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Essays on Human Development and Public Policy

A Dissertation submitted in partial satisfaction
of the requirements for the degree of

Doctor of Philosophy

in

Economics

by

Neha Rajaram Raykar

August 2011

Dissertation Committee:

Dr. Anil B. Deolalikar, Chairperson
Dr. Jorge Agüero
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The Dissertation of Neha Rajaram Raykar is approved:

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Acknowledgments

This dissertation would not have been possible without the grace of God, and the blessings, guidance, and support of several people who have greatly contributed to my professional and personal well-being in the last five years as a graduate student. This entire journey has been a thoroughly humbling experience and as I reach this important milestone, I must thank the following remarkable people who have made this happen.

I am deeply grateful to my dissertation advisor, Dr. Anil Deolalikar, without whom, I would not have been here. Right since I joined the doctoral program at Riverside, Dr. Deolalikar has been a precious source of knowledge, support, and help. I am grateful to him for painstakingly monitoring my dissertation and graduate progress in general. His confidence in my abilities and eternal optimism have always inspired me to do my best. I am highly indebted to Dr. Jorge Agüero and Dr. Mindy Marks for their immense guidance, patient nurturing, and extraordinary support. As members of my dissertation committee, they have been actively involved in my academic progress; they have inspired new ideas in me, given me the opportunity to professionally collaborate with them, and have regularly advised me on a wide range of issues, academic and otherwise. I cherish their contribution to my graduate life, and hope for a lifetime of collaboration with them. I am very grateful to Dr. Aman Ullah for his continued guidance and encouragement through the last five years. I thank Dr. Jang-Ting Guo for his expert advice and practical tips in troubleshooting that have seen me through many difficulties. Moreover, I want to sincerely thank all the professors in the Economics Department at UC Riverside for their valuable lessons and academic training. I also acknowledge the immense cooperation extended to me by the non-teaching staff at the department: Amanda Labagnara, Tanya Wine, Damaris Carlos, and Karen Ward.

I am humbled by the unconditional love, incredible patience and immense sacrifice of my father Rajaram Raykar and sister Tanvi Raykar. They have been wonderfully encouraging of my academic pursuits and have given me tremendous emotional strength in times of need, regardless of the physical distance between us. I must also thank my relatives for their kind support and blessings. Among my friends in India, Bijal Trivedi and Shyma Rajagopal deserve a special mention for being pillars of strength and hope. I am very thankful to all my exceptional friends in Riverside who have given me a home away from home for the last five years. I specially thank Vikrant Sanghai, Swati Sanghai, Shweta Puntambekar, Sonali Deshpande, and Amruta Garud for their continuous help, encouragement, and generosity throughout my stay in Riverside. From the Economics department, the very inspiring Trini Beleche has been the proverbial "friend, philosopher, and guide" in all respects; Xiangbo Liu, Chandler Lutz, and Deniz Baglan have brought me laughs, cheer, and fun in times of distress. I thank all my classmates and colleagues in the department for extending their kind cooperation and help from time to time.

To my late mother. Her undying love, strength, and optimism have been my constant support.

ABSTRACT OF THE DISSERTATION

Essays on Human Development and Public Policy

by

Neha Rajaram Raykar

Doctor of Philosophy, Graduate Program in Economics
University of California, Riverside, August 2011
Dr. Anil B. Deolalikar, Chairperson

Poverty alleviation and welfare improvement of the poor have been the primary goals of policy makers in the developing world. Governments, policymakers, and international development agencies have regularly allocated a wide range of resources in attempts to improve socio-economic indicators of well-being amongst the poor. Careful analysis backed by rigorous evaluation of these efforts is of utmost importance in order to ascertain whether these goals are being met. My work focuses on some of the development goals and the role of policy efforts in addressing these.

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Chapter 1

Introduction

My dissertation focuses on human development and the role of public policy in targeting development objectives in low-income countries. The first essay is a cross-country analysis of the general development goals adopted by 189 United Nations member countries in the form of the Millennium Development Goals (MDG) as a policy tool to increase global efforts toward improving human conditions in poor countries. The second essay addresses one of the development goals of universal primary education in the context of India and evaluates the effect of a public policy aimed at improving access to primary schooling on educational attainment of women. The third essay presents a review of the literature on nonmarket returns to schooling, with particular focus on outcomes related to fertility that are relevant to findings from the second essay.

