaciones Familiares** *Regime*

The 2008 version of *Asignaciones Familiares* maintains its contributory strand (which has been means – tested since 1995) and enlarges its non-contributory strand by expanding the programme's target population. It also introduces a proxy-means score that is jointly assessed with an income threshold to determine programme eligibility.

Its main objectives are to contribute to poverty alleviation and to foster participation in the educational system, particularly for the age group 14–17 where drop-out rates are high. Unlike most Latin American conditional cash transfer schemes which oftentimes have been set on specific institutional structures; this new programme is embedded in the social security system. This feature is not common in the Latin American experience on conditional cash transfer programmes (ECLAC, 2006; Rawlings, 2004).

[1] In Uruguay, primary school lasts 6 years and is compulsory. Children enter the system when they are 6 years old. Since 1996 a pre-primary year was also made compulsory. Secondary school takes another 6 years, and the first three ones are compulsory.

The target population of the new *Asignaciones Familiares* is composed of 500,000 children aged 0–17 living in households with income under the national poverty line (which is 50% of Uruguayan children), despite adults' contributory status. Households whose per capita average income is below a certain threshold (equivalent to US $87 a month) and who are proven to be affected by structural poverty conditions (measured through a proxy-means score) are entitled to obtain the benefit. The programme is conditional on school attendance for children aged 6–17. Monthly stipends will be transferred preferably to women in charge of the children, but such a decision is left to households.

Non-eligible households that have children and at least one formal worker will remain on the old contributory regime, receiving US $5 a month per child, provided their total income is below US $870 despite household size.

The monthly transfer has been significantly augmented with respect to the former transfer. At the same time, the new stipend increases when children attend secondary school. The base benefit is at 700$ (US $31) a month for the first child that attends primary school and 1000$ (US $45) for the first child that attends secondary school. In order to avoid undesired effects on fertility, an equivalence scale of 0.6 is used to calculate benefits at the household level. The total benefit per household can then be calculated as:

$$\mathrm{Th} = 700.(\mathrm{under18})^{\wedge 0.6} + (300).(\mathrm{under18\,s})^{\wedge 0.6}$$

where under18 is the number of children aged 0–17 in the household, under18 s is the number of children that attend secondary school and whose age is lower than 18; and 0.6 is the equivalence scale. The value of the transfer is adjusted quarterly according to the evolution of retail prices.

2.3 Baseline Scenario

The administration that has governed Uruguay since March 2005 implemented a new yet temporary programme from May 2005 to December 2007. It was called *Plan de Atención Nacional a la Emergencia Social* (PANES) and aimed at alleviating poverty and strengthening household earnings capacity. Its target beneficiaries were the first quintile of the population under the poverty line, which represented approximately 8% of the whole population. This temporary programme included an income transfer of US $65 a month per household, among other components.

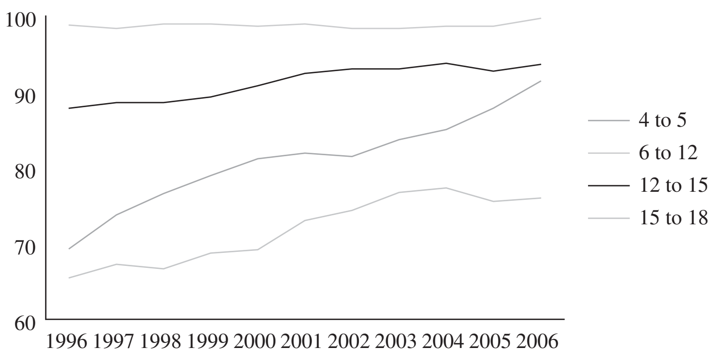
Our simulations are based on micro-data coming from the 2006 household survey (Encuesta Nacional de Hogares Ampliada). During that year, some households were receiving the monthly stipend corresponding to *Ingreso Ciudadano*. As a first stage of the analysis, we simulated our baseline scenario in order to reflect the situation that would prevail if *Ingreso Ciudadano* was removed. We took this option due to the temporary nature of that cash transfer. Our simulated baseline scenario thus includes the old *Asignaciones Familiares* and does not include *Ingreso Ciudadano.* This way, the effect of the new *Asignaciones Familiares* can be isolated.

3 Poverty, School Attendance and Child Work Before the Reform

Households with children are the group that experiences higher income deprivation in Uruguay. Previous research has shown that this outcome is closely linked with increasing labour earnings inequality and rising unemployment, which mainly hit low-skilled workers (UNDP, 2005; Amarante et al., 2004). Meanwhile, the better situation of elder adults is related to the almost universal pensions system that was established in Uruguay in 1950 and to the 1990s constitutional amendment that indexed pensions to increases in average wages.

Until 2008 a significant proportion of children aged 0–18 living in poor households did not receive the old *Asignaciones Familiares* stipend, as long as the income threshold of the non-contributive benefit was significantly lower than the poverty line. The new *Asignaciones Familiares* aims at covering all children living in poor households, provided they satisfy the programme's conditionalities (Table 14).

We now turn to child school attendance to show the situation before the reform. By the middle of the 1990s the government started to reform the educational system with three main objectives: expand coverage to children aged 3–5 years old, improve secondary school attendance and increase the number of hours children spent in primary school (the ordinary system consists of 4 h per day). As a result, attendance rates for children aged 4 and 5 increased significantly (Fig. 1).



1 Attendance rates in the educational system by age group. Uruguay, 1996–2006

Attendance rates at primary school have been almost universal since the early decades of the twentieth century and have been steady for a long time. Still, repetition is a severe problem, particularly in the first year where rates are stagnant at around 25% and mainly concentrated in low-income groups.

The main failure of the Uruguayan educational system can be seen at the secondary school level, where drop-out rates have been steady since the 1980s. As a result, average years of schooling among adults have been stagnant at around 8.6

and Uruguay's early achievements in this dimension have already been surpassed by other Latin American countries (UNDP, 2008).

Drop-outs are mostly boys at the lower income strata, who also show higher labour market participation rates (Bucheli and Casacuberta, 2000).[2] This persistent problem is one of the reasons for reformulating *Asignaciones Familiares* and increasing the monthly stipend for those who attend secondary school. Hence, both in terms of income poverty and educational achievement, children (especially those aged 12–18) constitute a vulnerable group.

Some of the reasons for dropping-out of school clearly refer to income shortages. Moreover, the decision regarding school attendance and work is probably a joint decision, as previous research suggests (see Bucheli and Casacuberta, 2000). We present the corresponding information for children aged 14–17, as long as the household survey gathers information on labour force participation for individuals aged 14 years old or more (Table 1). The educational attainment of adults in poor and indigent households is clearly lower than the average for the age group, probably reflecting the inter-generational transmission of poverty. The presence of Afro-Uruguayans is remarkably higher among children coming from the lower income strata. This issue has not been assessed in the context of poverty studies, but is relevant as long as it can be linked to discrimination.

The number of children that neither attend school nor work is surprisingly high, reaching 24% in poor households and 34% in indigent ones. In order to deepen our analysis for this group, we assessed the information from a special module run with the 2006 household survey during one quarter. This module gathered information on market and domestic work for children aged 6–17. Hence, the work status of children aged 14–17 can be classified using two criteria: the traditional one used for working age population and another one based on the special module.

Crosstabs indicate that most of the children aged 14–17 that are labelled under the not study/not work condition on the basis of the traditional questions do, in fact, work (almost 44%, in fact) as they carry out domestic chores. As expected, the incidence of domestic work among the group of young people that do not work nor study is considerably higher among girls than among boys (26, 5 versus 62, 5%) (Table 15). This evidence is consistent with findings for other countries showing that traditional questions on activity and work for working age population are not able to capture teenage work in a proper way.

This evidence on the prevalence of domestic work among those who either do not study or work is important in terms of our simulation counterfactuals. Unfortunately, it is difficult to value domestic work, as our data does not include any information about the specific tasks, periods, and hours of work involved, among other aspects. In our simulations, opportunity costs for these children correspond to predicted market wages, and this will be shown later in our study.

[2] During the crisis, attendance rates in secondary school increased.

Table 1 Socioeconomic characteristics of children aged 14–17 by income group in Uruguay, 2006

Income group	Average years of schooling of adults in the household	Monthly per capita income in pesos (1 US dollar = 22.6 pesos)	Afro Uruguayan	Beneficiaries of *Asignaciones Familiares*	Attends school	Attends school and works	Only works	Does not attend school and does not work
Hh. under the poverty line	6.94	1943	18.5%	70%	62%	5%	9%	24%
First income quintile	6.48	1012	23.2%	72%	60%	5%	9%	26%
Hh. under the indigence line	6.41	966	27.3%	57%	52%	5%	9%	34%
All households	8.65	5534	11.3%	62%	74%	3%	6%	15%

Source: own calculations based on household surveys and population estimates

4 The Microsimulation Model

Although predicting the effects of social programmes is an old challenge for economists, the development of techniques such as microsimulations applied to social policies is relatively new. The increasing concern for poverty and distributional impacts of public policies has led to the extension of this methodology, which allows for the full exploitation of the information contained in large datasets such as household surveys. Although the literature on ex-post evaluations of conditional cash transfers is abundant, ex-ante analysis has not been an extended practice. A well-known attempt is the ex-ante evaluation of *Bolsa Escola* in Brazil (Bourguignon, Ferreira and Leite, 2002), which is also a key methodological reference for this research.

Unless results are analysed in a broader simulation framework, estimations provided by microsimulations do not account for general equilibrium effects and yield only partial effects. In the case of large scale programmes as the one analysed in this chapter, this can constitute an important limitation.

Microsimulations can be based on structural models or can result from the estimation of reduced form equations that are indirectly related to a theoretical model. In the first case, the estimated equations are rooted on rigorous theoretical models. This approach is difficult to undertake, as it usually involves many econometric problems and data requirements. The second approach is the strategy followed in this chapter.

Following Bourguignon, Ferreira and Leite (2002) (BFL from now on), we consider two dimensions as endogenous in a first step: child labour supply and child school attendance. In a second step, we depart from the BFL framework and analyse the behavioural response of adult labour supply. Family composition and fertility decisions are considered as exogenous and independent of the conditional cash transfer. In what follows we discuss the modelling of individual behaviour for each of the endogenous dimensions.

Considering that one of the objectives of the programme is to foster school attendance at the secondary level and given that primary level attendance is almost universal in Uruguay, this part focuses on changes in the behaviour of children aged 14–17. Child labour supply has been examined theoretically (for example, Grootaer and Kanbur, 1995) and has been widely addressed in empirical research (see, for example, Ravallion and Wodon, 2000; Arat, 2002; and Chakraborty and Mausumi, 2005). Following BFL, we develop a discrete labour supply model, where a child decides to either study, work or carry out both activities. This specification is suitable for developing countries where it is usual for children at these ages to be involved in both activities.

The school attendance decision is taken at the household level, and can be modelled as a discrete variable S_i:[3]

[3] In this setting we do not consider separately those youngsters who do not work nor attend school. To differentiate them, the choice variable should have taken four values, and this may generate some problems in the econometric estimation.

$S_i = 0$ if i does not attend school
$S_i = 1$ if i works and attends school
$S_i = 2$ if i attends school and does not work (full-time study)

BFL estimate a multinomial model for this decision, with each i representing an optimal choice according to:

$$S_i = k \text{ if } S_k(.) > S_j(.) \quad \text{for all } j \neq k \tag{1}$$

The schooling decision is then a function of a set of variables:

$$S_j(X_i, H_i, Y_{ij,} v_{ij}) \tag{2}$$

where X_i represents specific characteristics of individual i (age, sex, schooling, etc.), H_i represents household characteristics (type of household, parental education, etc), Y_{ij} represents total household income when choosing j and v_{ij} is the disturbance term (iid).

Household income is the sum of children's income (y_{ij}) and income from the remaining household members (Y_{-i}). The set of non-income variables X_i and H_i can be combined into Z_i, and the linearization of the model becomes the random utility representation for the household of child i under the schooling choice j:[4]

$$U_{ij} = \gamma_j Z_i + \alpha_j(Y_{-i} + y_{ij}) + v_{ij} \tag{3}$$

Assuming that potential earnings for child i are observable (w_i), the contribution of the child to household income, y_{ij}, becomes:

$$y_{i0} = Kw_i \tag{4}$$

$$y_{i1} = My_{i0} = MKw_i \tag{5}$$

$$y_{i2} = Dy_{i0} = DKw_i \tag{6}$$

meaning that if the child only works and does not attend school ($S_i = 0$) gets a fraction K of his potential earnings, if he works and attends school ($S_i = 1$), he gets a fraction MK of his potential earnings, and if he only goes to school ($S_i = 2$) he may contribute to domestic production for a fraction DK of his potential market earnings. This last equation implies including the contribution of children to the household's income through domestic work.

Assuming that wages are determined in accordance with the standard human capital model, earnings w_i can be modelled as:

$$\log w_i = \delta X_i + m.1\{S_i = 1\} + u_i \tag{7}$$

[4] Although the linear utility function is easier to handle and can be empirically treated on the basis of discrete choice models, its adoption assumes a risk neutrality behaviour.

where X_i is the standard set of individual characteristics, u_i is a random term that represents unobserved earnings determinants and the second term (indicator function 1) reflects that earnings of a child under option $S_i = 1$ may be lower because some time is spent at school.

Combining these equations, the utility representation of the household of child i under each schooling option becomes:

$$U_{i0} = \gamma_0 Zi + \alpha_0 Y_{-i} + \beta_0 w_{i0} + v_{i0} \quad (8)$$

$$U_{i1} = \gamma_1 Zi + \alpha_1 Y_{-i} + \beta_1 w_{i1} + v_{i1} \quad (9)$$

$$U_{i2} = \gamma_2 Zi + \alpha_2 Y_{-i} + \beta_2 w_{i2} + v_{i2} \quad (10)$$

with

$$\beta_0 = \alpha_0 K; \beta_1 = \alpha_1 MK; \beta_2 = \alpha_2 DK. \quad (11)$$

In this way we get a complete simulation model. Assuming exponentially distributed errors, this model becomes a multinomial logit and child's occupational type selected by household i is

$$j^* = \text{Arg max}[U_i(j)] \quad (12)$$

The model can be used for microsimulation by looking at the effect of an exogenous variation of household income under schooling options $j = 1, 2$. What remains is obtaining estimates of α, β, γ and v_{ij}

In a discrete choice model estimation, since the coefficients are identified only relative to a certain choice category ($\alpha_\varphi - \alpha_0$; $\beta_\varphi - \beta_0$; $\gamma_\varphi - \gamma_0$), it is necessary to identify the three components (i.e.: α_0, $\alpha_1 \alpha \nu \delta \alpha_2$) as long as the cash transfer is state dependent, meaning that t income is asymmetric across alternatives.

If we name $\hat{\alpha}_j$ and $\hat{b}_j$ the coefficients estimated from the multinomial model, then:

$$\alpha_1 - \alpha_0 = \hat{\alpha}_1 \quad (13)$$

$$\alpha_2 - \alpha_0 = \hat{\alpha}_2 \quad (14)$$

$$\alpha_1 MK - \alpha_0 K = \hat{b}_1 \quad (15)$$

$$\alpha_2 DK - \alpha_0 K = \hat{b}_2 \quad (16)$$

BFL propose to arbitrarily set a value for K or for D. This strategy allows for identifying all the parameters, as M is identified from the earnings equation. Their identifying assumption is that $K = 1$, which means that children working on the market and not going to school have zero domestic production. So, the estimates can be transformed into the structural parameters of the model:

$$\alpha_1 = \frac{\hat{a}_1 - \hat{b}_1}{1 - M} \tag{17}$$

and

$$\alpha_2 = \alpha_1 + \hat{a}_2 - \hat{a}_1 \tag{18}$$

The set of residuals cannot be observed or precisely estimated, but for each i the set of residuals v_{i0}, v_{i1} and v_{i2} is expected to belong to a certain interval, such that given the parameter estimates and the individual characteristics they are consistent with the actual choice. For instance, if observation i has made choice 1, it must be the case that:

$$Z\gamma_1 + Y_{-i}\hat{a}_1 + \hat{b}_1 w_1 + (v_{i1} - v_{i0}) > Sup\left[0, Z_i\gamma_2 + Y_{-i}\hat{a}_2 + \hat{b}_2 w_i + (v_{i2} - v_{i0})\right] \tag{19}$$

Disturbance terms $v_{ij-}v_{i0}$ must be drawn to satisfy this inequality.

We also need to estimate potential earnings for each child, w_i. Following BFL, this estimation uses OLS, and random terms u_i for non-working children will be generated by drawing in the distribution generated by the residuals of the OLS estimation. Potential selection bias in the estimation of wage equations is not addressed.

Once the model is completely identified, the cash transfer impact can be simulated. Supposing that the transfer amount is T_i and we incorporate means test (assuming that the household is eligible if household income is not greater than Y^0), our model leads to choosing the alternative with maximum utility among the following conditional cases:

$$U_{i0} = \gamma_0 Zi + \alpha_0 Y_{-i} + \beta_0 w_{i0} + v_{i0} \tag{20}$$

$$U_{i1} = \gamma_1 Zi + \alpha_1 Y_{-i} + \beta_1 w_{i1} + v_{i1} \quad \text{if} \quad Y_{-i} + Mw_i > Y^0 \tag{21}$$

$$U_{i1} = \gamma_1 Zi + \alpha_1 (Y_{-i} + T) + \beta_1 w_{i1} + v_{i1} \quad \text{if} \quad Y_{-i} + Mw_i \leq Y^0 \tag{22}$$

$$U_{i2} = \gamma_2 Zi + \alpha_2 (Y_{-i}) + \beta_2 w_{i2} + v_{i2} \quad \text{if} \quad Y_{-i} > Y^0 \tag{23}$$

$$U_{i2} = \gamma_2 Zi + \alpha_2 (Y_{-i} + T) + \beta_2 w_{i2} + v_{i2} \quad \text{if} \quad Y_{-i} \leq Y^0 \tag{24}$$

This general framework can be used to evaluate the effects of modifying the amount of the transfer, such as changing the means test. Nevertheless, it must be kept in mind that the schooling decision is reflected in a very simple way that entails the following assumptions (BFL, 2002):

1. the problem of having more than one child in the same household and the simultaneity of the decision is not considered. This implies assuming that all households have only one child from a behavioural point of view, so a transfer ceiling per household cannot be introduced.

2. households behave as a unit and income is assumed to be pooled. The issue of how the decision about child's time allocation is taken within the household is not addressed.
3. the decision on child schooling is taken once occupational decisions of adults in the household have already been made.
4. non-child income is also exogenous as it is not affected by the presence of the means-tested transfer.[5] In this aspect, as stated before, we go beyond BFL methodology and model adult labour supply and its response to different transfer settings.
5. household structure is exogenous.
6. cross-sectional income effects estimated using a household survey coincide with the income effects that will be produced by the programme under study. This means that income effects over time for a given agent are the same as the effect of cross-sectional incomes.

The first and second assumptions are very restrictive for our purposes, considering the scheme of benefits that we are analysing. In our simulation the conditional cash transfer design involves equivalence scales, and decisions regarding one of the children in those households with more than one child can thus affect the other children in the household. This may be an important issue in the process of decision-making. We assume that all eligible children under 14 receive the transfer. This is a reasonable assumption as most children aged 6–13 fulfil the condition of school attendance. For children aged 14–17, we consider the marginal contribution to total income of each child, taking into account each child's decision in a separate way.

We also estimate the behavioural responses of adult's labour supply, in an attempt to loosen assumptions 3 and 4. Our main results are presented in the next section. Another departure from BFL methodology is that we estimate a dogit model instead of a multinomial logit.

5 Main Results

In this section we describe the results obtained from the regression analysis (4.1) and then focus on microsimulated changes on school attendance (4.2), poverty (4.3) and inequality (4.4). We also analyse the reform's potential effects on labour supply (4.5).

These simulations are based on micro-data coming from the 2006 household survey (*Encuesta Nacional de Hogares Ampliada*) that gathered information for 85,316 households in urban and rural areas.

[5] BFL argue that assuming that the presence of the means test does not affect labour supply of adults in the household might not be so restricting if means test is based on some score based proxy for permanent income and not on current income.

5.1 Basic Equations Estimates

In order to microsimulate the programme's impact on poverty, inequality, school assistance and child work, we estimated a wage equation and a discrete choice model to predict the probability of study and work for children (Table 2). The estimation of a wage equation was required to obtain parameter M to carry out the microsimulation and to predict potential earnings that were plugged into the estimation of the schooling decision equation. As is the case with BFL, some attempts to correct for selection bias were done, but no appropriate instruments were found.

Table 2 Wage equation estimates. Explained variable: logarithm of monthly earnings. Workers aged 14–20 years old

Variables	Coefficient	T statistic
Region 2: major urban areas except Montevideo	−0.074	(2.69)[a]
Region3: minor urban areas	0.084	(2.37)[b]
Region 4: rural areas	0.140	(4.45)[a]
Sex (0 = female; 1 = male)	0.396	(16.49)[a]
Age = 15	0.230	(2.67)[a]
Age = 16	0.423	(5.32)[a]
Age = 17	0.565	(7.40)[a]
Age = 18	0.710	(9.23)[a]
Age = 19	0.872	(11.41)[a]
Age = 20	0.983	(12.91)[a]
Schooling = secondary school	0.175	(6.38)[a]
Schooling = technical school	0.051	(1.25)
Schooling = tertiary	−0.057	(0.91)
Ethnic group (white = 0; African Urug. = 1)	−0.126	(3.80)[a]
Average income by census tract	0.489	(10.86)[a]
Study and work = 1	−0.455	(9.81)[a]
Constant	2488	(6.41)[a]
Observations	6097	
R-squared	0.21	

Robust t statistics in parentheses.
[a] significant at 1%.
[b] significant at 5%.
Source: own calculations based on household surveys.

The dependent variable is the log of monthly earnings. Explanatory variables include region, sex, schooling and schooling squared, and a dummy variable indicating if the child works and studies. Additionally, we included dummy variables indicating single ages. Although our interest group is restricted to children with ages 14–17, we estimated the wage equation for those aged 14–20 to strengthen its explanatory power. Other specifications were also attempted such as quantilic regressions, but these estimations presented weaker goodness of fit than OLS estimations, so we maintained the OLS.

Regional dummies indicate Montevideo (omitted), major urban areas, minor urban areas and rural zones. Earnings of children living in major urban areas are lower than those living in the remaining regions. In turn, children living in rural zones have higher earnings conditional on the remaining covariates, probably reflecting a higher number of working hours.

As it has been shown in studies assessing gender differentials, monthly wages for male earnings are approximately 40% higher than female ones'. These differences can result from either hourly earnings or from differences in the number of hours at work. As expected, age shows a non-linear and increasing effect on earnings.

Schooling was reflected by including dummies on maximum educational level, considering primary school or less (omitted), secondary school, technical school and tertiary education. Signs show a very different pattern respective to the one observed in wage equations for adults since earnings of children that reached secondary school are higher than that of the remaining groups. Technical and tertiary schooling do not present significant differences in relation to the omitted category. In the latter case, this can be related to the fact that those attending tertiary school tend to work in part-time jobs, especially at these ages.

Having African ancestors reduces child earnings around 12%. It remains to be assessed in further studies whether it can reflect discrimination or differences in hours of work. As it was shown at the beginning of this document, the proportion of self-declared African Uruguayans is around 27% among the poor aged 14–17 and the figures are similar when considering those aged 14–20.

School attendance is reflected in a dummy variable that is significant and presents the expected sign suggesting that most of the differences in earnings are related to the amount of time allocated to work.

The next step was to obtain predicted wages for children aged 14–17 by computing the observed part of the prediction on the basis of the regression estimates, and obtaining the corresponding residuals. Residuals were obtained by bootstrapping the wage equation several times and computing the corresponding residuals until we obtained the number of cases aged 14–17 in our sample (17,698). These residuals were randomly merged with the observations corresponding to each child.

The following step then consisted of estimating a multinomial logit model considering three different situations: the child does not study (0), the child studies and does not work (1) and the child studies and works (2). Separate equations were estimated for boys and girls,[6] showing a reasonable adjustment.

The potentially relevant drawback of multinomial models is the underlying assumption of independence from irrelevant alternatives (Hausman and McFadden, 1984). In the context of the model estimated in this chapter, it implies that the probability of choosing "only studies" relative to "only works" is independent of the possibility of "studies and works" simultaneously. Hausman's test results showed that the null hypothesis was not rejected and the multinomial estimation should not be carried out. The results of the multinomial estimation and the corresponding Hausman test are depicted in Tables 16 and 17. Following Harris and Duncan (2002), we estimated a dogit model (see Annex 2), compatible with the utility function assumed in Section 4 but does not require the assumption of irrelevance of alternatives (Table 3).

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[6] Those who do not study nor work are included in the first group.

Table 3 Dogit estimation results. Children aged 14–17

	Boys						Girls					
	Only studies (1)			Studies and works (2)			Only studies (1)			Studies and works (2)		
Variables	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Per capita household income	0.00003	0.0000	0.0	0.00001	0.0000	0.0	0.00004	6.0E-06	0.0	0.00002	0.0000	0.0
Child’s predicted wage	−0.0002	0.0000	0.0	−0.0007	0.0001	0.0	−0.00022	3.8E-05	0.0	−0.0007	0.0001	0.0
Average schooling of adults	0.1358	0.0190	0.0	0.0148	0.0284	0.6	0.13609	2.3E-02	0.0	0.0728	0.0300	0.0
Log household size	−0.7575	0.1210	0.0	−0.6078	0.2020	0.0	−1.05103	1.3E-01	0.0	−0.4483	0.2000	0.0
Child’s years of school	1.0944	0.0544	0.0	1.2820	0.0740	0.0	1.11941	5.5E-02	0.0	1.2825	0.0700	0.0
Ranking of the child	1.1029	0.1115	0.0	0.8493	0.1992	0.0	1.17321	1.2E-01	0.0	0.6822	0.2000	0.0
Region 2	−0.2258	0.0931	0.0	−0.1637	0.1570	0.3	−0.03670	1.0E-01	0.7	0.1271	0.2000	0.4
Region 3	−0.6684	0.1601	0.0	−0.3613	0.2565	0.2	−0.15429	1.8E-01	0.4	−0.1769	0.3000	0.6
Region 4	−1.0844	0.1778	0.0	−0.0139	0.2565	1.0	−0.69912	1.8E-01	0.0	−0.4977	0.3000	0.1
Constant	−8.6763	0.4724	0.0	−10.7770	0.7189	0.0	−8.82941	5.2E-01	0.0	−12.1460	0.7000	0.0
Wald Statistic	541.2						547,938					
Observations	8,919						8,779					

Source: own calculations based on household survey

Explanatory variables included household and child characteristics. Income was included using two different variables. The first one reflects per capita household income excluding child earnings, and shows a positive effect in both groups with respect to the omitted one. There are no significant differences by gender. The second variable included is the prediction of child's potential earnings obtained from the first equation. Estimates show a negative relation between the probability of studying or studying and working relative to not studying. Gender differences are also minor.

Educational attainment of adults, measured by their average years of schooling, is positively correlated with full-time school attendance and with study and work, showing a separate effect from income. Differences among boys and girls appear for group 2 where the coefficient for girls is twice the one of boys. This difference may reflect that the option of working and studying for girls is associated with households that present a clearly higher educational attainment (though lower than group 1) relative to the omitted group, whereas in the case of boys these differences are not clear. Child's completed years of schooling is positively correlated with the probability of being in groups 1 or 2. Coefficients are higher for girls in the two groups.

A negative association with household size was also found. At the same time, the ranking of the child shows a strong and positive association with present schooling: the higher the rank of the child, the higher the probability of studying. Regional dummies were significant for group 1 for boys and girls.

Once these equations were estimated, we computed parameters α_0, α_1 and α_2, M, K and D on the basis of the formula presented in the previous section (Table 4). The resulting α parameters are very similar by gender.

Table 4 Micro simulation parameters

	Boys	Girls
α_1	0.00187	0.00205
α_1	0.00190	0.00208
α_2	0.00189	0.00207
M	0.63433	0.63433
D	0.87057	0.87817
K (by assumption)	1	1

Source: own calculations based on household survey

On the basis of these parameters, we computed the differentials on child utility for non-study, full-time study and study and work, and obtained the predicted changes in schooling. To obtain our final predictions, residuals were randomly sampled from a Gumbell distribution. Residuals were chosen to be consistent with the actual choice of the individual in the baseline (Equation 19).

As mentioned before, ex-ante impact evaluations yield results that can provide an idea of what will be obtained once the programme is fully incepted. The results presented in the next sections should be understood in this perspective. Once ex-post evaluation results are available, the comparison among these could yield very interesting insights.

5.2 Potential Effects on Teenage Schooling

In order to microsimulate child school attendance, we considered three scenarios involving similar costs. In each case, results were compared to our simulated baseline situation, which does not consider the amount of the transfer of *Ingreso Ciudadano*. Although the transfer covers children aged 0–17, the focus of this section on teenage schooling comes from the fact that primary schooling is almost universal in Uruguay and high school drop-out rates are around 40%.

Scenario 1 is the new *Asignaciones Familiares* regime recently implemented. Scenario 2 considers a per capita transfer of 400$ for children aged 0–12 years and 900$ for those aged 13 and 17 years. The aim of this alternative is to assess the effect of the equivalence scale stated in the first scenario and to increase the premium for children attending secondary school relative to the first scenario. Scenario 3 considers a per capita amount of 500$ for all children, to evaluate the effects of removing the additional incentive for secondary schooling (Table 5).

Table 5 Different designs of the new *Asignaciones Familiares* programme

Scenario 1	Th = 700\$.(under18)$^{\wedge 0.6}$ + 300\$.(under18 s)$^{\wedge 0.6}$
Scenario 2	Th = 400\$.(under18)$^{+}$900\$.(under18 s)
Scenario 3	500$ per child

Note: 1 US dollar = 20$
Source: own calculations based on household survey

Compared to the baseline situation, all scenarios show a considerable increase in school attendance (Table 6). The change in attendance rates for children who attend school and do not work varies between 6 and 8% points, with the change being higher for girls than for boys. As female enrolment rates were higher than male's before programme implementation, the gap is widened by the transfer. Compared to the actual situation in 2006, the increase in attendance rate is between 1 and 3% points. This indicates that both the removal of *Ingreso Ciudadano* and the inception of the new *Asignaciones Familiares* have a net positive (but moderate) effect on school attendance.

The second scenario, which consists of a higher per capita transfer for children in secondary school and does not include equivalence scales, yields more promising results in terms of school attendance achievements, although differences among the three scenarios are moderate.

Changes in the work status of children are not estimated. In this setting the omitted group includes all children that are not currently attending school, despite their work status.

The transition matrix between labour/school assistance status before and after the policy change shows that around 28.5% of the children who are out of the educational system would return to study under scenario 1, with this proportion being higher for girls (34.9%) than for boys (23.7%) (Table 7). In this scenario, only 0.4% of those children that work and study would leave their present occupation to study full time. This transition matrix also indicates that favourable movements (from not attending to attending or attending and working) are maximized under scenario 2.

Table 6 Predicted child status by scenario

	Only studies (1)			Studies and works (2)			Drop-outs (0)			School attendance (1+2)		
Scenario	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
2006	69.6	79.3	74.4	5.9	3.6	4.8	24.5	17.1	20.8	75.5	82.9	79.2
Baseline (2006 without Ingreso Ciudadano)	65.2	73.8	69.5	4.8	3.3	4.0	30.0	22.9	26.5	70.0	77.1	73.5
Scenario 1	71.2	81.7	76.4	5.9	3.5	4.7	22.9	14.9	18.9	77.1	85.2	81.1
Scenario 2	72.7	82.9	77.8	6.0	3.5	4.8	21.3	13.5	17.4	78.7	86.5	82.6
Scenario 3	70.7	80.9	75.8	5.8	3.5	4.7	23.4	15.6	19.6	76.6	84.4	80.5

Source: own calculations based on household survey

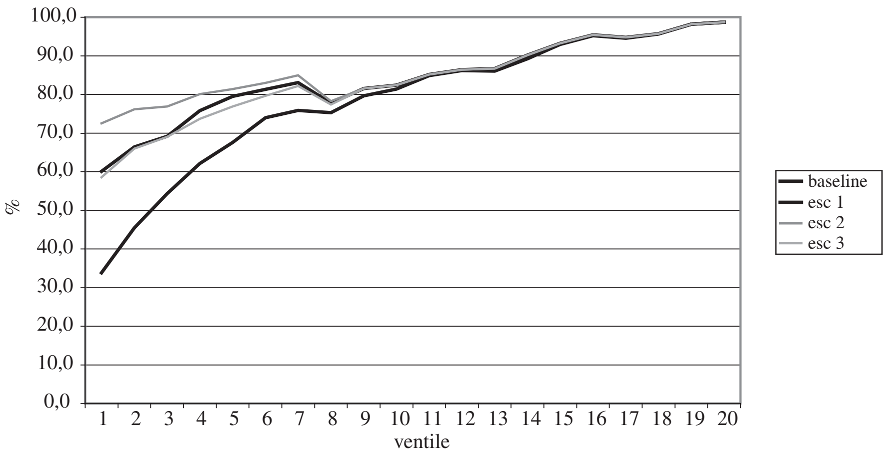
Table 7 Simulated effects of *Asignaciones Familiares* on schooling and working status by scenario

	Baseline situation								
	Boys			Girls			Total		
	Not attending	Attending	Attending and working	Not attending	Attending	Attending and working	Not attending	Attending	Attending and working
Scenario 1									
Not attending	76.3	0	0	65.1	0	0	71.5	0	0
Attending	20.1	100	0.2	33.8	100	0.8	26	100	0.4
Attending and working	3.6	0	99.8	1.1	0	99.2	2.5	0	99.6
Scenario 2									
Not attending	71	0	0	59.2	0	0	66	0	0
Attending	24.9	100	0.2	39.5	100	0.6	31.2	100	0.3
Attending and working	4.1	0	99.8	1.2	0.6	99.4	2.9	0	99.7
Scenario 3									
Not attending	78.1	0	0	68.2	0	0	73.9	0	0
Attending	18.5	100	0.2	30.8	100	0	23.7	100	0.1
Attending and working	3.4	0	99.8	1	0	100	2.4	0	99.9

Source: own calculations based on household survey

Our results are very similar to those obtained by BFL for *Bolsa Escola*. They report that one of every three children aged 10–15 who are presently not enrolled in school would get enough incentive from *Bolsa Escola* to change occupational status and go to school, a figure very close to our 34.1% under scenario 2. Although our target population is older and has higher opportunity costs, the conditional cash transfer exerts a similar and significant effect on school attendance in the two programmes.

In all scenarios the increase in school attendance is progressive, as changes are higher for children belonging to the lower income strata. This result can be driven by the fact that at low-income levels, drop-out rates are higher and simultaneously, the incentive is bigger if measured by the share of the transfer compared to household income. Scenarios 1 and 3 yield similar results, whereas under scenario 2 changes are higher for children from poorer households (Fig. 2). The progress in school attendance also emerges when the cumulative pattern of children that attend school in the baseline and in the different scenarios is compared to the cumulative distribution of children aged 14–17. Lines representing the three scenarios are indistinguishable among themselves but lie in-between the distribution of children in the pre-reform situation (Fig. 6).



2 Attendance rates by scenario and income ventile. Children aged 14–17

Results presented up to now reflect that the equivalence scale used in scenario 1 reduces the additional monthly stipend received by the child and hence, the incentive to attend school is higher under scenario 2. We analysed the distribution of children by income strata using different equivalence scales (0.4, 0.6, 0.8 and 1). The effect of the adjustment is considerably larger in the lower income strata, as larger households are placed there. Hence, the incentive to schooling provided by scenario 2 is higher in the first 6 ventiles and this explains differences across schooling behaviour by scenario. A case for increasing the equivalence scale, or even not including this adjustment, could be done on this basis. Nevertheless, it must be kept in mind that we are not taking into account the potential effects on fertility, which could lead to an increase in the size of poorer households in the medium term, as a response to the transfer.

Under this transfer scheme, changes in teenage behaviour regarding school attendance can be attributed to different factors. There is a pure income effect due to the increase in household income because of transfers given to children younger than 14. There is another direct incentive given by the transfer that strictly corresponds to the teenager. Our model does not allow disentangling these effects due to the income pooling assumption in the schooling equation, where the decision depends on total household income, despite the beneficiary of the transfer. In this setting, the effect due to the transfer to siblings equalizes the effect due to the transfer of the teenager, and results are thus unchanged whether the target population of the transfer is constituted by the teenager or by his/her younger siblings. This is a limitation of our model, and further research should try to illustrate modelling of these effects.

5.3 Potential Effects on Poverty

Results of the programme's effects on inequality and poverty include all children aged 0–17 and also consider two additional static scenarios. The first one deems that the cash transfer has no effect on schooling, and child schooling remains the same as present. This can be interpreted either as the removal of the transfer's conditionality or as a full take-up scenario. The second scenario considers that, as a result of the transfer, all children aged 6–17 attend school.

Simulation results indicate that the reform significantly reduces extreme poverty. The transfer scheme's inception reduces indigence incidence between 40 and 50% in overall households and the reductions of its intensity and severity are around 50 and 65%, respectively, again reflecting a progressive pattern (Table 8). As before, scenarios 1 and 3 show similar effects, whereas under scenario 2 the reduction in extreme poverty is a bit higher. Although indigence is low in Uruguay, the finding that *Asignaciones Familiares* significantly contributes to lower it is relevant since the removal of *Ingreso Ciudadano* could have led to an important income loss for those households situated at the bottom of the income distribution. Changes in extreme poverty indexes are in all cases statistically significant.

Poverty incidence decreases around 1 percentage point for the population as a whole and 2 points for households with children (Table 9). Again, the reduction of the intensity (around 13%) and severity (around 21%) of poverty is higher, reflecting a progressive pattern. The three scenarios yield similar results.

The transfer's progressive pattern is shown in Fig. 3, where the distance of the FGT curves increases with the poverty aversion parameter despite the poverty threshold. As long as curves corresponding to scenarios 1, 2 and 3 overlap, we only present microsimulations corresponding to scenario 1, the two static scenarios and the baseline curve. In this case, differences by scenario increase with the parameter of poverty aversion, showing that the conditions mainly affect poorer households.

Table 8 Extreme poverty indexes by scenario and presence of children in the household. Urban areas

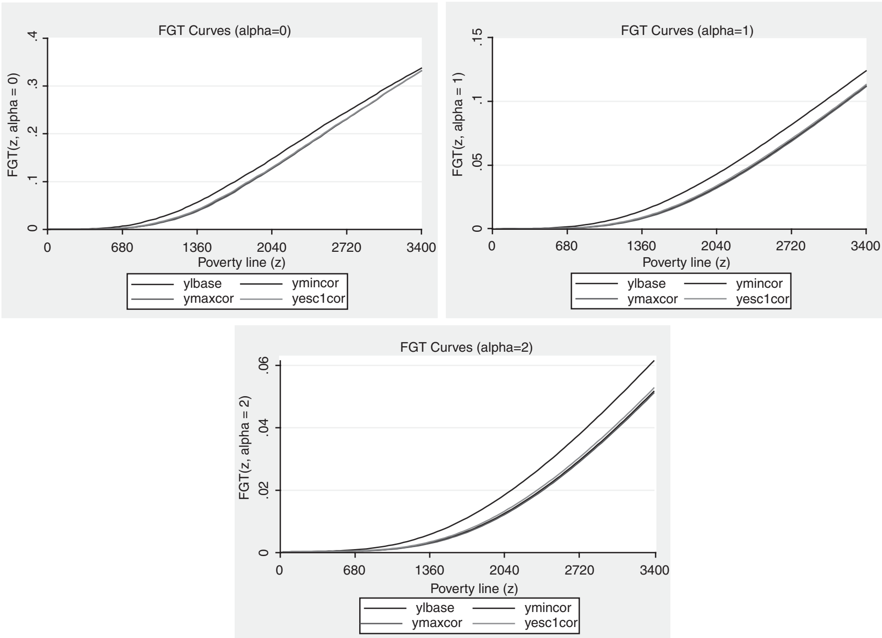
	FGT 0				FGT 1				FGT 2			
	Est.	STD	LB	UB	Est.	STD	LB	UB	Est.	STD	LB	UB
All households												
Baseline	0.026	0.000	0.025	0.026	0.006	0.000	0.006	0.007	0.003	0.000	0.002	0.003
Static simulation												
No change in schooling	0.015	0.000	0.014	0.015	0.003	0.000	0.003	0.003	0.001	0.000	0.001	0.001
All children attend school	0.013	0.000	0.013	0.014	0.004	0.000	0.004	0.005	0.001	0.000	0.001	0.001
Behavioural simulation												
Scenario 1	0.016	0.000	0.015	0.016	0.004	0.000	0.003	0.004	0.001	0.000	0.001	0.002
Scenario 2	0.014	0.000	0.013	0.014	0.003	0.000	0.003	0.003	0.001	0.000	0.001	0.001
Scenario 3	0.016	0.000	0.015	0.016	0.003	0.000	0.003	0.004	0.001	0.000	0.001	0.002
Households with children												
Baseline	0.040	0.001	0.039	0.041	0.010	0.000	0.009	0.010	0.004	0.000	0.004	0.004
Static simulation												
No change in schooling	0.022	0.000	0.021	0.023	0.005	0.000	0.004	0.005	0.002	0.000	0.002	0.002
All children attend school	0.020	0.000	0.019	0.021	0.004	0.000	0.004	0.005	0.002	0.000	0.002	0.002
Behavioural simulation												
Scenario 1	0.024	0.000	0.023	0.025	0.005	0.000	0.005	0.006	0.002	0.000	0.002	0.002
Scenario 2	0.021	0.000	0.020	0.022	0.005	0.000	0.004	0.005	0.002	0.000	0.002	0.002
Scenario 3	0.024	0.000	0.023	0.025	0.005	0.000	0.005	0.005	0.002	0.000	0.002	0.002

Source: own calculations based on household surveys

Table 9 Poverty indexes by scenario and presence of children in the household. Urban areas

	FGT 0				FGT 1				FGT 2			
	Est.	STD	LB	UB	Est.	STD	LB	UB	Est.	STD	LB	UB
All households												
Baseline	0.258	0.001	0.256	0.260	0.088	0.000	0.087	0.089	0.042	0.000	0.041	0.042
Static simulation												
No change in schooling	0.245	0.001	0.243	0.248	0.076	0.000	0.075	0.077	0.033	0.000	0.033	0.034
All children attend school	0.245	0.001	0.243	0.247	0.075	0.000	0.074	0.076	0.033	0.000	0.032	0.033
Behavioural simulation												
Scenario 1	0.246	0.001	0.244	0.248	0.077	0.000	0.076	0.078	0.034	0.000	0.034	0.035
Scenario 2	0.245	0.001	0.243	0.247	0.075	0.000	0.075	0.076	0.033	0.000	0.033	0.033
Scenario 3	0.247	0.001	0.245	0.249	0.078	0.000	0.077	0.078	0.034	0.000	0.034	0.035
Households with children												
Baseline	0.379	0.002	0.376	0.383	0.132	0.001	0.131	0.134	0.064	0.000	0.063	0.064
Static simulation												
No change in schooling	0.359	0.002	0.355	0.362	0.113	0.001	0.112	0.115	0.050	0.000	0.050	0.051
All children attend school	0.357	0.002	0.354	0.361	0.112	0.001	0.111	0.113	0.049	0.000	0.049	0.050
Behavioural simulation												
Scenario 1	0.360	0.002	0.357	0.363	0.115	0.001	0.114	0.116	0.052	0.000	0.051	0.052
Scenario 2	0.358	0.002	0.355	0.361	0.113	0.001	0.111	0.114	0.050	0.000	0.049	0.050
Scenario 3	0.362	0.002	0.358	0.365	0.116	0.001	0.115	0.117	0.052	0.000	0.051	0.053

Source: own calculations based on household surveys



3 FGT curves

This finding suggests that the introduction of the conditions could turn into a loss of the poverty reduction power of the intervention, a result that is not clearly seen when considering aggregate indexes instead of curves.