In September 2000, the United Nations Millennium Summit adopted the Millennium Declaration which included eight MDG - quantified time-bound targets covering a wide range of development indicators - that the developing countries of the world are expected to meet by 2015. The basic idea behind the MDG is to build a broad time-based policy road map to achieve these development objectives, serve as an effective tool to track progress toward the goals, and galvanize international efforts in cooperation with the developed countries to aid the developing countries in achieving these (UN Millennium Project, 2005). With only four years to achieve the goals in 2015, there has been continuous effort in evaluating the global, regional, or country-specific progress towards the MDG. In the first essay, we first review the current evaluation method and conclude that it suffers from two main drawbacks. First, it uses a narrow definition of *success* and *failure* toward achievement of a goal, ignoring the progress made by countries over time. Secondly, using a binary outcome such as *success* or *failure* ignores the initial conditions of the countries. Our premise is that the current framework of MDG as set in 2000 is analogous to the discussion in microeconomics between poverty and social welfare. We propose the use of the theoretical tools used in the poverty-social welfare discussion to empirically evaluate achievement toward the goals. There are two main approaches to this essay. We first propose an alternative method of evaluation based on social welfare analysis, conditional on the goals as they were originally designed by the United Nations Millennium Summit in September 2000. In the second approach, we investigate whether our evaluations remain robust to an alternative design of the goals. More specifically, we test whether changing the prescribed targets for absolute goals, or changing the goals from relative to absolute alters the gains in overall welfare. To the best of our knowledge, no other work has analyzed the progress towards the MDG from a social welfare point of view.

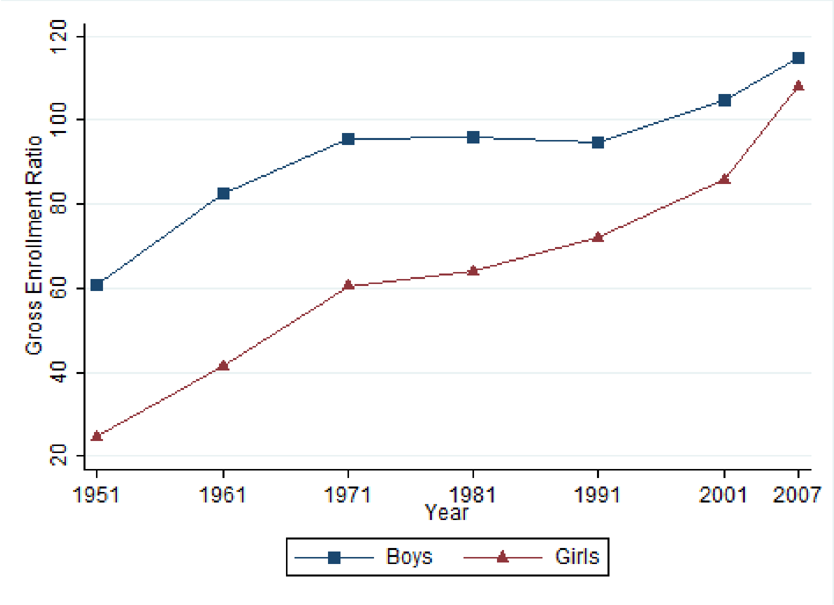
Our findings show that there are significant gains in worldwide welfare from the early 1990s to the mid 2000s. The gains are even higher when we account for improvements of the poorest countries. A decomposition of the overall improvements by region reveals that although Asia is the driving force of overall progress, a welfare evaluation of Sub-Saharan Africa (SSA) shows significant improvements in well-being, thus contradicting the popular view of this region as a "failure". Further we find that the overall gains in welfare are independent of the targets; alternative specifications of the targets continue to suggest worldwide improvements over time. Our findings contribute to the existing literature on the MDG in two crucial ways. Firstly, in line with the proposed role of the MDG as a tool to track progress on development indicators, we propose an objective, welfare-based method of tracking or measuring that progress, taking the current design as given. Secondly, we show that the welfare gains thus measured, are strong and robust to a possible redesign of some of the goals, addressing discussions about the unfairness of their current design. These results have important policy implications if the MDG are believed to galvanize greater development effort by encouraging global partnership and international aid for the poor countries.