5.4 Potential Effects on Inequality

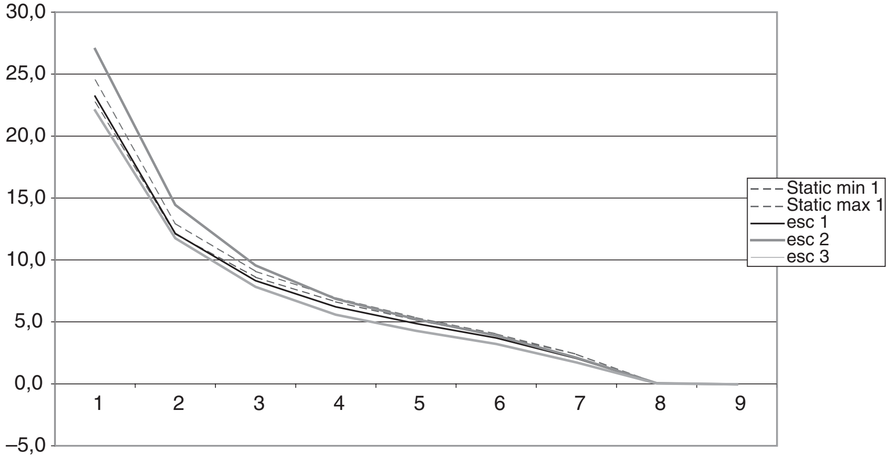
The programme entails an inequality reduction for all scenarios: Gini coefficients decrease around one point (Table 10). Confidence intervals for the simulated Gini coefficient do not overlap with the baseline index, indicating that the reduction is statistically significant. Differences among the three behavioural scenarios are not statistically significant.

Table 10 Gini indexes by scenario

Scenario	Estimate	STD	Lower Bound	Upper Bound
Baseline	45.5	0.1	45.2	45.7
Static simulation				
No change in schooling	44.6	0.1	44.4	44.8
All children attend school	44.6	0.1	44.3	44.8
Behavioural simulation				
Scenario 1	44.7	0.1	44.5	44.9
Scenario 2	44.6	0.1	44.4	44.8
Scenario 3	44.7	0.1	44.5	45.0

Source: own calculations based on household survey

The redistribution operates increasing average incomes from the lowest strata in a higher proportion (Fig. 4). This outcome results from two facts: attendance grows faster in the lower strata and the transfer represents a bigger share. Although the pattern is the same in all the scenarios, scenario 2 performs better in terms of changes in income for poorer households.



4 Variation in average income per ventile

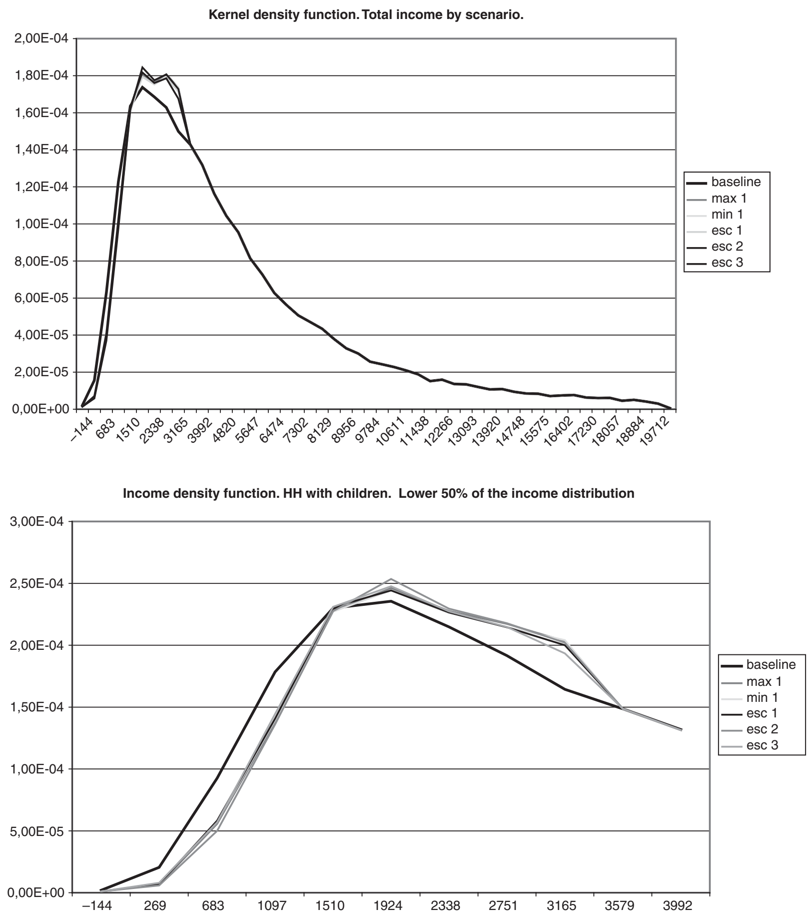
Changes in the income distribution are illustrated by kernel density functions (Fig. 5). There is a movement to the right due to changes in the situation of households with children. Again, different scenarios show similar patterns.[7]

To conclude this section we analysed the role of the targeting method. The interferences generated by the use of proxy-means tests to target beneficiaries are not usually addressed in the literature. We compared the programme's effects on the ideal target population with the results obtained when the proxy-means score is used to select beneficiaries. Effects on schooling, poverty and inequality are very similar whether we assume perfect targeting or we calculate the proxy-means, suggesting that efficiency losses due to the use of a proxy-means test to select the beneficiaries are not important, provided the information given by households is accurate.

5.5 Potential Effects on Adult Labour Supply

In order to microsimulate behavioural responses of adult labour supply, we estimated a labour supply model for adults, and we used the corresponding parameters to simulate the effect of changes in cash transfers under the three scenarios

[7] As expected, the cash transfer generates movements of households along the distribution: a considerable percentage of households that do not have children and belong to the lower half of the distribution are re-ranked downwards.



5 Income density functions

considered. By doing so, we are able to assess the transfer's potential effects on adult labour supply, although we do not fully endogenize labour supply within the model previously presented. Nevertheless, the exercise provides useful information about what to expect in terms of adult labour market behavioural responses to cash transfers, and sets questions for further research.

The traditional formulation of the labour supply model considers that:

$$H = h(W, V, X, \varepsilon) \text{ if } W > W_r$$
$$H = 0 \text{ if } W < W_r$$

where W is the wage rate, V is non-wage income, X are other variables determining labour supply, W_r is the reservation wage and ε is a random disturbance term. The estimation of this labour supply model faces the problem of constructing a wage variable for all individuals that may participate in the labour market. Specifically, it is necessary to predict wage rates for those who are not working, as the wage rate is missing for them. A way to deal with this sample selectivity problem is to estimate a Tobit model – also called standard censored regression (Amemiya, 1984) – where the wage is replaced by human capital variables that are available for all the individuals. This method assumes that individuals are able to modify their observed hours of work at the margins as a consequence of a policy reform, an assumption that has been widely criticized in the literature.[8] We argue that, although this assumption may be non-realistic for workers as a whole, it may be a reasonable approach in our case. We are considering low-skilled workers highly concentrated in occupations such as domestic service in the case of women or construction in the case of men, or the self-employed (without investment). The nature of their labour market ascription may allow for more flexibility in changes in hours of work at the margins.

Results from the labour supply equation using the Tobit method (maximum likelihood estimation) for eligible households (both in terms of income and the presence of children) are presented in Table 11. Three equations were estimated, separately considering household heads, spouses and other adult household members' labour supply.

The coefficients obtained for the variables reflecting personal characteristics show the expected signs. Specifically, hours of work are decreasing with age and are higher for men in the three cases. Years of schooling has the expected positive sign, its magnitude being considerably lower for household heads. Controls reflecting region of residence (with the omitted variable being Montevideo) indicate that living in rural areas is associated with higher hours of work for household heads, but the contrary holds for spouses and other household members, probably reflecting differences in female participation rates.

Average years of schooling are associated with higher hours of work both for household heads and spouses, but not for other members. The presence of children aged 0–5 has a negative effect on hours of work for both household heads and spouses, and the magnitude is higher for the latter, as expected. On the contrary, the variable yields a positive sign for other household members. It is worth noting that half of these other members in eligible households are younger than 24 years.

In the household heads equation, their own non-labour income (in logs) is included as a dependent variable, showing the expected negative sign. In the case of spouses, household head's income is included, again showing the expected negative sign. In the equation for other members, both income from household head and spouse are included, and they present the expected negative association with hours of work. Contributive transfers are included here.

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[8] Literature discussing labour supply modelling has been abundant, because many computational and analytical problems are involved. Two approaches have been proposed to model the choice of hours: they may be considered as continuous and unconstrained (Moffitt 2002) or they may be treated as a number of finite outcomes, assuming, for example, that there is a choice between no work and part- or full-time work (Creedy and Duncan 1999).

Table 11 Labour supply estimation. (Tobit)

	Household head	Spouse	Other members
Age	−0.600	−0.214	−0.182
	(54.76)[a]	(9.27)[a]	(8.66)[a]
Sex	15.691	28.551	22.121
	(53.22)[a]	(33.74)[a]	(38.69)[a]
Years of schooling	0.479	1.493	2.428
	(7.99)[a]	(14.75)[a]	(18.71)[a]
Major urban areas (exc. Mdeo)	0.850	0.635	−0.520
	(3.30)[a]	(1.35)	(0.88)
Minor urban areas	0.113	−9.933	−8.030
	(0.23)	(10.96)[a]	(6.61)[a]
Rural areas	8.127	−4.047	−6.007
	(16.39)[a]	(4.63)[a]	(4.59)[a]
Average years of school. (hh)	0.631	1.647	−2.267
	(8.97)[a]	(13.17)[a]	(14.17)[a]
Children 0–5	−4.302	−8.091	2.719
	(16.80)[a]	(16.91)[a]	(4.58)[a]
Non labour personal income	−1.799		
	(53.59)[a]		
Household head income (ln)		−1.494	−0.668
		(11.92)[a]	(4.82)[a]
Spouse's income (ln)			−0.673
			(9.79)[a]
Non contributory transfer income (ln)	−0.507	−0.906	**0.014**
	(9.58)[a]	**(9.04)**[a]	**(0.11)**
Constant	49.136	7.372	10.013
	(62.96)[a]	(4.25)[a]	(5.35)[a]
Observations	38069	29730	21208

Absolute value of t statistics in parentheses
[a]significant at 1%.
Source: own calculations based on household survey

A variable reflecting average years of schooling of adults in the household has been also included in order to reflect structural household conditions. It yields a positive and significant coefficient for household heads and spouses, and a negative sign for other members.

Our interest variable, non-contributory transfers income (in logs), is significant both for household heads and spouses, presenting the expected negative sign and a small magnitude. This result indicates that both household heads and spouses would be affected by transfer income to the extent of changing their labour behaviour, and the effect is higher for spouses.

We carried out the microsimulation for household heads and spouses. The parameters obtained from their supply equation were used to predict their hours of work once households received the conditional cash transfer. Residuals were simulated assuming a normal distribution.

The amount of the cash transfer used for the microsimulation is given by the results from the simulation carried out in the previous section (considering the three scenarios). This means considering the studying status of children predicted by the previous model and assumes that once the new regime is established, households choose the work/study status of the child and after that, spouses' labour choices are made. Comparisons of the predicted hours of work before and after the new cash transfer are presented in Table 12. Among eligible households, the cash transfer would imply a slight reduction of 4 h a month for household heads, and around 3 h for spouses.

Table 12 Microsimulation of changes in hours of work per week for household heads and spouses

	Household heads			Spouses		
	Predicted hours of work (weekly)	95% confidence interval		Predicted hours of work (weekly)	95% confidence interval	
All						
Baseline	40.4	40.3	40.5	32.3	32.2	32.4
Scenario 1	40.1	40.0	40.2	32.1	32.0	32.2
Scenario 2	40.1	40.0	40.2	32.1	32.0	32.2
Scenario 3	40.1	40.0	40.3	32.1	32.0	32.2
Eligible households						
Baseline	37.3	37.1	37.5	28.4	28.3	28.5
Scenario 1	36.4	36.2	36.6	27.6	27.5	27.7
Scenario 2	36.4	36.2	36.6	27.6	27.5	27.7
Scenario 3	36.4	36.3	36.6	27.6	27.5	27.7

Source: own calculations based on household survey

In the three scenarios, confidence intervals on average hours of work do not overlap with the one corresponding to baseline hours of work, indicating that the change is statistically significant. Results by scenario do not differ. For the whole population, the average change is very small.

As mentioned before, the occupational profile of this population allows some flexibility in terms of decisions regarding hours of work. Therefore, these results suggesting a reduction in the intensive margin of working hours seem plausible.

However, these results must be interpreted with caution. In the case of spouses, almost a third of them work in domestic service, and in most cases they are engaged for an hourly wage by different households 2 or 3 h a week. In the case of household heads, one third of them work as unskilled labourers and in domestic service, and almost 60% are informal workers. Thus, they have reduced hours of work in precarious and low-paid jobs. This could also imply more leisure time that can be reflected in better quality child rearing.

To conclude this section, we computed the reduction in household income and again run the microsimulations to assess changes in poverty and inequality.

Table 13 shows that the changes are negligible. Substitution effects going on among beneficiaries do not seem to exert a significant reduction in the potentiality of the programme to reduce poverty, extreme poverty and inequality.

Table 13 Poverty and inequality indexes by scenario including labour force effects. All households

	Presented in previous sections				Including labour supply effects			
Scenario	Estimate	STD	LB	UB	Estimate	STD	LB	UB
Gini index								
Scenario 1	44.7	0.1	44.5	44.9	44.8	0.1	44.5	44.9
Scenario 2	44.6	0.1	44.4	44.8	44.7	0.1	44.4	44.8
Scenario 3	44.7	0.1	44.5	45.0	44.7	0.1	44.5	45.1
Extreme poverty incidence								
Scenario 1	0.016	0	0.015	0.016	0.018	0	0.015	0.017
Scenario 2	0.014	0	0.013	0.014	0.017	0	0.013	0.015
Scenario 3	0.016	0	0.015	0.016	0.019	0	0.015	0.017
Poverty incidence								
Scenario 1	0.246	0.001	0.244	0.248	0.249	0.001	0.245	0.251
Scenario 2	0.245	0.001	0.243	0.247	0.248	0.001	0.246	0.249
Scenario 3	0.247	0.001	0.245	0.249	0.251	0.001	0.247	0.253

Source: own calculations based on household survey

6 Concluding Remarks

This chapter presents an ex-ante evaluation of Uruguay's conditional cash transfer programme. Results on schooling indicate that teenage attendance rates might increase from 6 to 8% points as a result of the reform. This increase in school attendance shows a progressive pattern. The higher incentive for schooling is provided by the scenario which includes a higher transfer for secondary school students and does not consider equivalence scales. This scenario also maximizes progressiveness. A case for increasing the equivalence scale, or even excluding this adjustment, could be done on this basis. Nevertheless, it must be kept in mind that we are not taking into account the programme's potential effects on fertility. The magnitude of the change in school attendance is very similar to the one found in the ex-ante evaluation of *Bolsa Escola.* Unfortunately, our model does not allow for disentangling the effect due to the transfer to the teenager and the effect due to the transfer to siblings. Further research should try to advance modelling of these effects.

The new programme significantly reduces extreme poverty, and there is also a decrease in the intensity and severity of poverty. Effects on poverty incidence and inequality are moderate. The removal of conditionalities does not entail a significant change in the regime's progressiveness in terms of indigence, poverty and inequality.

Finally, the transfer may influence adult labour supply, inducing a reduction in hours of work for household heads and spouses. This result does not necessarily entail a negative consequence, as most of these workers have precarious and low-paid jobs, and the substitution effect would allow them to spend more time at home. Calculations incorporating this reduction in working hours in terms of indigence, poverty and inequality show that this change is negligible and does not modify the results previously obtained.

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Annex 1: Tables and Graphs

Table 14 Children aged 0–18 by income group and coverage of old *Asignaciones Familiares*. 2006

	Children aged 0–18	Beneficiaries of old *Asignaciones Familiares* regime	Children aged 0–18 that do not receive *Asignaciones Familiares*	% required to cover the whole group
Hh. below the poverty line	488,978	324,088	164,891	50.9
First income quintile	328,795	224,558	104,236	46.4
Hh below the indigence line	65,896	36,094	29,802	82.6

Source: ILO (2007)

Table 15 Analysis of children aged 14–17 that do not study nor work, 2006

	All children		Boys		Girls	
	Incidence	Distribution	Incidence	Distribution	Incidence	Distribution
Neither studying nor working	13.05	100.0	13	100.0	13.12	100.0
Domestic work	5.73	43.9	3.45	26.5	8.17	62.3
Working (module of child work)	0.2	1.5	0.28	2.2	0.11	0.8
Unemployed	3.2	24.7	4.13	31.8	2.26	17.2
Neither studying nor working	3.9	29.9	5.14	39.5	2.58	19.7

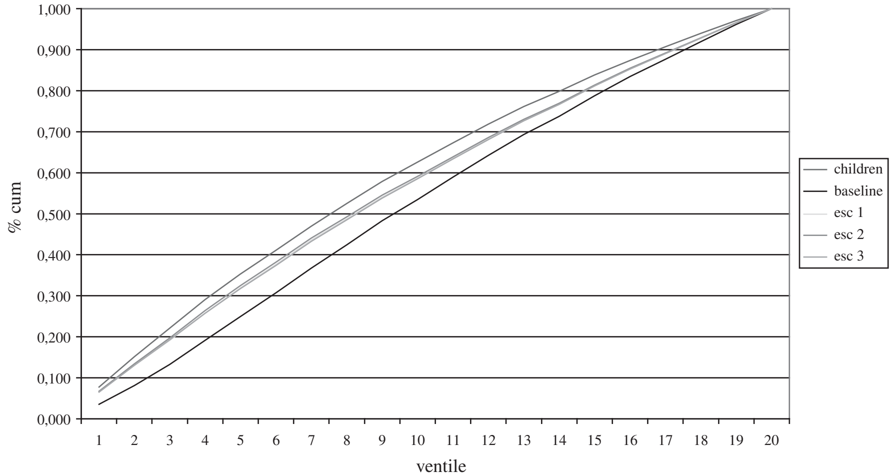
Source: own calculations based on household surveys

Table 16 Multilogit estimation results. Children aged 14–17

	Boys						Girls					
	Only studies (1)			Studies and works (2)			Only studies (1)			Studies and works (2)		
Variables	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Per capita household income excluding child	0.00003	0.0000	0.00	0.00001	0.0000	0.01	0.00004	0.0000	0.00	0.00002	0.0000	0.01
Child's predicted wage	−0.0001	0.0000	0.00	−0.0004	0.0000	0.00	−0.0002	0.0000	0.00	−0.0006	0.0001	0.00
Average schooling of adults (years)	0.1325	0.0140	0.00	0.0345	0.0217	0.11	0.1362	0.0168	0.00	0.0753	0.0282	0.01
Log household size	−0.7518	0.0897	0.00	−0.6151	0.1562	0.00	−0.9597	0.0990	0.00	−0.3728	0.1961	0.06
Child's years of schooling	0.6917	0.0217	0.00	0.8300	0.0363	0.00	0.7492	0.0244	0.00	0.9681	0.0475	0.00
Ranking of the child (decreasing in age)	0.8874	0.0839	0.00	0.6669	0.1499	0.00	0.9103	0.0920	0.00	0.5008	0.1993	0.01
Region 2	−0.1520	0.0703	0.03	−0.0875	0.1212	0.47	−0.0296	0.0799	0.71	0.1416	0.1526	0.35
Region 3	−0.5036	0.1177	0.00	−0.2511	0.2036	0.22	−0.0871	0.1407	0.54	−0.1181	0.2786	0.67
Region 4	−0.8704	0.1246	0.00	0.0191	0.1975	0.92	−0.5992	0.1352	0.00	−0.4228	0.2899	0.15
Constant	−5.3457	0.2483	0.00	−7.3840	0.4422	0.00	−5.5037	0.2833	0.00	−9.7410	0.6166	0.00
Model statistics												
Pseudo R2	0.2551						0.2697					
Chi squared	3, 475.5						2, 865.8					
Hausman test												
Observations	8, 919						8,779					

Table 17 Results of Hausman test

Categories	$\chi 2$	df	$P > \chi^2$	Evidence
Boys				
0 (only studies)	13,789	8	0.087	for Ho
1 (studies and works)	1942,659	8	0	against Ho
2 (part-time)	19,781	7	0.006	against Ho
Girls				
0 (not attending)	11,063	7	0.136	for Ho
1 (only studies)	1069,385	8	0	against Ho
2 (studies and works)	14,984	7	0.036	against Ho



6 Cumulative proportion of total children attending school by scenario and income ventile. Age 14–17

Annex 2: Dogit Estimator

Discrete choice models are frequently used in microsimulation exercises to analyse the effects of policy reforms on agents' decisions on a set of alternatives. By far, the multinomial logit model is the specification more often used in empirical applications. This model provides a convenient closed form for underlying choice probabilities, thus allowing a relatively simple estimation.