The second essay addresses one of the MDG - universal primary education - in the context of India. Since independence, Indian policymakers have been primarily concerned with improving literacy levels and educational outcomes, with particular policy focus on women. Amidst vast improvements in literacy, enrollment rates, and dropout rates, there still exists a wide gender disparity in these indicators; however, these gender gaps have considerably narrowed over time. Figure 1.1 shows the gross enrollment ratios in primary school by gender. Figure 1.2 shows the dropout rates in primary schools by gender. The central as well as state governments have taken various initiatives to improve these educational indicators. This essay evaluates the impact of a primary school expansion program called the Education Guarantee Scheme (EGS) launched by the state government of Madhya Pradesh (MP) in India on the educational attainment of women. The EGS was set up in partnership with local communities as an alternative to government-run schools and were aimed at improving access to primary education in the remote areas of the state that were previously beyond the outreach of the state's schooling network. Most studies documenting the rapid increase of primary schools along with increased enrollment and attendance rates in MP largely consist of subjective field studies conducted in a few districts of MP and lack a rigorous treatment-effect type of analysis (Gopalakrishnan and Sharma, 1998; Clarke, 2003; Leclerque, 2003). The main problem with these studies is that they do not establish any causal relationship between the increase in schools through the EGS and the increased enrollment and attendance rates. Thus, it is impossible to rule out the confounding effects arising from various socioeconomic factors such as a general improvement in income, awareness about education, other state-specific policies and demographic trends, etc. that could simultaneously affect educational outcomes irrespective of the EGS.

I address this issue by using a natural experiment framework whereby I exploit the difference in exposure to the EGS between MP and its neighboring states to establish a causal relationship between the scheme and its impact on educational attainment of women. Variance in exposure to the EGS co-determined by differences in the women's age at the time of the scheme's launch as well as their state of residence. Using the 2005-2006 round of the National Family Health Survey, I compare the educational attainment of the treated group (women who reside in MP and were young enough to benefit from the primary school expansion in 1997) versus the control group (women who resided in the neighboring states or were too old at the time of the EGS launch to be impacted by the scheme). The results indicate a significantly positive impact of the EGS on rural women's completed years of schooling as well as their probability of attending secondary school. The impact is driven by the youngest cohorts of women that were 6 to 8 years old at the time of the program launch. This suggests that the scheme was effective in reducing the private costs of schooling for women who were just young enough to start primary school. These costs remain significantly high for the older cohorts who are unaffected by the EGS; this suggests that the costs of starting school may be highly non-linear for women in rural households - an important result for policies aimed at providing additional schools in remote, rural areas of developing countries. Further, the results remain robust to a battery of checks on the identification strategy explained above.

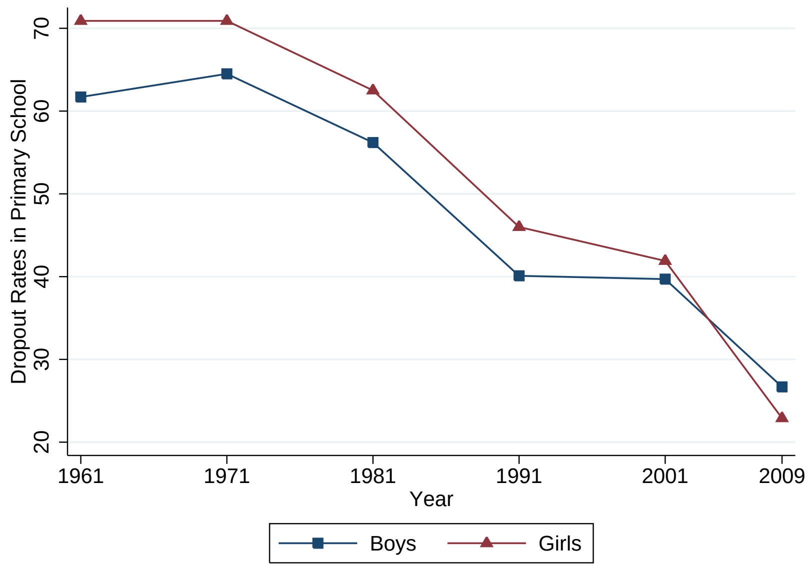
The third essay reviews the literature on the effects of education on two main variables of interest: age at first marriage and contraceptive use. These outcomes are of particular interest as they explain some of the pathways through which education impacts fertility and family size in general. The existing literature that estimates educational effects on these outcomes suffers from limitations due to sample selection and endogeneity biases. Studies using an instrumental variable approach address some of these problems. Future work is aimed at estimating the impact of educational attainment on these outcomes by exploiting variation in the exposure to a school expansion scheme in India as an instrument for educational attainment.