However, it is widely known that a potentially relevant drawback of these models is the underlying assumption of independence from irrelevant alternatives (Hausman and McFadden, 1984). This property states that the ratio between the probabilities of any two alternatives i and j is independent of the characteristics of any other alternative belonging to the choice set. For example, in the context of the model estimated in this chapter, it implies that the probability of choosing "only studies" relative to that "only works" is independent of the possibility of "studies and works" simultaneously.

The Dogit model was introduced by Gaudry and Dagenais as an alternative discrete choice model that is generally unconstrained by the independence from irrelevant alternatives assumption. Harris and Duncan (2002) use dogit models in the context of microsimulation analysis. Dogit probabilities are given by:

$$P_i = \frac{e^{V_i} + \theta_i \sum_j e^{V_j}}{\left(1 + \sum_j \theta_j\right) \sum_j e^{V_j}} = \frac{e^{V_i}}{\left(1 + \sum_j \theta_j\right) \sum_j e^{V_j}} + \frac{\theta_i}{\left(1 + \sum_j \theta_j\right)} \quad i, j = 1, \ldots, M$$

where P_i is the probability of the ith of M choice alternatives; θ_i is the parameter associated with the eith alternative; V_i if a function of the K independents attributes (X_{ik}). If all θ_j are zero, the dogit model collapses to the multinomial logit specification. Therefore, logit is a particular case of dogit model. The parameters of both models have the same interpretation. The model can be consistently estimated using the maximum likelihood estimator.

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The Impact of the Increase in Food Prices on Child Poverty and the Policy Response in Mali

Sami Bibi, John Cockburn, Massa Coulibaly, and Luca Tiberti

Abstract Since 2006, Mali has experienced the full effects of the global food crisis, with price increases of up to 67%. This study presents simulations of the impacts of this crisis and a number of policy responses with respect to the welfare of children. The impacts are analyzed in terms of monetary (food) poverty, nutrition, education, child labor, and access to health services of children. According to simulations, food poverty among children would have increased from 41 to 51%, with a corresponding rise in caloric insufficiency from 32 to 40%, while the impacts on school participation, work, and access to health services would have been relatively weak. To prepare an adequate response, the government should start by identifying the poor individuals who are to be protected, based on a limited number of easily observed socio-demographic characteristics. A method of targeting these individuals is proposed in this study. However, simulations show that with targeting about one quarter of poor children would be erroneously excluded (under-coverage), while more than a third of non-poor children would be erroneously included (leakage). These identification errors, which increase in proportion with the extremity of poverty, reduce the impact and increase the cost of any public intervention. That having been said, it is important to note that leakage to the non-poor can nonetheless improve the conditions of children in terms of caloric intake, school participation, child labor, and access to health services, none of which are exclusive to poor children. When targeting children or sub-groups of children by age, benefits will likely be deflected to some extent to other family members. Moreover, it is total household income, regardless of the member targeted, that determines decisions relating to child work, education or access to health services. School feeding programs are found to be a particularly efficient policy in that they concentrate public funds exclusively on the consumption of highly nutritious foods, while cash transfers can be used by households for other purposes. Moreover, school feeding programs are likely to have desirable effects on school participation and child labor. However, there are some caveats due to the fact that these programs exclude children who do not attend

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school, the difficulty of exclusively targeting poor children and the possibility that child food rations at home will be proportionally reduced.

Keywords Food crisis · Child poverty · Nutrition · Education · Child labor · Health · Mali

1 Introduction

Mali, like most developing countries, has undergone a difficult ordeal as a result of the global food crisis. Food expenses represent a significant or even predominant share of total household expenses, particularly among the poor. An increase in food prices in the order of 30–40% can rapidly force poor populations to make difficult, or nearly impossible, reductions in their spending on food, and in the education and access to health services for their children. It can also deplete their meager savings. Children in such a context are particularly vulnerable in terms of food, nutrition, education and health.

However, not everyone is affected in the same way. The increases in food prices can vary substantially by region of residence, while individuals in households that produce and sell food products could even see some benefit from the increase in food prices. Differences in consumption patterns are such that the average impacts differ from one region to another. Also, households with greater total income have more capacity to adjust.

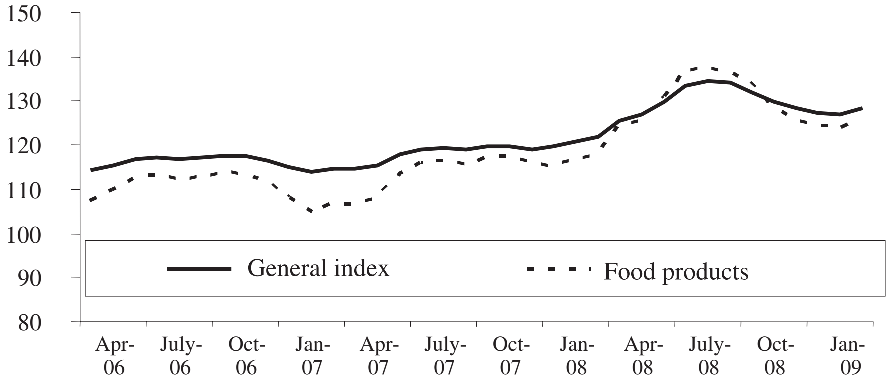
This study presents detailed simulations of the impacts of the food crisis on Malian children. Over and above the impacts on monetary poverty, the impacts on nutrition, education, labor, and children's access to health services are also analyzed. The study also reviews a number of compensatory policies that the Malian government could consider to respond to this crisis in order to protect the most vulnerable populations.

2 General Context

International prices for staple foods have rapidly increased since 2006. The FAO food price index rose by 7% in 2006, by 16% in 2007 and by 50% between the third quarter of 2007 and the third quarter of 2008. While food prices have subsequently subsided, they remained considerably above their long-term average in early 2009. Moreover, the financial crisis is likely to have exacerbated the situation by reducing real income in poor countries. The poverty gap and severity of monetary poverty in West and Central Africa seem to have regressed, threatening food and nutritional security among many rural and urban households. Children and pregnant or lactating women are of particular concern. In addition to aspects of their welfare, children may be less likely to attend school.

2.1 National Context – Mali

The rise in food commodity prices at the global level resulted in a general increase in prices in Mali (Fig. 1).



1 Change in the monthly harmonized index of consumer prices (IHPC) in Mali from 2006 to 2009.
(Source: DNSI)

More generally, the inflation rate, which was 1.5% in 2006 and 1.4% in 2007, rose to 9.1% in 2008. The increase in inflation resulted from price increases for hydrocarbons as well as food products, which are both imported by Mali. For example, the price of gasoline at the pump increased from 615 CFA francs per liter to 695 CFA between August 2006 and August 2008 (with a peak of 704 CFA in July 2008) while diesel rose from 525 to 585 CFA per litre.

From 2000 to 2008, Mali's real GDP at factor cost (which does not account for indirect taxes and subsidies) increased from 830 to 1,459 billion CFA francs, indicating an average annual growth rate of 6.1% (compared to the 7% that would have been required to achieve Mali's poverty reduction objectives). The economy remains dominated by the primary sector, which accounts for an average of 39% of GDP, as opposed to 24% from the secondary sector and 37% from the tertiary sector. However, growth has been stronger in the tertiary sector (9.3%) than the secondary sector (5.1%) and the primary sector (4.0%) (see Table 1).

The current objective is to produce 10 million tonnes of grain by 2012 in order to satisfy local demand and to make Mali a net grain exporter, particularly of rice. It is expected that the Rice Initiative will attain 1 million tonnes of production of husked rice, providing 900,000 tonnes for local consumption and leaving 100,000 tonnes for export. For now, the country's exports (32% of GDP in 2008) are dominated by gold (582 billion CFA of exports in 2008), non-factor services, livestock and cotton products. The last of these has continued to decline, from 247,000 tonnes in 2007 to 190,000 tonnes in 2008, compared to 415,000 tonnes in 2006 and 534,000 tonnes in 2005.

Table 1 Change in real GDP (billions of CFA and percentage)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual average
Real GDP	830	928	960	1,138	1,157	1,228	1,317	1,368	1,459	1,154
Primary	42%	42%	39%	40%	38%	38%	37%	36%	38%	39%
Secondary	24%	26%	30%	23%	23%	24%	24%	22%	21%	24%
Tertiary	34%	32%	31%	37%	39%	38%	39%	42%	41%	37%
Growth	−2.8%	11.8%	3.4%	18.5%	1.7%	6.1%	7.2%	3.9%	6.7%	6.1%
Primary	−10.5%	11.4%	−3.3%	19.6%	−4.0%	6.5%	4.3%	2.5%	13.4%	4.0%
Secondary	4.7%	20.4%	19.0%	−8.7%	2.7%	8.5%	8.2%	−4.7%	−0.7%	5.1%
Tertiary	3.0%	6.1%	−0.3%	43.9%	7.1%	4.4%	9.5%	10.2%	4.9%	9.3%

Source: DNSI and République du Mali (2009).

Returning to the increase in prices, it should be said that it was accentuated by the weakness in stocks of grains and other food products. At the beginning of July 2008, total rice stocks were estimated at 91,000 tonnes, 46% of which was set aside in a number of storage depots in the country. Stocks of cooking oils were barely 1,000 tonnes, while milk powder stocks only amounted to 800 tonnes (République du Mali, 2008a). Local cottonseed oil producers saw much less activity due to lower availability of cottonseed. The main producer (HUICOMA) experienced months of production delays despite numerous orders for oil and soap.

The data indicate that the food crisis brought about sizeable price increases (of more than 50%) for the main staples consumed and the main grains produced by the Malian population (Table 2). The geographical variations can be explained by the differing degree of food dependence in each region, particularly for imported products, as well as the differing shares of more rigid marketing/transport costs. This explains why Bamako, the capital, had the largest price increases for most products.

The extent to which these price variations affect the local populations rises with the share of their income that is dedicated to food consumption (Table 3). We also see that the consumption of inexpensive grains – millet, sorghum and maize – and total food consumption are highest in the poorest quintile.

2.2 Compensatory Policies Adopted in West and Central Africa and in Mali

This study focuses on the impacts of the food crisis on child poverty, going beyond monetary poverty to include dimensions such as nutrition, school participation and access to health services. While certain interventions, particularly cash transfers to the poorest, can simultaneously act on all dimensions of poverty, other interventions such as free schooling or nutritional programs target specific dimensions of child poverty. The types of policies adopted by developing countries to address the food crisis can be characterized by four main groups:

- *Adjustment of economic prices*: tax reductions (customs tariffs, VAT, sales taxes, etc.), price controls, consumer subsidies.
- *Local food supply*: export restrictions, stock adjustments, producer supports.
- *Safety nets*: cash transfers (conditional or otherwise), public works programs, subsidies targeting consumers, food rations/assistance, traditional support mechanisms.
- *Safety nets targeting children*: cash transfers directly targeting children, school feeding programs, nutrition programs for children under the age of 5.

A complete review of the policies actually adopted in Mali in response to the food crisis was carried out by Coulibaly et al. (2007) and the policies relating to children's welfare are detailed in a number of other documents (for example, Pereznieto and Diallo, 2008; Wodon and Zaman, 2008). The principal policies adopted in Mali

Table 2 Change in consumer and producer prices of food from August 2006 to August 2008 (percentage)

	Region								
	Kayes	Koulikoro	Sikasso	Ségou	Mopti	Tombouctou	Gao	Kidal	Bamako
	Consumer price								
Rice	49	36	37	37	14	14	14	14	49
Millet/sorghum	24	17	21	21	17	17	17	17	24
Maize	33	17	34	34	33	33	33	33	33
Other grains	23	13	27	27	5	5	5	5	23
Beef	14	6	21	21	22	22	22	22	14
Chicken	56	17	20	20	30	30	30	30	56
Fish	7	21	32	32	−2	−2	−2	−2	7
Milk products	40	41	45	45	29	29	29	29	40
Oils	38	31	14	14	35	35	35	35	38
Fresh/dry fruit	6	3	27	27	37	37	37	37	6
Vegetables	16	3	10	10	26	26	26	26	16
Coffee/tea	12	34	4	4	67	67	67	67	12
Sugar	3	−1	17	17	20	20	20	20	3
Condiments	8	21	−21	−21	30	30	30	30	8
Drinks	4	7	0	0	23	23	23	23	4
	Producer price								
Rice	30	30	25	30	30	30	30	30	30
Millet/sorghum	28	12	20	18	7	16	16	16	16
Maize	73	73	73	71	73	73	73	73	73

Source: Author's calculations from DNSI data (for the consumer price) and the OMA (for the producer price).

Table 3 Budgetary share of principle staples and non-food consumption in Mali before the crisis (percentage of total expenditures)

	Population						
	Urban	Rural	Bamako	Total	Quintile1	Quintile2	Quintile5
Rice	10.9	10.6	8.9	10.7	6.9	10.0	11.1
Millet/sorghum	5.4	15.9	3.8	12.2	15.8	16.0	6.4
Maize	1.1	3.2	0.7	2.5	5.4	3.8	1.0
Other grains	4.1	2.8	4.5	3.3	2.3	3.4	3.8
Beef	5.5	3.4	4.9	4.2	2.3	3.5	5.2
Chicken	0.6	0.7	0.5	0.7	1.0	0.7	0.6
Fish	2.5	3.5	2.5	3.1	3.4	3.4	2.7
Milk products	2.2	2.3	1.9	2.2	1.5	2.1	2.5
Oils	3.2	4.8	2.4	4.3	5.0	4.5	2.9
Fresh/dry fruit	1.9	1.8	2.4	1.8	2.0	2.1	2.0
Vegetables/tubers	5.7	5.7	5.5	5.7	6.2	6.3	5.1
Coffee/tea	1.8	2.8	1.4	2.4	2.3	2.4	1.8
Sugar	3.5	4.5	2.7	4.1	5.2	4.3	3.1
Condiments	2.8	2.8	2.3	2.8	2.9	2.7	2.5
Drinks	0.6	0.7	0.2	0.7	0.9	0.8	0.6
Food (total)	51.8	65.5	44.6	60.7	63.1	66.0	51.3
Non-food	48.3	34.4	55.5	39.3	37.2	34.0	48.7

Notes: the quintiles are defined here based on total expenditures (food and non-food).
Source: Author's calculations from ELIM (2006).

to address the food crisis consisted of price stabilization measures and structural policies to stimulate domestic supply, as well as strengthening of the structures of grain management institutions, on which we now focus our attention.

2.2.1 Price Stabilization Measures

Some governments in the region have tried to limit the impact of rising food prices by imposing price controls and/or granting subsidies (Benin, Burkina Faso, Cameroon, Congo, Niger and Senegal) and/or suspending/reducing import tariffs and/or the VAT on food (Benin, Burkina Faso, Cameroon, Niger, Mali, Sao Tomé and Principe, Senegal and Togo). Others, such as Burkina Faso, Guinea and Niger, have banned grain exports. This approach can stabilize internal prices but reduces supply and pushes prices higher in neighboring import-dependent countries.

Eliminating taxes and engaging in subsidy programs are not financially sustainable in the long run. The fiscal space to expand food subsidies is limited, except in the oil-producing countries. Food subsidies have also been criticized as poorly targeted.

While traditional support mechanisms can also help to limit the impacts of food price increases on the poor to some degree, these mechanisms have weakened in recent years without being replaced by formal social protection systems that reach the majority of the population. In most West and Central African countries, the state has rolled out social security systems that only cover workers in the formal sector and thus exclude 80–90% of the population, including nearly all of the poorest and most vulnerable households. Very few countries in the region, the exceptions being Cape Verde, Ghana, Sierra Leone and Nigeria, have begun to develop social protection programs that favor poor households; even these countries only have small pilot programs that reach a very limited number of those in extreme poverty.

In response to rising food prices, the government of Mali has set price targets, especially for basic necessities, and has made efforts to secure supplies for the population in order to address imbalances between supply and demand on food markets. Two key strategies were to lower prices and to strengthen food security among the most vulnerable groups. The second of these was pursued by increasing grain reserves through the Agricultural Products Office of Mali (OPAM) and encouraging productivity growth in domestic agriculture.

In terms of prices, the policy response consisted of eliminating import tariffs and taxes and turning to price controls for basic food staples. The use of this intervention mostly responds to three considerations (République du Mali, 2008b):

- The price level with respect to the 5-year average.
- The level of stocks of the product, and whether shortages may be expected.
- Market supply, and whether it seems to be functioning normally.

The measures applied to three widely consumed foods: rice, cooking oils and milk powder. These products were exempted from import customs and tariffs and were sold at wholesale and retail prices that were set in advance, with the possibility of putting a ceiling price on competing local goods in the future.[1]

2.2.2 Structural Policies

Over and above the economic responses to the increase in food prices, the Malian state launched an initiative called the "Rice Initiative," which had the initial goal of increasing rice production in 2008–2009 to 1.6 million tonnes, a 50% increase with respect to 2007/08. Of this production, it was hoped that 90% will be traded on the domestic market with 10% remaining for exports. The strategy follows the general effort of "increasing productivity of different productive systems by agricultural intensification and developing agricultural fields and improving value added by putting efficient processing facilities into place" (République du Mali, 2008c). The planned actions are meant to act at the level of inputs (seeds, fertilizers, and water), as well as the equipment for harvesting and transformation to be made available to producer groups.[2]

3 Methodology

The methodology followed in this study is presented in detail in Bibi et al. (2009). To summarize, the analysis aims to capture the effects of the food crisis and possible

[1] For details, see Bibi et al. (2009).
[2] For details, see Bibi et al. (2009).

policy responses on various aspects of poverty for children aged 14 and less: food poverty, caloric insufficiency, school participation, child labor, and access to health services.

The increase in food prices is observed directly through data from the Agricultural Markets Observer (OMA, for production prices) and from the National Institute of Statistics (DNSI, for consumer prices). These data include prices for each major product consumed or produced by households for each region in Mali. The price changes observed between August 2006 (before the crisis) and August 2008 (during the crisis) have been used to avoid issues of seasonal price fluctuations. In the absence of price observations for some products in some regions, price changes in the neighboring region are used.

The impact of the price increases on the nominal income of households that sell these products and on the cost of living are considered in each region. On the production side, the volume of sales is presumed unchanged by the crisis while the value of these sales simply increases proportionately to the price increase for each product. This underestimates the impact somewhat, given recently observed increases in the volume of sales in Mali in response to higher prices. Higher input costs, which counteract to some extent the increase in the value of sales, are also accounted for.

On the consumption side, changes in the consumption of each main food item facing price variations, changes in prices of other food products and changes in nominal household income are all considered. This is accomplished by estimating an econometric model of the complete demand system based on survey data from Malian households in 2006 (ELIM 2006). The consumption analyzed includes purchased food products as well as own consumption (goods that are both produced and consumed by the household). The demand system is then used to predict household adjustments in the quantity of consumption of each item following the observed price increases and the different policy scenarios that are analyzed. Re-evaluating these consumption quantities at the new prices yields the value of food expenditures under the different scenarios.

The value of food expenses before the crisis is subtracted from the predicted value of food consumption after simulating the price increase in order to obtain the real income loss associated with the food crisis for each individual. The real income loss is calculated in 2008 local currency (F CFA). The poverty line (by region and separately for both urban and rural areas) adopted is the one constructed for Mali by the World Bank (2007).

The analysis concerns food poverty rather than total poverty, given the nature of the (food) crisis analyzed. Food poverty is measured by comparing each individual's real food expenses to the expenditures required to satisfy their caloric requirements – which we call the food poverty line – using a typical consumption basket. In contrast, total poverty is determined by comparing an individual's total expenses with a total poverty line, which is generally estimated as the food poverty line plus some fixed percentage deemed necessary to satisfy non-food needs. In both cases, an individual is identified as poor if her/his expenses are under the poverty line under consideration. The headcount index is a measure of the incidence of poverty that indicates the percentage of the population that is poor, while the poverty gap measures the average deviation between actual expenses and the poverty line. Finally, to capture the distribution of expenditures among the poor, we can measure the severity of poverty as the average squared deviation from the poverty line.

A nutritional table (Barikmo et al., 2004) indicates the caloric contribution of the principal Malian staples, which can be used to calculate caloric consumption before and after the crisis for each individual. This calculation is done assuming that the staples are allocated equitably (according to caloric needs) between household members. This could turn out to be a strong assumption if there is discrimination, whether positive or negative, based on age or sex. Finally, data on both monetary and caloric consumption are collected at the household level and then translated into individual terms by using a per adult equivalent scale based on minimal calorie requirements.

To uncover the impact of the crisis and policy reactions on children's participation in the labor market and at school, an econometric model of this simultaneous choice is estimated. This model accounts for other characteristics of the children, their household, the head of their household and their community, that influence this choice. It is the impact on real income that matters for predicting how households at risk adjust to the crisis, as the other explanatory variables are kept unchanged over time and assumed to be unaffected by the food crisis.

Similarly, estimating an econometric model of the decision to consult health services when a child is sick – and of which type of health services is chosen – allows us to analyze the impacts that changes in real income have at this level. The model can then be used to analyze the impact on these decisions of the predicted change in real income resulting from the food crisis and policy responses.

A number of policy responses to the food crisis are analyzed as below:

- Cash transfers to all individuals identified as poor ("All");
- Cash transfers to all individuals identified as being among the poorest 20% of the population, i.e., the first two deciles in terms of food expenses per equivalent adult ("20%");
- Cash transfers to all children aged 0–14 who are identified as poor ("0–14")
- Cash transfers to all children aged 0–5 who are identified as poor ("0–5")
- Cash transfers to all children aged 6–10 who are identified as poor ("6–10")
- Cash transfers to all children aged 11–14 who are identified as poor ("11–14");
- Current policy: consumption subsidies and tariff exemptions for rice (2%), powdered milk (13.6%) and cooking oils (4.4%) ("current"); and,[3]
- School feeding program (targeted food assistance): meals provided year-round (365 days) to all primary school children identified as poor. This policy does not precisely correspond to the policy in place in Mali, which targets all children in schools in poor regions rather than individuals identified as poor across the country and provides the typical meal 180 days a year.

[3] We do not treat the price stabilization measures or structural policies such as the Rice Initiative here.

The size of the cash transfer is equal to the average estimated loss of real income among the poor as a result of the crisis. This cash transfer is calculated and applied separately for each region and area (rural or urban). For cash transfers that target children, two alternative assumptions are adopted. According to the first, the cash transfers are not shared with other family members. In this case, the impacts on the children are identical to those in the first simulation ("All") where all the members of the household receive the cash transfer. According to the second hypothesis, the cash transfer targeting the child is actually shared equitably (according to caloric needs) within the household. Although the first hypothesis is fairly unrealistic, it may be useful for estimating the maximum potential gain for children that such a policy would be able to provide.

A major challenge in applying these different policies involves correctly identifying and targeting poor individuals. In the absence of reliable data on income or expenditures across the Malian population, the government is required to predict their status using a number of socio-demographic characteristics that can be easily observed. To do this, we estimate the relation between these characteristics and the food expenditures (per equivalent adult) observed in the households covered by the ELIM 2006 survey.[4] The estimated relationship is then used to predict food expenditures (and therefore the food poverty status) across the population or among those who requested support. In order to test how well this method performs, it is possible to use the ELIM 2006 household survey to predict the status of all individuals according to their observed food expenditures, which allows us to determine the targeting errors resulting from the prediction model. These errors arise in the form of under-coverage (poor individuals excluded because they were predicted as non-poor) and leakage (non-poor individuals included because they were predicted as poor).

In order to analyze the impacts of each of the scenarios presented above, we use the same procedures that were used to analyze the impact of the food crisis. The governments' costs are estimated for each scenario excluding administrative costs (i.e., the costs involved in identifying the beneficiaries, carrying out the cash transfers, etc.). These costs therefore only correspond to the total amount of cash transfers allocated or, in the case of the current policy, the cost of subsidies/exemptions provided.

4 Empirical Results

The impact of different policies on child food poverty, caloric insufficiency, school participation and child labor, as well as access to health services, are each studied. In order to effectively compare the different polices, it is first necessary to have an idea of their respective costs, which we explore in the following section.

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[4] See Bibi et al. (2009).

Table 4 Costs of intervention policies under different scenarios

	Cost		
	In billions of CFA	In % GDP	In % of budgetary receipts
Scenario			
All	86.3	2.2	16.0
20%	12.5	0.3	2.3
0–14	43.4	1.1	8.0
0–5	18.7	0.5	3.5
6–10	15.3	0.4	2.8
11–14	9.4	0.2	1.7
Current	8.5	0.2	1.6
School feeding	14.4	0.4	2.7

Source: Authors' calculations from ELIM 2006.

4.1 Policy Costs

The costs of interventions vary from 7.1 to 86.3 billion CFA francs, amounting to 0.2–2.6% of Mali's GDP (Table 4). Targeting all poor individuals ("All") is by far the most expensive intervention. Limiting the intervention to the poorest 20% of the population reduces costs dramatically, by 86%. These savings can be explained in part by the fact that the poorest 20% represent half of all the poor (39.6% of Mali's total population is poor in food terms), but mostly because targeting the poorest is much less precise such that the majority of the 20% poorest are erroneously excluded (Table 5).

Table 5 Targeting performance (in percentage)

	Target population			
	All poor		Poorest 20% of the population	
Predicted status	Non-poor	Poor	Non-poor	Poor
Real status				
	National			
Non-poor	64.6	35.4	95.4	4.7
Poor	25.8	74.2	77.7	22.3
Total	45.4	54.6	91.8	8.2
	Urban			
Non-poor	91.0	9.0	98.9	1.1
Poor	53.4	46.6	76.4	23.6
Total	79.7	20.3	96.9	3.1
	Rural			
Non-poor	43.9	56.1	93.3	6.7
Poor	19.3	80.7	77.9	22.1
Total	29.5	70.5	89.5	10.5

Source: Authors' calculations from ELIM 2006.

It turns out that when all poor individuals are targeted, 25.8% of the poor are erroneously excluded (predicted as non-poor), while 35.4% of the non-poor are erroneously included (predicted as poor). Overall, 54.6% of the national population benefits from these cash transfers. However, when targeting the poorest 20%, only 8.2% of the population that benefit from these cash transfers, as more than three-quarters (77.7%) of eligible individuals are erroneously excluded. As such, the savings come at the cost of dramatic under-coverage. These targeting problems can be explained by the difficulties encountered in distinguishing the poorest 20% of the Malian population from the rest of the poor based on their easily observable characteristics. Table 3, for example, shows that the food habits of the poorest 20% (the first quintile) are very similar to those of the second quintile, who are also included among the poor.

The targeting errors are costly even when all of the poor are targeted. By excluding more than a quarter of the poor population, the impact of any intervention is substantially blunted. Furthermore, including 35.4% of the non-poor amounts to a large additional intervention cost that has no impacts on food poverty. Obviously, it would be desirable to minimize these errors without having to go to the astronomical effort and expense of collecting annual income (or expenditure) data for the entire Malian population. At the same time, in order to be administratively feasible, it is important that the targeting mechanism relies on a limited number of variables that are easily observable but difficult to falsify. In this context, there will always be targeting errors. It may be of some consolation that the poor who are excluded tend to be the less extreme cases (and are therefore more easily mistaken as non-poor), while the non-poor who are mistakenly included tend to be the poorest of the non-poor.[5]

When only targeting poor children ("0–14"), the costs are half of what they are (at 43.4 billion CFA) when targeting all poor, i.e., children and adults. These savings reflect the fact that children represent half of the poor population in Mali. Similarly, targeting by age group yields costs in proportion to the group's respective share of the poor population. Since children aged 0–5 are more numerous than those aged 6–10 (also because the mortality rate for children aged 0–5 is very high in Mali), the costs for targeting this younger age group are higher. Targeting the group aged 11–14 is even cheaper for the same reasons, as well as the obvious fact that this group only covers 4 years. The current policy – which consists of consumption subsidies and reduced import tariffs for rice, milk powder and cooking oils – generates benefits for the entire population and costs somewhat less than targeting 11–14-year-olds.

Extending the current school feeding program policy – which is provided on school days to all children (regardless of whether or not they are poor) in selected schools in the poorest regions in Mali – to instead target for 365 days a year all primary school students that are predicted as poor has among the lowest costs of all

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[5] For example, the median value of food expenditures among the excluded poor is 15% higher than the poor who were correctly identified.

the scenarios studied. Indeed, this intervention is only aimed at children aged 6–10 who go to primary school.

4.2 Food Poverty

Food poverty is a measure of monetary poverty that focuses entirely on food expenditures, which are compared to a food poverty line. This poverty line is defined as the necessary level of expenditures to satisfy an individual's caloric needs when adopting the typical diet in the population. It is distinguished from total poverty, a more commonly used indicator of monetary poverty, which includes non-food expenditures. The decision to focus on food poverty is based on the fact that we are analyzing a food crisis and on the importance of food consumption for children. As such, the food poverty rate presented in this study does not correspond to the total poverty rate for Mali that is generally reported in the official reports.

4.2.1 Initial Situation (2006)

In 2006, before the price increase for food products, the incidence of food poverty among Malian children – i.e., the percentage of children who were poor – was 41.5% (Table 6). While approximately half of rural children suffered from food poverty (48.1%), this figure was as low as a quarter of all children in urban areas. Substantial regional gaps are also noted, from 6.7% in Kidal and 13.5% in Bamako, to 63.4% in Sikasso and 44.6% in Koulikoro. There is more food poverty in male-headed households, at 42.1%, compared to 30.5% among children living in female-headed households (but they only account for 5% of all children). The child food poverty rate also increases with the number of children in the household, exceeding 50% in households with seven or more children.

When considered by age group, food poverty affects youngest children less.[6] Given the extreme vulnerability of the youngest children, particularly in consideration of the food crisis, this result is somewhat reassuring.

Finally, the incidence of food poverty is uniformly lower in the general population, reflecting the fact that a greater portion of children than adults are found in poor households.

4.2.2 Impact of the Food Crisis

The present analysis of the food crises only captures the impacts of changing food prices that were brought about by the crisis by isolating the impact of policies that were subsequently put into place by the Malian government. The latter are simulated separately, as discussed in sub-section "The Current Policy: Consumption/Production Subsidies ("Current")" below.

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[6] See Bibi et al. (2009).

Table 6 Child food poverty (0–14 years) before and after the food crisis with policy simulations

	Portion of the population[a]	Headcount index						Poverty Gap					Severity				
		Before	After	All	20%	0–14	Current	Before	After	All	20%	0–14	Before	After	All	20%	0–14
	Percentage (%)	%	Change in percentage points					%	Change in percentage points				%	Change in percentage points			
Total		41.5	10.3	6.8	10.1	7.8	10.0	14.1	4.9	1.7	4.3	2.7	6.8	2.9	0.4	2.3	1.1
Area																	
Urban	*29.0*	25.3	7.5	6.3	7.2	6.7	6.9	7.5	2.5	1.6	2.3	1.8	3.5	1.2	0.5	1.0	0.7
Rural	*71.0*	48.1	11.4	7.0	11.2	8.2	11.3	16.7	5.9	1.8	5.1	3.0	8.1	3.5	0.3	2.8	1.2
Region																	
Kayes	*13.0*	40.8	13.9	7.0	13.1	8.4	13.5	12.8	6.0	2.0	5.7	3.1	5.3	3.5	0.8	3.3	1.5
Koulikoro	*16.5*	44.6	10.7	5.7	10.7	6.7	10.5	15.4	5.0	1.2	4.8	2.3	7.3	3.1	0.1	2.9	1.0
Sikasso	*18.9*	63.4	11.3	8.2	10.7	9.4	11.4	25.9	6.9	1.4	4.3	3.0	14.2	4.5	−0.4	1.9	1.1
Ségou	*18.0*	37.0	10.8	7.0	10.8	9.0	10.6	12.1	4.8	1.4	4.6	2.4	5.5	2.7	0.3	2.6	0.9
Mopti	*16.4*	37.9	10.0	8.3	10.0	8.3	9.5	10.5	4.5	2.6	4.4	3.2	4.6	2.3	0.8	2.1	1.3
Tombouctou	*4.1*	38.2	5.4	4.5	5.4	4.7	3.9	12.0	3.4	2.9	3.4	3.0	5.4	1.9	1.5	1.9	1.6
Gao	*4.3*	29.0	11.5	9.5	11.5	9.5	11.5	5.7	4.0	3.2	4.0	3.3	1.7	1.4	1.0	1.4	1.0
Kidal	*0.5*	6.7	10.3	10.3	10.3	10.3	10.3	0.9	1.2	1.2	1.2	1.2	0.3	0.3	0.3	0.3	0.3
Bamako	*8.3*	13.5	2.5	1.8	2.5	2.3	2.3	3.9	1.0	0.8	1.0	0.8	1.8	0.5	0.3	0.5	0.4
Sex of head																	
Male	*95.0*	42.1	10.3	6.7	10.0	7.7	10.0	14.4	5.0	1.7	4.4	2.7	6.9	2.9	0.4	2.3	1.1
Female	*5.0*	30.5	10.4	9.5	10.4	9.5	10.4	8.5	3.5	1.9	3.3	2.4	3.7	1.5	0.5	1.4	0.8
Number of children																	
1	*1.8*	13.2	5.8	5.4	5.8	5.6	5.7	3.7	1.8	1.5	1.8	1.7	1.6	0.8	0.6	0.8	0.7
2	*5.1*	16.7	8.2	6.3	8.2	8.0	8.1	5.1	1.7	0.9	1.7	1.3	2.3	0.7	0.2	0.7	0.4
3	*9.4*	24.8	5.9	4.6	5.9	4.7	5.9	7.2	2.8	1.7	2.7	2.1	3.3	1.3	0.5	1.3	0.8
4	*12.2*	25.6	9.4	6.1	9.4	7.5	8.9	7.2	3.1	1.6	3.1	2.1	3.0	1.5	0.6	1.5	0.9
5	*11.9*	34.6	12.1	8.4	12.1	9.3	12.0	10.2	4.3	2.1	4.3	2.8	4.5	2.0	0.6	2.0	1.1
6	*10.6*	40.2	10.6	7.4	10.6	7.6	9.6	13.1	4.6	1.9	4.6	2.7	5.9	2.7	0.8	2.7	1.4
7 or more	*49.0*	54.4	11.2	7.0	10.7	8.2	11.0	19.6	6.5	1.7	5.2	3.0	9.8	4.0	0.2	2.9	1.2

[a]Children between 0 and 14 years of age
Source: Authors' calculations from ELIM 2006.

When comparing the observed changes in food prices (Table 2) with the predominant share of food in the typical Malian household's budget (Table 3), we can anticipate the size of the effects of the food crisis. The simulations show that increases in food prices cause an increase in food poverty among children (0–14 years old) from 41.5 to 51.8% (Table 6), an increase of 10.3 percentage points. The impacts on the poverty gap (average distance from the poverty line) and the severity of poverty are not as large in terms of percentage points, but given that they start at a lower level, they are larger in relative variation. As such, it seems that the decline in real income is larger among the poorest, which can be explained by their dependence on food consumption and the fact that they are less likely to sell food, which would bring income benefits from the price increases.

The incidence of food poverty increases proportionally more in urban than rural areas[7] due to the crisis, but it starts from a lower absolute level.[8] Thus, the total percentage of the population falling into poverty is greater in rural areas.[9] The more than proportional impact in urban areas reflects larger price increases (e.g., Bamako in Table 2) and the large portion of consumption that is purchased by urban households. Rural households, however, have greater recourse to own consumption, which is sheltered from the food crisis. Furthermore, rural households that sell grains benefit from the price increase, although this effect is tempered by the simultaneous increase in the cost of agricultural inputs. Yet, analysis of urban household behavior (estimation of demand systems) shows that they have a greater capacity to absorb the impact of rising food prices by reducing their non-food consumption: urban households are generally richer and, as economic theory predicts, set aside a larger portion of their budget to non-food consumption. Therefore, the share of non-food consumption among urban households falls from 48.3 to 41.9% in response to higher food prices, while this share remains relatively stable (going from 34.4 to 33.8%) among rural households (Table 7).

Table 7 Food and non-food budgetary shares before and after the crisis (percentage of total consumption)

	Food		Non-food	
	Before the crisis	After the crisis	Before the crisis	After the crisis
Mali	60.7	63.3	39.3	36.7
Rural	65.6	66.2	34.4	33.8
Urban	51.7	58.1	48.3	41.9
– Bamako	44.5	53.9	55.5	46.1

Source: Authors' calculations from ELIM 2006.

[7] 29.5% in urban areas, compared to 23.8% in rural areas.

[8] 25.3% in urban areas, compared to 48.1% in rural areas. As such, the absolute increase is greater in rural areas (11.4 percentage points, compared to 7.5 percentage points in urban areas).

[9] 11.4% in urban areas compared to 7.5% in rural areas.

However, in the simulation the food poverty gap and severity increase proportionally in rural areas (Table 6). This is due to much higher initial levels of food poverty in rural areas and the weight of food consumption among the poor.

The simulation shows that rising food prices do not substantially change the rank of child food poverty between regions, whether we consider the headcount index, poverty gap, or squared poverty gap (poverty severity). The percentage of the population falling into poverty is relatively uniform at 10–12% with the exception of Kayes (13.9%), Tombouctou (5.4%), and Bamako (2.5%). While there are regional variations, prices increase strongly in all regions, leading to significant absolute increases in food poverty in each case. Bamako is notable for its inhabitants' capacity to protect their food consumption by reducing their non-food consumption, with the portion of their budget allocated to food consumption increasing from 44.5 to 53.9% (Table 7). Tombouctou and Kayes differ in their level of own consumption, which is very high in Tombouctou and very low in Kayes.[10] This explains the difference in the impacts of the food crisis in between these two regions.

The increase in food poverty among households headed by a male or a female is nearly identical, at 10.3–10.4 percentage points (Table 6). Finally, the percentage of children falling into food poverty generally increases with the number of children in the household, from 5.8 percentage points of children in one-child households to 10 percentage points of children in households with 5 or more children.

In the general population, including adults, the incidence of food poverty increased from 39.6 to 49.5%, an increase of 9.9 percentage points, similar to the increase already observed among children. The profile of the impacts by area, region, the household head's sex, and number of children are also similar to what has been observed among children. Finally, no particular trends come from an analysis of the impacts by age (Table 8).

Table 8 Impacts on the incidence of food poverty by age group before and after the food crisis with policy simulations

			Targeted group (of poor)					
	Before	After	All	20%	0–14	0–5	6–10	11–14
	%	Change in percentage points						
0–5 years	39.3	10.3	7.0	10.0	7.9	9.0	9.5	9.9
6–10 years	42.7	10.4	6.8	10.1	7.8	9.5	9.0	9.8
11–14 years	44.0	10.3	6.6	10.1	7.6	9.4	9.2	9.1
0–14 years	41.5	10.3	6.8	10.1	7.8	9.2	9.3	9.7

Source: Authors' calculations from ELIM 2006.

4.2.3 Policy Simulations

Table 6 shows the change (in percentage points) in the headcount index, poverty gap and the severity of poverty with respect to the situation before the crisis under the

[10] For example, rice, which represents 41% of food consumption among the poor in Tombouctou, is more than 25% from own consumption.

different targeting scenarios. As pointed out earlier, the food crisis brought about a 10.3 percentage points increase in the incidence of food poverty among children age 0–14. That is to say that the food crisis led an additional 10.3% of Malian children into food poverty.

In each of the following policy response simulations, the cash transfer made to each eligible individual is the average real income loss per equivalent adult due to rising prices among those who are poor after the crisis. This average loss of income is calculated separately for each area (urban or rural) in each of the nine regions studied (Table 9). Depending on the targeting scenario, one or more members in a household are eligible to receive this transfer. These cash transfers are therefore cumulative at the household level.

Table 9 Annual cash transfer granted per individual by region and area, in CFA

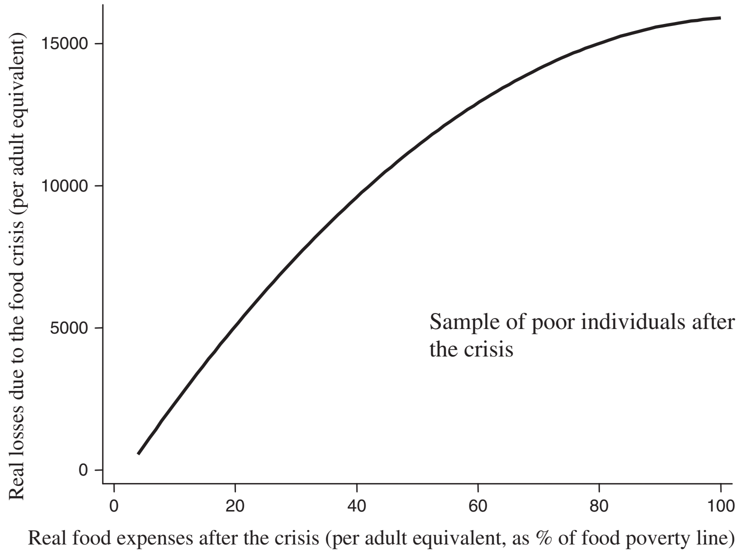
Region	Urban	Rural
Kayes	14,552	19,819
Koulikoro	8,461	12,073
Sikasso	9,112	12,558
Ségou	10,295	12,158
Mopti	15,928	10,584
Tombouctou	11,363	9,056
Gao	17,134	10,679
Kidal		17,076
Bamako	9,768	

Source: Authors' calculations from ELIM 2006.

Cash Transfers Targeting All of the Poor After the Crisis ("All")

When the cash transfer targets everyone, children and adults, who is poor after the crisis, the increase in the incidence of food poverty is reduced from 10.3 to 6.8 percentage points. One may have expected even more positive results, but it must be recalled that the targeting is not perfect. By only using information that is easily observable by the government authorities to determine whether a household is poor, the model only correctly identifies 74% of those who are actually poor and erroneously includes 35.4% of non-poor individuals. As a results, 25.8% of the poor do not benefit from the transfer, which substantially reduces its impact. At the same time, cash transfers to non-poor individuals do not have any impact on the incidence on food poverty, yet increase the cost of the intervention.

Furthermore, the cash transfer is equal to the average annual loss of real income among poor households in the region and area in question. As seen in Fig. 2, the real loss increases with the level of food expenditures, surpassing 15,000 CFA per year for those whose food expenses were 80–100% of the poverty line. Given that the average loss across the country is 12,582 CFA (about $25 in 2009 terms) per year, the cash transfer is less than the loss of real income for individuals who are closer to the poverty line. At the same time, the transfer exceeds real losses for the poorest individuals. These individuals find themselves better off than before the crisis. It is this progressive feature of the fixed transfer that explains the strong impacts this policy has on the food poverty gap (for which the increase is reduced from 4.9 to



2 Real losses due to the food crisis, by food expenditures.
Source: Authors' calculations from ELIM 2006

1.7 percentage points) and the severity of food poverty (from 2.9 to 0.4 percentage points).

This first scenario succeeds best in rural areas, bringing the increase in the incidence of food poverty down from 11.4 to 7 percentage points, due to the fact that the poor are more effectively targeted than in urban areas. Indeed, in rural areas, the model correctly identifies 81% of the poor, as opposed to only 47% in urban areas. However, the model incorrectly identifies 56% of the non-poor as poor in rural areas, while this "leakage" rate, which raises the costs of the intervention (see Section 4.1), falls to 9% in urban areas.