Figure 1.1: Gross Enrollment Ratio in Primary School



Source: Statistics released by the Ministry of Human Resource Development of India

Figure 1.2: Dropout Rates in Primary School



Source: Statistics released by the Ministry of Human Resource Development of India. Total dropout during a course (stage) has been taken as percent of intake in the first year of the course (stage).

Chapter 2

Measuring Achievement of the Millennium Development Goals (with Jorge Agüero)

Abstract: With half the time already passed to achieve the Millennium Development Goals (MDG) in 2015, there is a need to evaluate the progress towards the goals. We argue that the current evaluation strategy used to measure achievement toward the MDG uses a narrow definition of success and is insensitive to the initial conditions of poor countries. In this paper, we first use a welfare-based approach to evaluate progress that overcomes limitations of the current strategy by building a social welfare function that satisfies the main assumptions in the social choice literature. This includes, as a special case, the current evaluation methods of the MDG by international organizations. Secondly, we also consider an alternative design for some of the goals to examine whether our evaluations are robust to alternatively specified targets. Our findings show that there are significant gains in worldwide welfare. The gains are even higher when considering the improvements of the poorest countries. While the gains are higher for Asia, a welfare-based evaluation for Sub-Saharan Africa shows significant improvements in well-being, contradicting the common view of the region as a "failure". Furthermore, the gains in overall welfare are robust to modifications in the design of the MDG.

2.1 Introduction

In September 2000, the United Nations Millennium Summit adopted the Millennium Declaration which included eight Development Goals in an attempt to improve social and economic conditions in the world's poorest countries. The Millennium Development Goals (MDG) are quantified and time-bound targets that should be met by the year 2015 and constitute the world's biggest promise to reduce world poverty and human deprivation (Hulme 2009).

However, since their creation, the MDG have been controversial and have sparked several debates. The discussion includes, but is not limited to, the cost to achieve the goals (Clemens, 2007), whether the focus should be regional or country specific (UN Millennium Project, 2005; Vandemoortele, 2007; Vandemoortele, 2009) their feasibility (Clemens and Moss, 2005; Sahn and Stifel, 2003; Besley and Burgess, 2003; Collier and Dollar, 2001) and the fairness of their design with respect to the performance of specific regions (Eeasterly, 2008).

Furthermore, with only four years to achieve the goals in 2015, there is a continuous effort in evaluating the global, regional, or country-specific progress towards the MDG. In this paper, we first review the current evaluation method and conclude that it suffers from two main drawbacks. Firstly, it uses a narrow definition of *success* and *failure* toward achievement of a goal. In particular, it does not take into account the progress made by countries over time. Whether a country will achieve a goal or not is determined merely by whether the prescribed thresholds (officially called targets) specified per goal will be met by 2015. For example, consider the indicator of poverty headcount (proportion of population below the poverty line of one dollar per day). The prescribed target is to achieve a fifty percent reduction in the poverty headcount measure by 2015. Suppose country A has 30% of its population below the poverty line. To achieve the prescribed target, it is expected to reduce its ratio to 15% by 2015. Now suppose country A manages to reduce its headcount ratio to 16% instead. Clearly, this country will be termed as a "failure" despite the fact that it achieved significant improvements in its headcount ratio but missed the target by only one percentage point. Thus, the current method is insensitive to progress achieved over time.

Secondly, the use of a binary outcome such as *success* or *failure* ignores the initial conditions of the countries. For example, consider again, the above indicator of poverty headcount (proportion of population below the poverty line of one dollar per day). Hypothetically, if two countries A and B start with 70% and 40% of their respective populations below the poverty line, they are expected to reduce these numbers by half i.e., to 35% and 20% respectively. Now if both countries A and B manage to reduce the headcount ratio to 36% each, both these will be termed "failures" despite the fact that Country A reduced the headcount by 34 percentage points whereas Country B reduced it only by 4 percentage points. Thus, the currently prevalent strategy is not sensitive to the fact that even amongst the poor countries, some countries are poorer than the others.

Our premise is that the current framework of MDGs as set in 2000 is analogous to the discussion in microeconomics between poverty and social welfare. We propose the use of the theoretical tools used in the poverty-social welfare discussion to empirically evaluate achievement toward the goals. To the best of our knowledge, no other work has analyzed the progress towards the MDG from a social welfare point of view.

There are two main approaches to this paper. We first propose an alternative method of evaluation based on social welfare analysis, conditional on the goals as they have been originally set by the United Nations (UN). In the second approach, we investigate whether our evaluations remain robust to alternative design of the goals. More specifically, for the absolute goals, we test whether changing the prescribed targets alters the gains in overall welfare. For the relative goals, we test whether redefining relative thresholds to absolute thresholds changes the gains in overall welfare.

Our findings show that there are significant gains in worldwide welfare from the early 1990s to the mid 2000s. The gains are even higher when we account for improvements of the poorest countries. Although Asia is the driving force of overall progress, a welfare evaluation of Sub-Saharan Africa (SSA) shows significant improvements in well-being, thus contradicting the popular view of this region as a "failure". Further we find that the overall gains in welfare are independent of the targets; alternative specifications of the targets continue to suggest worldwide improvements over time. Our findings contribute to the existing literature on the MDG in two crucial ways. Firstly, in line with the proposed role of the MDG as a tool to track progress on development indicators, we propose an objective, welfare-based method of tracking or measuring that progress, taking the current design as given. Secondly, we show that the welfare gains thus measured, are strong and robust to a possible redesign of some of the goals, addressing discussions about the unfairness of their current design. These results have important policy implications if the MDG are believed to galvanize greater development effort by encouraging global partnership and international aid for the poor countries.

2.2 Millennium Development Goals

In September 2000, the United Nations Millennium Summit comprising of 189 UN member nations and 23 other international agencies adopted the Millennium Declaration at the UN Headquarters in New York. The Declaration adopted eight MDG that were derived from agreements made at the UN conferences in the 1990s, calling for global commitment to tackle extreme poverty, poverty, and inequality. The MDG are quantified targets that are expected to be met by the year 2015. The aim of the MDG is to build a broad time-based policy road map to achieve a wide range of development objectives, serve as an effective tool to track progress toward the goals, and galvanize international efforts to aid the developing countries in achieving these. There are 18 such targets with one or more indicators corresponding to each target. Each indicator represents a measure of living standard that would help quantify whether a target has been achieved; there are 48 such indicators to track the MDG.

It is noteworthy here to take a brief look at how the MDG have been originally designed. Some of the goals are set as "relative" targets whereas others are set as "absolute" targets. For example, Goal 1 of halving poverty and extreme hunger is a *relative* goal since the targets are relative to initial levels of poverty; by 2015, countries are expected to achieve a 50% reduction in poverty and hunger from their initial levels in 1990. On the other hand, some goals are stated as *absolute* targets. For example, Goal 2 is that of universal primary education; by 2015, countries are expected to reach 100% completion of primary schooling for all boys and girls, regardless of their initial levels of primary school enrollment or completion rates. A complete list of the goals and targets can be found on: `http://www.unmillenniumproject.org/goals/gti.htm`.