This policy's expected success also varies by region, with the strongest impacts in Kayes and Koulikoro and practically no impact in Kidal and Bamako, two highly urbanized regions. The reduction in the incidence of poverty is also more pronounced for children in male-headed households (even more so in rural areas) and those with four or more children. The profile of the results is similar in terms of the poverty gap and severity of food poverty. When analyzing the impacts by age group (Table 8), we observe an increasing impact with the age of the children.

This first scenario may be unrealistic due to its cost (Section 4.1). However, we see in section "Cash Transfer Targeting All Poor Children After the Crisis: With Sharing ("All")" that the results obtained here for children are identical to those that would be obtained from a cash transfer that targets children alone, if we assume that the transfer is not shared with other household members.

Cash Transfer Targeting the Poorest 20% After the Crisis (20%)

An obvious way to reduce the costs of the cash transfers while still reaching the most vulnerable is to target the very poorest. This is what we explore in this simulation, which targets the poorest 20% of the population after the crisis. As may be expected, such an intervention has very little impact on the incidence of food poverty – which increases by 10.1 percentage points rather than 10.3 percentage points in the absence of the transfer – but it does reduce the food poverty gap (from 4.9 to 4.3 percentage points) and the severity (from 2.9 to 2.3 percentage points) of food poverty, and costs only one-seventh as much as targeting all the poor (see Section 4.1). The savings are not only due to targeting only the poorest, but they also result from lower leakage (non-poor households benefiting from erroneous identification). The profile of the impacts is not altered substantially, although male-headed households and the Kayes and Sikasso regions benefit somewhat more, since they are overrepresented among those identified as the 20% poorest.

Cash Transfer Targeting All Poor Children After the Crisis: With Sharing ("All")

As discussed in Section 4.1, an intervention that targets all individuals identified (correctly or not) as poor would be very costly. If we are determined to protect children from the impacts of the crisis, then targeting cash transfers to children seem to be an obvious choice.

However, it is important to understand that it is nearly impossible to know how transfers intended for children will actually be distributed within a household. There is nothing to stop the household from allocating the transfer equitably (for example, according to caloric needs) between all the members of the household. The following simulations adopt two alternative hypotheses: with and without sharing with other household members.

If only the targeted children benefit from the cash transfer, i.e., it is solely used to increase their food expenditures without sharing with other household members, the impacts on the targeted children would be identical to the first simulation, where all family members receive the cash transfer ("All"). However, the cost of this more targeted policy is only a fraction of the cost of targeting all the poor since the transfers are only provided to children (simulation "0–14" in Section 4.1).

Cash Transfer Targeted to Poor Children After the Crisis: With Sharing ("0–14")

If, however, we apply a policy that only targets children and assume that the cash transfer is shared equitably between all members in the household, the impacts on children are clearly lower. This is exactly what is observed in the "0–14" scenario. The observed increase in the incidence of child food poverty is somewhat smaller; 7.8 percentage points as opposed to the increase of 6.8 percentage points when the transfers exclusively benefit the children (or when the transfers are made to all the family members ("All")). The reduction in the impact on the poverty gap (to 2.7 percentage points rather than 1.7 percentage points) and the severity (to 1.1 percentage points rather than 0.4 percentage points) of poverty is also smaller. The cost of the intervention is reduced by half, improving the efficiency of the program in terms of the headcount index and poverty gap, but not in terms of the severity of poverty.

In general, although the magnitude of the impacts is smaller, the profile of the impacts of transfers targeting children when there is sharing are similar to those without sharing (or when all the poor are targeted).

Cash Transfer Targeting Poor Children Aged 0–5, After the Crisis ("0–5")

If we were especially concerned about the impacts of the food crisis on the youngest, we could decide to exclusively target them. Table 8 shows the expected effects of the different policies studied on children by age group. It can be seen that the food crisis ("After") increases the incidence of poverty among children aged 0–5 by 10.3 percentage points, as is the case for children as a whole. A policy that makes cash transfers to all poor households ("All") manages to bring this increase down to 7.0 percentage points, while targeting the poorest 20% has almost no impact. Targeting only children with intra-household sharing has almost as much impact on 0–5-year-olds as without sharing (or the case with cash transfers to all of the poor ("All")); an increase of 7.9 percentage points as opposed to 7.0 percentage points.

Of particular interest here are the impacts of a policy that exclusively targets children aged 0–5. Again, if we can ensure that only the targeted children benefit from these transfers, we obtain exactly the same effects on this age group as when all the poor were targeted ("All"). However, if we assume that these transfers end up being shared equitably within the household (according to the share of caloric needs for each individual in the household), the increase in the incidence of poverty is only reduced to 9.0 percentage points ("0–5"). The reductions are smaller, by slightly less than half, than those obtained from targeting all children ("0–14") due to the fact that 0–5-year-olds no longer share in the cash transfers to their elders. Given that the cost of the intervention is less than half as much – by stopping the "leakage" toward households that only have children over the age of 5 – we could say that there is an efficiency gain in terms of the impact on 0–5-year-olds. However, it is important to note that the reductions, through sharing, in the incidence of food poverty among "6–10-" and "11–14"-year-olds are cut by more than half when only targeting "0–5"-year-olds.

Cash Transfers Targeting Poor 6–10-Year-Olds After the Crisis: With Sharing ("6–10")

Likewise, if the concern relates to 6–10-year-olds, for example to avoid school drop outs, the cash transfers could target this group. Again, if the transfer only benefits 6–10-year-old children (without sharing), it will have the same impacts on this age group as the policy that made transfers to all poor individuals ("All"), but at a fraction of the cost. However, if sharing is present ("6–10"), the impact on the incidence of food poverty among 6–10-year-olds is only brought down to 9.0 percentage points, although the cost of the intervention is six times smaller (Section 4.1). Also, the impact of this policy on children in other age groups (via sharing within the household) is smaller.

Similar impacts are observed when targeting 11–14-year-olds.

The Current Policy: Consumption/Production Subsidies ("Current")

The simulated impacts of the current policy on food poverty are very weak, bringing the increase in food poverty from 10.3 to 10.0 percentage points for the population as a whole. The urban population benefits much more from this than the rural population because the targeted products represent a greater share of their consumption.

Obviously, we only capture the immediate effects of the consumption subsidies and the tariff exemptions that were attributed to a handful of specific products. The Malian government has other policies, such as the school feeding programs that are discussed in the following section and the Rice Initiative that aims to increase domestic production and thus has effects that go beyond the scope of the analysis in this study.

4.3 Caloric Insufficiency

4.3.1 Initial Situation (2006)

Insufficient caloric intake plagued Mali even before the crisis (Table 10). Nearly a third (32.1%) of Malian children did not obtain the minimal caloric requirements which, here, is set at 2450 kcal a day (the same threshold used by the World Bank to calculate the absolute food monetary poverty line). As is the case for food poverty (monetary), there is a gap in caloric deficiency between rural (34.5%) and urban (26.3%) children. The rural–urban gap is not as big in terms of caloric insufficiency due to the importance of own consumption of food among rural Malian households which shelters them somewhat from global food prices.

Regional gaps persist in terms of insufficient caloric intake among children, although they are somewhat less than those observed for food poverty. While the rate of caloric insufficiency is relatively low in Kidal (7.5%), it reaches 37.6% in Kayes, and 40.6% (more than two in five children) in Sikasso. While the caloric insufficiency rate slightly exceeds the food poverty rate in Bamako, Kidal, and Gao, it is much lower in Koulikoro, Sikasso, Ségou, and Mopti, these last regions all being characterized by high levels of own consumption of food (e.g. 25% of millet consumption in Koulikoro is own consumption). Furthermore, they consume more millet than rice, and millet is much cheaper per calorie.

While the rate of caloric insufficiency is much higher for children living in male-headed households (32.4% as opposed to 26.5% for children in female-headed households), the gap is less than that observed for food poverty. Again, this is due to the fact that male-headed households are more common in rural areas where own consumption partially compensates for food poverty.

Caloric insufficiency increases with the number of children in the household. Finally, as may be expected, the rate of caloric insufficiency decreases dramatically according to their decile ranking in terms of food expenditures. Only 5.8% of children in the poorest decile do not suffer from caloric insufficiency.

The profile of the caloric insufficiency in the general population is similar to that observed for children.

Table 10 Rate of caloric insufficiency among children, before and after the food crisis, with simulated policies

			Simulation scenarios											
	Population share[a]	Before	After	All	20%	0–14	0–5	6–10	11–14	Current				
	Percentage		Change in percentage points								After		School feeding	
		0–14									6–10	11–14	6–10	11–14
Total		32.1	8.5	4.6	7.9	5.6	7.0	7.4	7.9	8.3	8.9	7.4	2.5	1.9
Area														
Urban	*29.0*	26.3	2.0	1.2	2.0	1.4	1.8	1.9	1.9	2.4	3.1	1.3	−0.5	−2.3
Rural	*71.0*	34.5	11.1	5.9	10.3	7.3	9.2	9.6	10.3	10.6	11.2	10.1	3.7	3.7
Region														
Kayes	*13.0*	37.6	9.6	4.5	9.6	5.9	7.7	8.1	9.4	9.5	10.4	6.9	2.2	1.8
Koulikoro	*16.5*	31.6	6.1	−0.2	5.8	1.9	4.4	4.6	4.9	6.1	6.2	6.9	−1.8	0.8
Sikasso	*18.9*	40.6	13.3	7.0	10.9	8.3	9.8	11.3	11.9	13.1	14.3	10.8	3.0	−0.2
Ségou	*18.0*	32.3	11.9	8.0	11.9	9.3	11.0	10.7	11.5	11.5	13.1	11.1	7.5	6.1
Mopti	*16.4*	24.0	8.5	6.7	8.0	7.1	8.1	8.1	8.5	7.8	8.7	7.1	6.4	6.1
Tombouctou	*4.1*	37.0	4.2	3.8	4.2	3.8	4.2	4.2	3.8	3.1	4.2	5.6	3.1	3.5
Gao	*4.3*	33.1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.2	−3.0	−6.5
Kidal	*0.5*	7.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	7.9	20.3	7.9	20.3
Bamako	*8.3*	19.0	−1.9	−1.9	−1.9	−1.9	−1.9	−1.9	−1.9	−1.0	−1.7	−2.9	−4.6	−5.7
Sex of household head														
Male	*95.0*	32.4	8.4	4.4	7.8	5.4	6.9	7.2	7.8	8.2	8.9	7.4	2.4	1.9
Female	*5.0*	26.5	9.9	7.5	9.9	9.4	9.7	9.8	9.9	10.2	10.0	7.0	5.1	1.5
Number of children														
0													0.0	0.0
1	*1.8*	14.1	3.1	1.9	3.1	1.9	2.5	2.5	3.1	2.7	4.8	6.7	4.8	5.3
2	*5.1*	17.5	4.7	3.0	4.7	3.3	4.2	4.0	4.1	4.4	4.6	4.5	1.9	4.5

Table 10 (continued)

	Population share[a]	Before	Simulation scenarios: After	All	20%	0–14	0–5	6–10	11–14	Current	After		School feeding	
	Percentage		Change in percentage points											
		0–14									6–10	11–14	6–10	11–14
3	*9.4*	19.8	6.4	4.6	6.4	5.5	5.8	6.1	6.3	6.6	5.4	4.1	3.1	1.5
4	*12.2*	23.3	6.2	4.9	6.2	5.3	5.9	6.0	6.0	6.0	7.7	5.4	4.7	3.4
5	*11.9*	26.7	6.1	4.1	6.1	4.7	5.2	5.7	5.4	5.1	4.9	5.6	1.7	3.2
6	*10.6*	30.6	10.1	6.4	10.1	7.4	9.1	9.7	9.7	9.8	11.9	4.8	6.7	0.4
7 or more	*49.0*	40.6	10.3	4.5	9.0	6.0	8.1	8.4	9.5	10.2	10.6	9.5	1.1	1.3
Decile														
1 (poorest)	*10.4*	94.2	2.7	−1.6	0.9	0.9	2.5	2.7	2.7	2.7	2.1	1.3	−1.6	0.2
2	*10.5*	76.2	11.4	2.9	11.2	5.7	9.3	9.5	10.2	12.0	12.7	9.9	−3.6	−1.5
3	*10.7*	56.4	20.2	10.3	18.2	11.9	15.7	18.0	18.4	19.3	19.8	18.5	3.8	3.9
4	*10.3*	38.9	22.0	13.7	20.6	15.7	18.1	17.7	20.0	21.5	24.6	20.4	12.7	8.6
5	*10.1*	24.1	12.7	9.8	12.4	10.3	11.8	12.3	12.3	11.7	12.4	9.2	5.0	2.1
6	*10*	9.6	9.3	6.9	9.3	7.7	8.3	8.7	9.1	8.4	9.0	6.1	5.2	2.5
7	*9.9*	6.1	3.4	2.1	3.4	2.1	2.3	2.1	3.4	3.3	3.7	3.3	2.7	2.7
8	*9.7*	3.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.8	−1.3	0.5	−1.8
9	*9.4*	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.0	0.3
10 (least poor)	*8.9*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[a]Share of the population of children aged 0–14.
Source: Authors' calculations from ELIM 2006.

As was the case for food poverty, the rate of caloric insufficiency is lower among the youngest children, varying from 35.0% for 11–14-year-olds to 25.7% among 0–5-year-olds.[11] Given that the youngest children are especially vulnerable, this result can be seen positively.

4.3.2 Impact of the Food Crisis

The caloric insufficiency rate among children aged 0–14 increases from 32.1% before the crisis to 40.6% after the crisis (Table 10). Children in rural areas are far more affected (an additional 11.1% of children fall into a situation of insufficient caloric intake, as opposed to 2.0% in urban areas) due to the incompressibility of their non-food consumption.[12] The largest increases in caloric insufficiency are in the Sikasso (13.3 percentage points) and Ségou (11.9 percentage points) regions, as well as in households headed by women (9.9 percentage points, as opposed to 8.4 percentage points for those headed by men). The small reduction in caloric insufficiency in Bamako can be explained by the capacity of households to absorb higher food prices by reducing their non-food consumption and by substituting toward more calorie intensive foods such as millet and rice. The crisis increases caloric insufficiency more for children living in households with a large number of children.

When comparing the impacts by decile of food expenditures, it is not surprising that it is the third and fourth deciles, which are closest to the poverty line, that have the highest percentage of children falling into caloric insufficiency. Caloric insufficiency is so high among the poorest decile that the food crisis can hardly make it worse, the rate increasing from 94.2 to 97%. This weak effect can also be explained by the fact that the poorest have a higher level of own consumption and are therefore less affected by the food crisis. Among the wealthiest deciles, the food crisis only leads to a small proportion of children experiencing caloric insufficiency. The impacts of the food crisis are mostly the same for the general population and do not vary systematically by age group among children.[13]

4.3.3 Policy Simulations

The changes in the caloric insufficiency rate among children (0–14 years) with respect to the situation before the crisis are presented in Table 10.

Cash Transfers Targeting All Poor Individuals After the Crisis ("All")

Granting a cash transfer to all poor individuals, equal to the reduction in their real income that results from the price increases, lowers the increase in the caloric insufficiency rate among children by nearly half (from 8.5 to 4.6 percentage points). This is consistent with the impacts already observed for food poverty. In addition, the profile of the impacts of this policy on caloric insufficiency generally conforms to

[11] For details, see Bibi et al. (2009).
[12] See Bibi et al. (2009).
[13] See Bibi et al. (2009).

those on food poverty, with particularly notable reductions in rural areas, in Kayes and Koulikoro, and in male-headed households. The decline in caloric insufficiency in Koulikoro illustrates the fact that malnourished children are mostly found among the poorest, for whom the transfer exceeds the real losses due to the crisis. The impacts of the policy are essentially focused among the poorest deciles and, as we could expect, actually lead to a reduction in the caloric insufficiency rate among the poorest decile relative to their pre-crisis situation.

Cash Transfers Targeting the Poorest 20% After the Crisis ("20%")

Exclusively targeting the poorest 20% for cash transfers has a moderate impact in comparison with full coverage, lowering the increase in caloric insufficiency from 8.5 to 7.9 percentage points. This decrease is greater than that obtained for the level of food poverty (from 10.3 to 10.1 percentage points), since there are more children closer to caloric insufficiency among the poorest 20%. Only children in rural areas benefit, mostly in Koulikoro, Sikasso, and Mopti, as well as those in male-headed households and in households with seven or more children. Not surprisingly, it is children in the poorest decile that benefit the most.[14]

Cash Transfers Targeting Poor Children After the Crisis: Without Sharing ("All")

Again, the impact of a policy that targets children without any sharing with other family members is the same as that of a cash transfer targeting all poor individuals ("All"), but at a fraction of the cost (see Section 4.1).

Cash Transfers Targeting Poor Children After the Crisis: With Sharing ("0–14")

In reality, it is reasonable to assume that cash transfers to children will be at least partly shared with family members. If we assume equitable sharing (proportional to caloric needs), the impact is limited somewhat, with the increase in the caloric insufficiency rate only being held back to 5.6 percentage points. Much of the expected benefits are still achieved, but at nearly half the cost.

These gains are relatively well distributed in terms of the number of children in the household or the area (rural or urban), but are particularly concentrated in certain regions (Sikasso, Kayes, Koulikoro, and Ségou) and in households headed by males or those in the poorest deciles.

Cash Transfers Targeting Poor 0–5-Year-Olds After the Crisis: With Sharing ("0–5")

We now turn to the situation of the youngest children, who are most vulnerable to the harmful effects that caloric insufficiency can have on their physical and mental development as well as their health. Recall that the caloric insufficiency rate

[14] Note that children in deciles 3 and 4 benefit from the policy when they are erroneously identified as being in deciles 1 or 2, i.e., the poorest 20% of the population (targeting error).

before the crisis increases with age, 0–5-year-olds having a rate of 30.2%. That still amounts to 3 in 10 children who cannot fulfill their caloric needs. Even worse, the crisis brings about an 8.7 percentage points increase in caloric insufficiency (Table 11).

Table 11 Caloric insufficiency rates by age group before and after the food crisis with policy simulations

	Scenario								
	Before	After	All	20%	0–14	0–5	6–10	11–14	School feeding
	%			Change in percentage points					
0–5 years	30.2	8.7	4.4	7.9	5.6	6.8	7.6	8.2	
6–10 years	32.8	8.9	5.0	8.4	*6.0*	7.7	7.6	8.4	2.5
11–14 years	35.0	7.4	4.0	6.9	5.1	6.6	6.6	6.5	1.9
0–14 years	32.1	8.5	4.6	7.9	5.6	7.0	7.4	7.9	

Source: Authors' calculations from ELIM 2006.

Cash transfers targeting all poor individuals ("All") cut this increase in half, whereas targeting the poorest 20% has a relatively small impact. Targeting the poorest children with intra-household sharing ("0–14") achieves a large share of the benefits of the transfer to all poor at about half the cost. When only targeting poor children aged 0–5, the impacts would be the same as for the transfer targeting all poor individuals ("All") if we could ensure that only the targeted children would benefit from the transfer. If we assume that there is equitable sharing within their respective households, the gains are cut in half in comparison with cash transfers that target the poorest children as a whole. That means that more than half of the benefits for children aged 0–5 in this latter scenario come indirectly from cash transfers aimed at their elders. In fact, we observe non-negligible gains for 0–5-year-olds even for policies that only target children in the 6–10 and 11–14 age groups.

Cash Transfers Targeting Poor 6–10 and 11–14-Year-Olds After the Crisis: With Sharing ("6–10" and "11–14")

Even though their initial caloric insufficiency rate is higher, 11–14-year-old children are somewhat less affected by the food crisis. The reduced impacts brought about by the various policies are generally less dramatic, especially for 6–10-year-olds. The exception, of course, is found in the policy that exclusively targets them.

Current Policy: Consumption/Production Subsidies ("Current")

The current policy, which consists of small consumption subsidies and tariff exemptions, only has a very small effect, reducing the caloric insufficiency rate from 8.5 to 8.3 percentage points. The subsidy policy encourages substitution toward the targeted products: rice, cooking oil and milk powder. Given that these products have higher costs per calorie than, for example, millet and sorghum, this policy even increases the caloric insufficiency rate in the urban area. However, this analysis does not consider protein of or other nutritional contributions of these items, which may justify this intervention.

School Feeding Programs

The Malian government currently operates a school feeding program in certain schools in the poorest regions in the country. The household survey does not indicate which children benefit from the program. Instead, we conduct a simulation of a policy where all children who are identified as poor and who attend primary school participate in the program. The program entitles them to a meal with 150 g of grains, 30 g of pulses and 10 g of vegetable oil, which provides them with 729 kilocalories, about a third of the daily caloric needs for the average male adult, without considering other nutritional needs (protein, fat, vitamins, etc.). The mean is here provided on a 365 days a year basis.

The simulations indicate that such a policy would reduce the increase in caloric insufficiency from 8.9 to 2.5 percentage points among 6–10-year-olds and from 7.4 to 1.9 percentage points among 11–14-year-olds (Table 10). Children aged 0–5 do not participate in this program since they are not old enough to go to school. This program exceeds the impacts of all other policies studied here by far in terms of caloric insufficiency, and does so at a fraction of the cost. The annual cost per student for the meals provided (9,245 CFA at Bamako prices in September, 2008) is similar or less than the value of cash transfers offered per individual for the other interventions in most regions (Table 9). As indicated in Section 4.1, the savings come from the fact that this intervention only targets children who are predicted as poor and participate in primary school. The sizeable reduction in the caloric insufficiency rate can be explained by the fact that this budget is exclusively available for highly nutritional goods which are supplied directly to the children, whereas the cash transfers can also be used to consume other goods, such as non-food consumption, and are more easily shared within the household.

As was the case for targeting based on predicted income, there are certain risks in terms of the excluded poor and included non-poor. However, given that caloric insufficiency also occurs among some non-poor children, any "leakage" in their favor still contributes to reducing the average rate of caloric insufficiency. However, primary school children who are erroneously predicted as non-poor as well as poor children who do not attend primary school do not benefit from this intervention. While the first of these are probably the least poor of the poor (and are thus most easily identified as non-poor by accident), children who don't go to school are disproportionately the poorest of the poor. Children who are too young to go to school are also excluded, despite having the most acute nutritional needs. Finally, an important caveat to this policy is the possibility that the child's rations will be reduced at home when they receive a meal at school, which clearly reduces the impact on their caloric insufficiency rate.

This policy would certainly also have impacts on food poverty, and even on school participation, child labor, and access to health services that go beyond the scope of the present analysis. It is often the positive impacts on school participation that constitute the principal objective of school feeding programs.

4.4 School Participation and Child Labor

4.4.1 Initial Situation (2006)

We analyze school participation before considering child labor. According to ELIM 2006 the school participation rate in 2006 was 48.1% for 6–10-year-olds and 56.7% for 11–14-year-olds, amounting to an average rate of 51.4% for children aged 6–14 (top of Table 12, "School" column). For children aged 6–10, as well as for their older siblings, the school participation rate is slightly higher for boys.

Among 6–10-year-olds, as expected, a greater portion of children go to school in urban areas (68.6%) than rural areas (40.0%). Outside Bamako (82.2%), the rate varies considerably, from 41.3% (Ségou) to 53.1% (Tombouctou). Evidently, the rate varies substantially according to the socio-demographic characteristics of the household head. For example, the school participation rate is 41.8% when the head of the household has not been to school, as compared to 87.9% when they have had schooling beyond primary school. Children from households headed by someone working in the public sector have higher participation rates (82.5%) than households headed by peasants or independent farmers (39.4%). Children in the wealthiest households, in terms of food expenditures, record a higher participation rate in primary school (69%), more than twice those in the poorest households (33%).

As for 11–14-year-old children, more than three-quarters of urban children attend school, as opposed to less than half in the rural area. The school participation rate varies most substantially between regions for children aged 6–10, ranging from 38.1% (Kidal) to 79.9% (Bamako). These are the only two regions where the school participation rate is lower than it is for 6–10-year-olds. The school participation rate for 11–14-year-olds is higher than for 6–10-year-olds in every other region regardless of the area, the education level of the household head, the decile of food expenditures, and the socio-professional category of the household head, with the only exception being employers, for whom we observe the opposite. The general profiles are the same as for 6–10-year-olds.

As for child labor, its overall level was estimated at 36% in 2006, with 30.4% for children aged 6–10 and 45.3% for 11–14-year-olds. As was the case for schooling, the labor participation rate is highest among boys. However, it should be noted that child labor identified in ELIM 2006 is defined as economic work, which includes work at a family farm or business, but excludes domestic work. It is clear that domestic work is much more widespread among girls.

The labor participation rate is three times higher in rural areas than in urban areas, whether considering 6–10-year-olds (38.8% in rural areas as opposed to 9.1% in urban areas) or 11–14-year-olds (57.2% compared to 19.0%). The highest rates are observed in Sikasso and Mopti (more than 60% among 11–14-year-olds), while Gao and Bamako have much lower rates of child labor. Child labor decreases with the level of education of the household head and with income (measured by decile of food expenditures). Particularly high rates are found among children living in households headed by independent farmers, while it is nearly inexistent in households led by a salaried worker.

Table 12 School participation rate and labor participation rate for children before and after the crisis, with policy simulations (in percentage)

Activity category	NW/NS	W/NS	NW/S	W/S	School	Work						
Age 6–14	24.4	24.2	39.6	11.8	51.4	36.0						
Activity category	NW/NS	W/NS	NW/S	W/S	School	Work	NW/NS	W/NS	NW/S	W/S	School	Work
Age subgroup	Age 6–10						Age 11–14					
Total	31.2	20.7	38.4	9.7	48.1	30.4	13.3	30.0	41.4	15.3	56.7	45.3
Child's sex												
Boy	29	21	39	11	50.2	32.0	10	30	42	18	60.3	48.3
Girl	34	20	38	8	46.0	28.6	17	30	41	12	53.1	42.1
Area												
Urban	26	5	65	4	68.6	9.1	16	35	70	9	78.4	19.0
Rural	33	27	28	12	40.0	38.8	11	31	29	18	46.9	57.2
Region							9	34				
Kayes	45	10	38	7	45.0	16.2	24	23	32	17	49.3	52.1
Koulikoro	30	23	39	8	46.7	31.7	7	46	44	14	57.4	44.9
Sikasso	23	31	26	20	46.5	51.0	9	31	28	29	56.9	63.2
Ségou	39	20	34	7	41.3	27.0	25	0	41	12	53.3	35.4
Mopti	24	33	31	12	42.8	45.3	38	23	31	16	47.0	61.5
Tombouctou	29	18	43	10	53.1	28.4	8	12	45	15	60.5	45.8
Gao	49	0	50	0	50.3	0.4			75	0	75.0	0.3
Kidal	29	22	48	1	49.1	22.6	11	10	38	0	38.1	23.4
Bamako	15	2	82	1	82.2	3.1	14	39	78	2	79.9	13.4
Education level of household head												0,0
None	34	24	31	11	41.8	34.7	15	35	34	17	50.2	51.4
Primary	23	9	61	7	67.5	15.9	10	15	62	13	75.1	27.8
Post-primary	11	1	83	5	87.9	6.1	3	9	81	7	88.1	16.1
Socio-professional category												
Salaried – public	17	1	79	4	82.5	4.3	2	5	86	6	92.4	11.6
Salaried – private	35	2	61	2	63.1	4.1	20	10	65	5	69.8	14.5
Employer	19	12	67	2	69.1	13.5	12	23	57	8	65.1	31.7

Table 12 (continued)

Activity category	NW/NS	W/NS	NW/S	W/S	School	Work						
Age 6–14	24.4	24.2	39.6	11.8	51.4	36.0						
Activity category	NW/NS	W/NS	NW/S	W/S	School	Work	NW/NS	W/NS	NW/S	W/S	School	Work
Age subgroup	Age 6–10						Age 11–14					
Independent farmer	31	29	26	13	39.4	42.4	12	41	27	21	47.4	61.4
Independent non-farmer	30	8	59	3	62.3	11.0	16	15	61	8	68.9	23.1
Other employed	27	30	34	9	43.4	39.2	8	42	39	11	49.8	53.4
Unemployed	39	13	39	9	48.0	21.7	21	21	45	13	58.2	33.9
Decile (in equivalent food expenditures in 2006)												
dec1 (poorest)	32	35	25	8	33.3	43.2	17	44	27	12	39.1	56.7
dec2	35	23	33	9	42.6	32.0	17	30	35	19	53.2	48.7
dec3	35	25	28	12	39.9	36.9	15	33	30	23	52.2	55.5
dec4	31	26	30	13	43.1	39.0	16	34	33	17	50.2	51.4
dec5	25	27	35	13	48.0	39.9	9	33	39	19	58.2	52.2
dec6	28	20	41	11	52.0	30.6	11	28	44	17	61.5	45.0
dec7	35	16	41	9	49.5	24.9	14	32	45	10	54.1	41.3
dec8	34	13	45	8	52.7	20.5	12	22	53	12	65.1	34.7
dec9	29	12	52	7	59.2	19.3	12	20	55	13	67.5	33.2
dec10 (least poor)	27	4	65	4	69.0	8.8	9	14	70	8	77.5	21.5
Scenarios												
After	0.31	0.40	−0.54	−0.17	−0.71	0.23	0.31	0.37	−0.30	−0.37	−0.67	0.00
All	0.11	0.02	−0.13	0.00	−0.13	0.02	0.07	0.04	−0.06	−0.04	−0.10	0.00
20%	0.29	0.30	−0.48	−0.11	−0.59	0.19	0.27	0.28	−0.27	−0.28	−0.55	0.00
0–14	0.16	0.13	−0.25	−0.05	−0.29	0.08	0.14	0.14	−0.14	−0.14	−0.28	0.00
0–5	0.26	0.30	−0.43	−0.12	−0.55	0.17	0.25	0.29	−0.25	−0.29	−0.54	0.00
6–10	0.25	0.28	−0.41	−0.12	−0.53	0.16	0.25	0.29	−0.24	−0.29	−0.53	0.00
11–14	0.28	0.34	−0.48	−0.14	−0.62	0.20	0.25	0.29	−0.25	−0.30	−0.54	0.00
Current	0.29	0.38	−0.51	−0.16	−0.67	0.22	0.29	0.35	−0.28	−0.35	−0.63	0.00

Notes: S/NW=School–no work; S/W=School–work; NS/W=no school–work; NS/NW=no school–no work
Source: Authors' calculations from ELIM 2006

Work is not just for children who do not attend school. Indeed, 11.8% of children combine work and education (“W/S”, top of Table 12); 15.3% among 11–14-year-olds. Conversely, the percentage of children who work and do not attend school (“W/NS”) is 42.2%; 20.7% of children aged 6–10 and 30.0% of those who are 11–14 years old. Nearly 40% of children attend school without working (“NW/S”) in the two age groups, while the “inactive” rate (“NW/NS”) is higher among 6–10-year-olds (31.2%) than among 11–14-year-olds (13.3%).

4.4.2 Determinants of School Participation and Child Labor

To analyze the impact of the food crisis and possible policies to respond to this crisis, a regression model can be used to predict the probability that a child is in one of the four situations listed above. That allows us to identify the principal determinants of school participation and child labor.

Given that the crisis essentially influences decisions through its effects on real household income, the analysis specifically focuses on the crisis’ impacts on this variable. As might be expected, the probability of attending school increases significantly with household income. Yet, income does not have a significant impact on the probability that a child works. However, a negative effect may be hidden by problems of endogeneity between child work and household income, either because child labor increases household income or this income comes from physical assets that are unobserved (in the household survey) but increase the demand for child labor (see Cockburn and Dostie, 2007).

When considering the marginal effects of different characteristics on the probability that a child is found in one of the four possible combinations of work and school, we find that household income has a positive effect on school participation (with or without work) and a negative effect on the probability that the child works without going to school (NS/W) or is “inactive”[15] (NS/NW).

Let’s take a brief look at the impact of the other variables, which we assume to be unchanged by the crisis. Whether considering children aged 6–10 (Table 13) or 11–14 (Table 14), we note that school participation is lower for girls and in rural areas, but is positively correlated with the number of children in the household (for 6–10-year-olds), school proximity, and the age and level of education of the household head. It is also significantly higher than the reference region (Kayes), in Koulikoro, Sikasso and Tombouctou (and, for 6–10-year-olds, in Bamako). It is interesting to see that owning animals appears to have a negative effect on school participation for 6–10-year-olds, possibly since children are often responsible for watching over and taking them to pasture. The school participation rate initially increases with age (among 6–10-year-olds) and then declines (among 11–14-year-olds). The older children are also more likely to go to school in female-headed households.

[15] Recall that the definition of child labor excludes domestic labor.

Table 13 Determinants of children's participation in school and work (6–10 years old)

	Coefficients		Marginal effects			
	School (S)	Work (W)	S/NW	S/W	NS/W	NS/NW
Income (logarithm)	0.214***	−0.075**	0.077***	0.009**	−0.030***	−0.055***
Sex of child: Girl	−0.132***	−0.165***	−0.025*	−0.028***	−0.020**	0.073***
Child's age: 6 (CG)						
7	1.016***	0.301***	0.234***	0.144***	−0.050***	−0.328***
8	1.345***	0.400***	0.279***	0.198***	−0.071***	−0.405***
9	1.422***	0.512***	0.237***	0.246***	−0.078***	−0.405***
10	1.308***	0.640***	0.205***	0.259***	−0.048***	−0.416***
Rural	−0.285***	0.484***	−0.142***	0.029***	0.100***	0.013
Region: Kayes (CG)						
Bamako	0.088	0.385***	−0.022	0.057***	0.065***	−0.100***
Gao	0.090	0.933***	−0.112***	0.148***	0.172***	−0.208***
Kidal	−0.078	0.403***	−0.072***	0.041***	0.087***	−0.056***
Koulikoro	−0.058	0.825***	−0.131***	0.108***	0.176***	−0.153***
Mopti	0.299***	0.371***	0.032	0.086***	0.035	−0.153***
Ségou	0.014	−1.584***	0.078*	−0.073***	−0.159***	0.153***
Sikasso	0.071	0.418*	−0.037	0.065*	0.074	−0.103*
Tombouctou	0.543***	0.128	0.142***	0.068**	−0.029	−0.181***
Education: None (CG)						
Primary	0.608***	−0.387***	0.237***	−0.002	−0.099***	−0.137***
Post-primary	1.052***	−0.337***	0.344***	0.027	−0.114***	−0.257***
Age of head: < 36 (CG)						
36–45	0.089	0.083	0.019	0.017	0.008	−0.044
46–60	0.161**	0.122	0.038	0.026**	0.009	−0.074**
61+	0.170**	0.247**	0.022	0.045***	0.030	−0.098***
Sex of head: Woman	0.076	0.016	0.022	0.008	−0.003	−0.027

Table 13 (continued)

	Coefficients		Marginal effects			
	School (S)	Work (W)	S/NW	S/W	NS/W	NS/NW
Number of children: 0–3(CG)						
4–6	0.225***	−0.117*	0.085***	0.005	−0.038***	−0.051**
7+	0.251***	−0.005	0.081***	0.019**	−0.020	−0.079***
Occupation: Independent farmer (CG)						
Unemployed	0.120**	−0.585***	0.092***	−0.044***	−0.097***	0.050**
Independent non*farmer	0.176***	−0.418***	0.099***	−0.029***	−0.078***	0.008
Other	0.239***	−0.472***	0.125***	−0.030***	−0.089***	−0.006
Access to land	−0.003***	−0.001***	−0.001***	0.000***	0.000	0.001***
Own animals	−0.130***	0.408***	−0.087***	0.036***	0.091***	−0.040***
Distance to potable water (minutes)	0.120**	−0.585***	0.092***	−0.044***	−0.097***	0.050**
Distance to market (minutes)	0.176***	−0.418***	0.099***	−0.029***	−0.078***	0.008
Distance to primary school (minutes)	0.239***	−0.472***	0.125***	−0.030***	−0.089***	−0.006
Interview in August	−0.075	0.582***	−0.079***	0.049***	0.100***	−0.070***
Constant	−3.615	−1.351				
Probability (y=1)			0.415	0.064	0.150	0.370
n observations	6,884					
Rho	−0.3332					
Wald rho test=0	Prob>chi2=0.0000					

Notes: CG: Reference group (for dummy variables); S/NW=School–no work; S/W=School–work; NS/W=no school–work; NS/NW=no school–no work; Econometric model: bivariate probit; significant at 1% (***), 5% (**), 10% (*).
Source: Authors' calculations from ELIM (2006)

Table 14 Determinants of children's participation in school and work (11–14 years old)

	Coefficients		Marginal effects			
	School (S)	Work (W)	S/NW	S/W	NS/W	NS/NW
Income (logarithm)	0.188***	0.002	0.040**	0.033***	−0.032**	−0.041***
Sex of child : Girl	−0.258***	−0.104**	−0.035**	−0.066***	0.025*	0.075***
Age of child: 11 (CG)						
12	−0.155**	0.143**	−0.063***	0.003	0.053**	0.007
13	−0.152**	0.187**	−0.071***	0.012	0.061***	−0.002
14	−0.376***	0.430***	−0.167***	0.019	0.149***	−0.001
Rural	−0.542***	0.503***	−0.222***	0.019	0.169***	0.034**
Region: Kayes (CG)						
Bamako	0.313***	−0.293***	0.130***	−0.012	−0.098***	−0.020
Gao	0.296***	0.252***	−0.004*	0.116***	−0.017	−0.095***
Kidal	0.149**	−0.388***	0.111***	−0.054***	−0.090***	0.033*
Koulikoro	−0.012	0.222**	−0.051	0.047**	0.041	−0.036*
Mopti	0.226*	−0.085	0.066	0.020	−0.052	−0.033
Ségou	0.551***	−2.765***	0.360***	−0.165***	−0.278***	0.083
Sikasso	−0.755***	−0.387	−0.164**	−0.126***	−0.013	0.304***
Tombouctou	0.120	−0.101	0.048	−0.001	−0.038	−0.009
Education: None (CG)						
Primary	0.543***	−0.345***	0.188***	0.009	−0.137***	−0.059***
Post-primary	0.786***	−0.400***	0.239***	0.025	−0.171***	−0.093***
Age of head: < 36 (CG)						
36–45	0.240*	0.239	−0.008	0.100***	−0.006	−0.086***
46–60	0.266*	0.242	0.005	0.098***	−0.004	−0.099***
61+	0.222	0.468***	−0.070	0.155***	0.028	−0.113***
Sex of head: Woman	0.324***	−0.190	0.109***	0.011	−0.083***	−0.038*

Table 14 (continued)

	Coefficients		Marginal effects			
	School (S)	Work (W)	S/NW	S/W	NS/W	NS/NW
Number of children: 0–3(CG)						
4–6	0.067	−0.051	0.025	0.001	−0.020	−0.006
7+	0.049	−0.057	0.023	−0.003	−0.019	−0.001
Occupation: Independent farmer (CG)						
Unemployed	0.128**	−0.593***	0.139***	−0.090***	−0.122***	0.072***
Independent non-farmer	0.013	−0.360***	0.071**	−0.066***	−0.067***	0.062***
Other	0.161**	−0.395***	0.115***	−0.053***	−0.093***	0.031*
Access to land	−0.154*	0.568***	−0.145***	0.086***	0.122***	−0.063***
Own animals	0.001	0.110*	−0.023	0.023*	0.020	−0.020
Distance to potable water (minutes)	−0.002	0.007***	−0.002***	0.001***	0.001***	−0.001**
Distance to market (minutes)	0.001**	0.000	0.000***	0.000***	0.000***	0.000***
Distance to primary school (minutes)	−0.003***	−0.001	0.000***	−0.001***	0.000***	0.001***
Interview in August	−0.083	0.194***	−0.059***	0.026**	0.049***	−0.017
Constant	−1.754***	−1.093				
Probability (y=1)			0.441	0.147	0.257	0.155
n observations	4,288					
Rho	−0.561					
Wald rho test=0	Prob>chi2=0.0000					

Notes: CG: Reference group (for dummy variables); S/NW=School–no work; S/W=School–work; NS/W=no school–work; NS/NW=no school–no work; Econometric model: bivariate probit; significant at 1% (***), 5% (**), 10% (*).
Source: Authors' calculations from ELIM (2006)

The same determinants of school participation also act on child labor. Child labor also increases with the child's age, as well as among girls and children living in rural areas. In addition there are regional differences, with the highest rate in Sikasso and a particularly low rate in Gao, followed by Bamako. It is lower when the household head has completed primary or secondary education, but seems to be particularly high in households which are headed by individuals over the age of 60 or, among 11–14-years old, who are unemployed (possibly to compensate for the lack of adult income). It increases with the distance from drinking water and access to land (among 6–10-year-olds), as expected. While weak, the negative impact of school distance is surprising.

4.4.3 Impact of the Food Crisis

To measure the impact of the food crisis, the variation in real income is predicted, accounting for the increase in the value of food sales and the increase in the cost of living, in order to then predict the resulting participation rates in school and work among children after the crisis (row "After" at the bottom of Table 12).

The predicted changes following the crisis are weak. The school participation rate falls by 0.71 percentage points among 6–10-year-olds, meaning that 1 in 140 children is taken out of school. When considering that only 48.1% of Malian children attend school in the first place, this means that about 1 in 68 school-going children quit as a result of the crisis. The impact is slightly lower among 11–14-year-olds (a decrease of 0.67 percentage points), and given the higher initial school participation rate (56.7%), it is nearly 1 in 85 students who leave school as a result of the food crisis. These impacts may seem small, but it should be kept in mind that the decision to send a child to school depends on a number of factors other than income, as seen in an analysis of the determinants of this decision.

We also find a negative effect, albeit very weak and not statistically significant, of the crisis on child labor among 6–10-year-olds. A greater reduction in the school participation rate among children who do not combine school and work ("NW/S") is observed (a decline of 0.3–0.5 percentage points) in comparison to those who work ("W/S") (a decline of 0.2–0.3 percentage points). These children tended to move slightly more toward "work" (W/NS) (with an increase of 0.4 percentage points for both age groups), than toward "inactivity" (NW/NS; 0.3 percentage points for both age groups).

4.4.4 Policy Simulations

By increasing household real income, each of the intervention scenarios succeeds in reducing the impact of the food crisis to some degree or another. In particular, they reduce the school dropout rate.

Cash Transfers Targeting All Poor Individuals After the Crisis ("All")

A cash transfer targeting all poor individuals has by far the largest impact, almost entirely countering the impact of the crisis. The "leakage" of transfers toward non-poor households, incorrectly identified as poor, still contributes to an improvement in school participation due to the fact that many of these households did not send their children to school before the crisis. As such, it is not just those who drop out as a result of the crisis who are helped out by the intervention: some non-poor households who did not send their children to school before the crisis also benefit from this policy. Similarly, the fact that the average cash transfer allocated does not necessarily correspond to the losses of real income for each household does not prevent this transfer from increasing the probability of attending school.

Cash Transfers Targeting the Poorest 20% After the Crisis ("20%")

Targeting the poorest 20% has much less of an effect, probably due to the fact that their incomes are too low to start with for the cash transfers to bring them to the point where they would decide to send their children to school.

Cash Transfers Targeting Poor Children After the Crisis: Without Sharing ("0–14")

Again, the impact of a policy that targets children without any sharing with other family members is the same as that of a cash transfer targeting all poor individuals ("All"), but at a fraction of the cost (see Section 4.1).

Cash Transfers Targeting Poor Children After the Crisis: with Sharing ("0–14")

Targeting all poor children reduces the impacts of the crisis by more than half. Excluding the adults in a household from the cash transfer means that the total cash transfer received by households with children is still reduced. Since it is household income that dictates school–work choices, the impact of this policy is substantially lower. However, at half of the cost (Section 4.1), there is a certain efficiency gain for the intervention at the expense of less complete coverage.

Cash Transfers Targeting Poor Children After the Crisis by Age Group: With Sharing ("0–5", "6–11", "11–14")

Reducing the amount received by households – for children in other age groups – means that targeting a specific age group reduces the net impact of the cash transfers on children even more. Targeting 6–10-year-olds nonetheless reduces the impact of the crisis on their school participation rates by more than a quarter (from 0.71 to 0.53 percentage points) for less than a fifth of the cost of a cash transfer program targeting all poor individuals.

Current Policy: Consumption/Production Subsidies ("Current")

The current policy of small consumption subsidies has almost no impact on children's work–school choice, reducing the impact of the crisis by barely 0.04 percentage points.

4.5 Access to Health Services

4.5.1 Initial Situation (2006)

The analysis indicates that 60.1% of sick children used a health service in 2006 (Table 15). The majority of them (57.1%) made use of community health services,[16] followed by traditional healers (17.1%) or a public hospital (10.6%). Private (7.7%) and regional/sub-regional (7.6%) services came in last.

The profiles of access to health services are not significantly different between boys and girls. However, the probability of consultation is much higher in urban areas (74.6%) than rural areas (55.4%). Urban consultations were much more likely to be in a hospital, regional, or sub-regional service or private service than rural areas, while community services are used proportionally more in rural areas. Access to health services is most prevalent in Bamako, followed by Sikasso and Gao. The Mopti region appears to have the poorest access to these services. Community health services are the most common in all regions, while the use of traditional healers is particularly common in Sikasso.

We also note lower use of health services and greater recourse to traditional healers for children in households headed by someone with no education or who is an independent farmer. The analysis per decile (of food expenditures per equivalent adult) shows that consultation is the greatest at the extremes: the poorest make greater use of traditional healers (36.1%), the least poor make the greatest use of private services (13.8%) and public hospitals (13.0%). There is no particular profile for the rate or type of consultation in the intermediary deciles.

4.5.2 Determinants of Access to Children's Health Services

The probability that a 0–14-year-old child consults a health services when ill increases with household income, registration with a parent's health insurance (such as private salaried workers in the formal sector who are registered with the National Institute of Social Security, INPS), proximity to a health structure, the number of children in the household, and the level of education of the household head.[17] Compared to Kayes (the reference region), use of health services is higher in Sikasso and Bamako, but is significantly lower in Mopti. Children in rural areas consult health services much less than those in urban areas. However, no significant difference is observed between girls and boys or between age groups.

In terms of the type of service consulted, sick children in Sikasso and Mopti used the services of traditional healers most often, while in Gao and Kidal they used them the least. It should be pointed out that use of this type of health service increases with the number of days that the child is sick (in comparison to the CSREF health referral centers or public hospitals) and decreases with household income and health insurance coverage. It is also lower when the head of the household is over the age

[16] See the note at the bottom of **Table 15** for details on suppliers of health services.
[17] For details, see Bibi et al. (2009).

Table 15 Rate of access to children's health services before and after the crisis, with policy simulations (in percentage)

	Percentage of ill children consulting a health service	Principal type of service consulted: Public hospital	Regional or sub-regional service °	Community service °°	Private service °°°	Traditional healers
		Percentage of children who consult health services				
Total	60.1	10.6	7.6	57.1	7.7	17.1
Child's sex						
Boy	60.7	10.7	7.0	57.4	8.1	16.9
Girl	61.4	10.4	8.3	56.7	7.3	17.3
Area						
Urban	74.6	25.1	13.0	38.2	12.1	11.5
Rural	55.4	3.4	4.9	66.4	5.5	19.8
Region						
Kayes	59.4	9.8	10.6	57.7	10.1	11.9
Koulikoro	60.4	13.2	6.3	58.6	8.1	13.8
Sikasso	74.9	8.9	11.0	46.7	8.0	25.4
Ségou	59.0	13.5	3.1	55.6	10.3	17.6
Mopti	47.7	4.7	7.5	67.5	2.7	17.7
Tombouctou	57.8	29.0	3.9	53.5	6.9	6.8
Gao	71.0	20.0	0.0	66.3	13.8	0.0
Kidal	61.2	5.0	5.4	89.6	0.0	0.0
Bamako	83.2	15.1	7.9	52.6	10.1	14.3
Household head education						
None	58.3	8.6	7.4	57.4	7.3	19.3
Primary	66.5	13.5	6.7	60.0	5.2	14.6
Post-primary	78.7	20.5	11.9	44.8	19.1	3.8

Table 15 (continued)

	Percentage of ill children consulting a health service	Principal type of service consulted				
		Public hospital	Regional or sub-regional service °	Community service °°	Private service °°°	Traditional healers
		Percentage of children who consult health services				
Socio-professional category						
Salaried – public	78.5	17.8	10.1	56.2	12.1	3.8
Salaried – private	81.1	13.5	12.8	48.1	16.5	9.1
Employer	60.7	41.1	0.0	53.7	0.0	5.3
Independent farmer	55.5	5.7	5.9	63.4	4.5	20.6
Independent non-farmer	69.3	16.1	11.7	48.1	9.0	15.1
Other employed	58.2	1.6	4.0	48.3	13.4	32.7
Unemployed	61.3	13.4	4.4	58.2	11.6	12.4
Decile						
dec1 (poorest)	70.6	3.7	9.0	46.7	4.4	36.1
dec2	58.7	7.3	3.0	57.3	8.6	23.8
dec3	59.6	10.9	3.5	48.4	9.7	27.6
dec4	53.6	12.6	6.5	63.8	5.4	11.7
dec5	61.3	12.3	10.7	54.6	4.7	17.7
dec6	57.1	4.9	7.9	67.5	4.5	15.1
dec7	61.8	10.0	9.2	52.3	6.6	21.9
dec8	58.8	12.3	6.2	66.3	6.3	8.9
dec9	56.7	15.1	11.1	51.1	8.0	14.8
dec10 (least poor)	71.4	13.0	7.9	59.0	13.8	6.3

Table 15 (continued)

	Percentage of ill children consulting a health service	Principal type of service consulted: Public hospital	Regional or sub-regional service °	Community service °°	Private service °°°	Traditional healers
		Percentage of children who consult health services				
Variations (in percentage points)						
After	−0.46	−0.08	−0.04	−0.85	−0.21	1.17
All	−0.13	−0.02	0.00	−0.17	−0.07	0.26
20%	−0.39	−0.06	−0.02	−0.68	−0.18	0.94
0–14	−0.22	−0.04	−0.01	−0.36	−0.10	0.51
0–5	−0.35	−0.06	−0.03	−0.62	−0.16	0.86
6–10	−0.37	−0.06	−0.03	−0.68	−0.17	0.94
11–14	−0.41	−0.07	−0.03	−0.74	−0.19	1.03
Current	−0.43	−0.07	−0.04	−0.81	−0.20	1.11

Notes: °Regional/sub-regional services include health referral centers at the level of “circles” (sub-regions). °°Community services include community and religious health services, as well as other public, private, or NGO community services. °°°Private services include private clinics and practices and pharmacies.
Source: Authors’ calculations from ELIM (2006).

of 60, especially in comparison with households headed by individuals under 36. Children's access to private health services tends to remain a privilege that is limited to households headed by someone with a post-primary education in comparison to all other groups. In general, access to public health services is relatively limited for rural compared to urban households, households headed by someone between 36 and 60 (compared to those with a household head under the age of 36), and is least commonly used by those living in Mopti, Kidal, and Bamako. The situation is very much the same for regional and national public hospitals.

4.5.3 Impacts of the Food Crisis

The results of the analysis allow us to understand the impact of the food crisis, and in particular the loss of real income that it incurs, on the probability that children between 0 and 14 consult a health services when ill, as well as the type of health services used. In general, the probability of using health services declined by 0.46 percentage points (about 1 in 200 sick children) as a result of the crisis. Community (−0.85 percentage points) and private (−0.21) health services are particularly affected. Conversely, there was a substantial increase in the number of people turning to traditional healers (1.17 percentage points, amounting to an increase of about 7%) with the crisis, surely due to the lower cost of these health consultations and traditional medicines, which are generally in the form of medicinal plants.

4.5.4 Policy Simulations

Cash Transfer Targeting All Poor Individuals After the Crisis ("All")

Again, this is the policy that has the greatest effect in reducing the impacts of the crisis, but it is also the most costly. It reduces the impact of the crisis by 70%. Thus there would only be one out of 750 children (=100/0.13) more who would not use any health services when sick as a result of the crisis, as opposed to 1 more per 219 (= 100/0.49) without any policy. As was the case for the school–work choice, the "leakage" of the program toward households who are incorrectly identified as poor nevertheless contribute to an increase in the use of health services. As such, the decline in the use of health services among the poor is partially counterbalanced by an increase in the number of non-poor who are incorrectly targeted by the policy. These impacts are distributed relatively evenly among the different types of health services.

Cash Transfer Targeting the Poorest 20% After the ("20%")

Targeting the poorest 20% definitely has a much lower impact on the total number of health consultations among sick children, only bringing the increase in children who do not consult health services due to the crisis down from 0.46 to 0.39 percentage points. This can be explained by smaller target population, substantial under-coverage, and the fact that these households have too little income to start with for the cash transfer to bring them to the point where they would decide to use health services when their child was sick. These impacts are similar for all types of health services.

Cash Transfer Targeting Poor Children After the Crisis: Without Sharing ("0–14")

Again, the impact of a policy that targets children without any sharing with other family members is the same as that of a cash transfer targeting all poor individuals ("All"), but at a fraction of the cost (see Section 4.1).

Cash Transfer Targeting Poor Children After the Crisis: With Sharing ("0–14")

In the presence of intra-household sharing of cash transfers targeting poor children, the impact of the crisis are reduced by nearly half, which is not far from the effect of the transfer targeting all poor individuals (children and adults). Its impact is less since there are no indirect benefits to children from transfers to adults in their households. At half the cost (Section 4.1), this policy achieves a certain efficiency gain, but at the cost of less coverage. The crisis' impacts on each of the types of services are brought down by more than half.

Cash Transfer Targeting Poor Children After the Crisis by Age Group: with Sharing ("0–5", "6–11", "11–14")

By removing cash transfers to children in other age groups, targeting a specific age group makes the total cash transfer to the households of affected children even lower, further decreasing the net impact of these transfers. Targeting children between the age of 0 and 5 has the greatest impact on the rate of consulting health services across all types of services.

Current Policy: Consumer/Producer Subsidies ("Current")

The current policy of limited consumption subsidies and tariff reductions has very little impact on the use of health services, reducing the impact of the crisis by less than 6%.

5 Conclusion

Mali has not escaped the global food crisis. The considerable increases in the prices of its principal food items, especially grains, the sizeable share of food in the budget of poor households and their limited ability to adjust to these price hikes has made the crisis a major challenge. The impacts on children are particularly worrisome due to their already precarious situation in terms of nutrition, school participation, child labor, and access to health services.

This document presents the results of an in-depth simulation analysis of the impacts of the food crisis and the different policies that are available to the policymakers. The analysis goes beyond the impacts on food consumption, also considering nutritional, educational, health, and child labor effects.

A number of key points can be taken from this analysis. Between August 2006 and 2008, Mali endured huge increases in food prices of up to 67% for some food products in some regions. For most of these products, it was the Bamako and Kayes regions that saw the strongest increases in food prices.

The crisis is estimated to have increased the rate of child food poverty from 41.5 to 51.8%. While the incidence of food poverty (the percentage of poor children) increased more in urban areas, increases in the poverty gap (average distance below the poverty line) and the severity were more extreme in rural areas. Regional and socio-economic variations are also observed.

As a result of the food crisis, the rate of caloric insufficiency among children is expected to have increased from 32.1 to 40.6%. It is especially children in rural areas who are predicted to have been the most affected due to the incompressible nature of their non-food consumption. In Bamako, by contrast, the initial share of non-food consumption was much higher, leaving them more flexibility to cut such expenditures in order to maintain their caloric intake.

There are also strong reasons to believe that households are more likely to take their children out of school and put them to work when they are faced with a loss in real income. The analysis effectively reveals a positive relation, albeit a weak one, between income and school participation, which is predicted to have led to the drop out of 1 out of every 80 school-going children. The slight majority of these children were put to work rather than becoming “inactive.”

Finally, a small decline (0.46 percentage points) is observed in the percentage of ill children with access to health services as a result of the crisis. A definite shift toward greater use of traditional medicine was also observed.

In terms of policies, most of the scenarios look to compensate the poor for the impacts of the food crisis using different types of cash transfers. The differences mostly have to do with the population targeted by the policy. Many important lessons can be taken from the results.

To start with, in the absence of reliable information collected on household income or expenditures, any policy targeting the poor requires that we can accurately predict whether the household is, or is not, poor. This work must be done using a limited number of easily observable characteristics that are difficult for the households to manipulate. The estimated relation between these characteristics and household income, based on analysis of recent household survey data, is used for this purpose. This is clearly not an exact science and some households will be misidentified, either in terms of under-coverage (erroneously excluding households that are actually poor) or leakage (erroneously including households that are actually non-poor). While the first error reduces the impact of the policy on the target population, the second increases it’s costs. A number of targeting approaches were tested. In the best of these cases, about a quarter of the poor were erroneously excluded, while a third of the non-poor were included. In rural areas, the exclusion errors are smaller and the inclusion errors are greater, whereas the opposite is true in urban areas. When targeting the poorest 20%, the exclusion error soars to more than three-quarters of the poor. This is because it is particularly difficult to effectively distinguish the poorest of the poor due to similarities in their observable characteristics.

In general, our simulations demonstrate the importance of having good criteria for identifying the poor. The better we can identify the characteristics that effectively identify the population of interest, the lower the costs and greater the effectiveness of the policy. The identification criteria must be operational (easily observed and difficult to manipulate) in the actual context of their implementation by government.

Rather than targeting all members in poor households, it is also possible to target poor individuals within households, such as children. Many lessons come from considering these approaches.

First, there is no way to control the allocation of a cash transfer within a household to make sure that only the children benefit. Even if the transfer is in the form of a meal that is directly provided to the child at school, it is quite possible that the allocation of household food resources to the child will be reduced in turn. If children could be precisely targeted, it would be possible to significantly reduce the costs of the policy (by eliminating all transfers to adults) without compromising the impacts on child food poverty and nutrition. However, even in this case, their participation in school and their access to health services suffers because these decisions depend on total household income. As such, the reduction in transfers to adults in their household has direct negative effects on children, and these effects increase with the adult-to-child ratio in the household. Clearly, excluding households that only include adults offer pure savings to a policy whose sole concern is the welfare of children.

If, however, we assume that the entire transfer to a child is, in fact, shared within the household – proportionally to the caloric needs of each member – nothing changes in terms of school participation or access to health services, but it dramatically reduces the impact of the price increase on children's food and nutritional poverty. That having been said, the decrease in the impact is proportionately smaller than the savings given that excluding households without children constitutes a "pure" savings. As such, we can speak in terms of a cost–benefit efficiency gain and of a significant absolute cost reduction, but at the price of a smaller average impact on the targeted children.

As for targeting specific age groups of children, such as the youngest when the main concern is nutrition or their elder siblings when the main concern is school participation, other lessons can be drawn from this exercise. Again, there is no way to guarantee that the transfers heading to a particular age group are not shared within the household, reducing the impact on food poverty and caloric intake. Regardless of intra-household sharing, the elimination of transfers to children in other age groups within the household reduces the impact on household total income and, consequently, on school participation and access to health services for the target age group.

These simulations also offer an interesting lesson concerning "leakage" (erroneously included non-poor households). While this leakage only increases costs without any benefits in terms of reducing food poverty, it has beneficial impacts on the caloric insufficiency rate, school participation and children's access to health services. This is because of the non-negligible number of non-poor children suffering from caloric insufficiency, not attending school and/or having no access to health services.

The policies of making cash transfers to all poor individuals (adults and children) is by far the most costly (86.3 billion CFE, or 2.6% of GDP), but has the strongest effects. The increase in food poverty due to the food crisis is brought down from 10.3 to 6.8 percentage points, while the rate of caloric insufficiency increases by only 4.6 percentage points rather than 8.5, the school participation rate decreases by just 0.1 percentage points rather than 0.7, and the decline in the number of children using health services is held to 0.13 percentage points as opposed to 0.46 when no policy to mitigate the effects of the crisis is considered.

When only targeting the poorest 20% of the Malian population, the cost falls by 80%, partly because the targeted population is half the size, but especially because exclusion errors (erroneously excluded individuals) increase from 25.8 to 77.7%. The decrease in the impacts range from 80 to 94% depending on the type of poverty analyzed for the same reasons. Given the difficulty in targeting this population, this policy does not seem desirable.

Whether targeting children in general or by age group, the savings are in tandem with the proportion of the poor in that age group (e.g., 50% savings when targeting children in general), but the impacts on school participation and access to health services decrease less than proportionally as the exclusion of adults-only households constitutes a "pure" savings. In terms of food poverty and caloric insufficiency, the impact depends on the assumptions with respect to intra-household sharing of the cash transfers. Without sharing of the benefits, the impact on children is the same as a policy of cash transfers to all poor individuals, but at a fraction of the cost. However, if the transfer is shared, the impact diminishes in proportion to the degree of intra-household sharing. Even if the sharing is "complete" (equitable), the impacts decline less than in proportion to the costs. As such, we can speak in terms of efficiency gains, even if these gains come at the price of a lower average impact.

The analysis of the school feeding program policy brings specific lessons for this intervention. If one supposes that the child's food rations at home are not reduced, this policy nearly manages to eliminate the impact of the food crisis on the caloric insufficiency rate. Positive impact in terms of food poverty, school participation (for which the school feeding program constitutes a strong incentive), and even access to health services (only if the household can reduce food expenses by limiting the child's rations at home) are also to be expected. Moreover, this intervention is less costly than cash transfers. These savings mostly originate from the fact that the program is limited to poor children going to primary school. Also, it specifically concentrates the funds on nutritional foods, while cash transfers granted to households can also be used for non-food consumption as well as less nutritious food consumption.

A few limitations to this policy should be kept in mind. To start with, this intervention does not reach children who do not go to primary school. Since these excluded children are young (when nutritional needs are most important) or are among the poorest children (less likely to attend school), this is an important exclusion error. Other complementary measures aimed at the excluded children should therefore be considered. Also, where children's food rations are cut at home, the impacts on the rate of caloric insufficiency and food poverty would be lower, although these savings for the household could lead to better school participation and access to health services. Also, the household (or the child) is deprived of the benefit of the increased non-food consumption that can result from cash transfers.

The last simulation is of the current policy adopted by the Malian government, which takes the form of consumer subsidies and tariff exemptions on specific products: rice, cooking oil, and milk powder. Although relatively inexpensive, this policy only has very weak effects on the aspects of child poverty investigated in this study. Additionally, it is not very efficient since the effects are spread among the entire Malian population, poor or otherwise. Finally, we observe that it is especially the urban population that benefits, due to the nature of the products that are chosen. This analysis neglects other policies put in place, notably the "Rice Initiative," which acts through supply-side channels.

This analysis has effectively shed some light on the inherent difficulties of implementing state interventions that benefit the poor. Although efforts to better target the poor simultaneously reduce costs (by excluding the non-poor) and increase its impacts (by maximizing the number of poor who are included), they should take into consideration the importance of using simple mechanisms, based on a limited number of easily observable characteristics that are difficult to falsify. It is tempting to target only the extreme poor to reduce costs, but they are even more difficult to effectively identify because they share similar observable characteristics with the "moderate" poor. The targeting errors reach unacceptable levels, which simultaneously increase costs and decrease the impacts. We might then prefer to carry out cash transfers that specifically target children, but this also carries certain dangers. On the one hand, we cannot be sure that the benefits in terms of food and caloric consumption would not be directly or indirectly shared with other household members. On the other hand, school-related decisions and access to health services are driven by total household income regardless of which member is targeted for cash transfers. Nonetheless, by excluding households without children, a certain efficiency gain is achieved by targeting children alone.

In the challenging context of the food crisis, simulations of a school feeding program policy stand up fairly well. By ensuring that the funds are only used to purchase highly nutritious food, it strongly reduces the caloric insufficiency rate and probably food poverty too, all the while acting as an incentive for children to go to school rather than work. However, a substantial portion of children do not benefit from this intervention. This group includes the most vulnerable (too young to go to school) and the most poor (too poor to go to school, even with the incentive of a school feeding program). As such, other complementary policies directed toward these excluded children should also be implemented.

Finally, in order to make policy interventions more cost-effective, this study helps us to identify a mix of responses which might be implemented with respect to specific features and vulnerabilities shown by each child age group. Children in the pre-school age (0–5 years old) might be targeted with specific nutritional programs as well as with cash transfers. Under the second option, if targeting methods based on proxy-means approaches are deemed as unfeasible in the Malian context, then a universal cash transfer to all children aged 0–5 might be considered. A similar approach would cost 0.97% of GDP and, among other positive effects, would very likely motivate households and local authorities to enhance the birth registration; if only poor children are entitled to benefit of the program, the cost would be 0.57% of GDP. For children in school age, a school feeding program or a broader school-based nutrition program (as that proposed in the text) for children going to school is suggested, with a cost of 0.22–0.44 as percent of GDP. Such a combination of policy interventions in favor of children in Mali would thus cost between 0.79 and 1.41% of GDP and show significant positive effects on the various poverty dimensions we discussed.

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