Previous literature on the MDG has mostly centered around their design and questioned their feasibility. Easterly (2008) argues that the poor and arbitrary setting of goals as absolute versus relative changes, expressed as change versus level targets, using positive versus negative indicators, makes countries in SSA appear as failures despite their remarkable progress on most social and economic indicators over the last few years. Clemens and Moss (2005) support Easterly's argument and question whether the goals are realistic on the grounds that the MDG expect even the poorest of countries to perform at the top end of the historical experience, thus turning "development successes into imaginary failures". Based on several demographic and health surveys from Africa, Sahn and Stifel (2003) conclude that despite commendable progress on most indicators, most of Africa will be unable to reach any of the MDG. Other studies such as Besley and Burgess (2003) and Collier and Dollar (2001) point out that the prospects for the poorest countries in general and for Africa in particular, are not very optimistic. However, as Deaton (1997) suggests, even if we all agree on what the goals should be, the mere counting of the number of countries that "fail" to achieve the goals should not be an object of policy. In this spirit, our paper posits an alternative method of evaluating progress toward the goals, given the current design of the goals and objectives. Considering that a chief role of the MDG is to serve as a tracking tool to assess progress of the developing countries, it is crucial that the measurement of progress is objective and unbiased. To that end, we suggest an approach based on social welfare to evaluate such progress and assess welfare gains in the developing countries. Further, we also examine whether these gains are robust to an alternative design of some of the goals, partially addressing Easterly's argument about the current arbitrary design of the MDG.

2.3 Social Welfare and the MDG

In this section we show how the current evaluation of the MDG is inconsistent with well established social welfare measures and propose an analytical framework to address these shortcomings.

2.3.1 Notation

Let $x_{i,j,t}$ be the standard of living for country i at time t measured by the j-th indicator. Similarly, let $z_{i,j}$ be the threshold associated with country i for the corresponding indicator j. Note that for some j, $z_{i,j} = z_j$ for all i. This is the case for the absolute targets in Tables 1 and 2. For the relative targets, z will vary by country. For example, when reducing poverty by half compared to the 1990 levels then $z_{i,j} = .5x_{i,j,1990}$. In the next subsection we use this notation to show how the current evaluation is inconsistent with a social welfare approach.

2.3.2 Current methods

The progress reports by the United Nations and other international organizations associated with the MDG have focused only on whether a country is "on track" or "off track" to achieve the goals. For instance, the Main Report of UN Millennium Project 2005 points out that SSA has the highest rate of undernourishment, lowest primary enrollment rates, highest incidence of tuberculosis, and maternal and child mortality ratios, and that without sustained support the region is "off track" to meet *any* of the goals by 2015. According to the UN World Summit Declaration of 2005, Africa is the only continent that fails to be "on track" to meet any of the goals of the Millennium Declaration by 2015. The World Bank and IMF Global Monitoring Report 2008 predicts that while most countries will "fail to meet" the goals of reducing maternal and child mortality, primary completion, nutrition and sanitation, SSA and South Asia (SA) are unlikely to meet a majority of the targets. Overall, such reports have consistently and unanimously used a binary method of evaluating "success" or "failure" toward achieving the MDG, rather than evaluating progress achieved over time. Thus, the current method of evaluation could be expressed by the following expression:

$$\text{Off-track}_{i,j} = \mathbb{1}(x_{i,j} \leq z_{i,j}) \tag{2.1}$$

where $\mathbb{1}(x_{i,j} \leq z_{i,j})$ is an indicator function that is equal to one if the country i's standard of living fails to achieve the $z_{i,j}$ for the j-th indicator. It is straightforward to compute the proportion of countries that are off-track, that we label "off-track headcount" by simply aggregating over a set of countries and dividing the sum by the total number of countries N.

Consider now the second goal of universal primary education. A country that increases primary completion rates from 60 percent to 90 percent (instead of the 100 percent as required by the goal) will be considered as much of a failure as another country that also started with a rate of 60 percent but increased it to only 70 percent. By classifying countries or regions solely on whether they are on-track or off-track, the current evaluation method fails to acknowledge the possible progress in standards of living that fall beyond the goals.

2.3.3 A social welfare approach

In this section we propose an evaluation method that addresses the issue raised above. We start by noticing that equation (2.1) fails to satisfy the minimum set of axioms of a social welfare function. Equation (2.1) violates the *monotonicity* axiom and the *transfer* axiom (Sen, 1976). Firstly, using our previous example of primary completion, the measure of standard of living is higher for the country that raised the indicator up from 60 percent to 90 percent compared to the country that raised it to 70 percent. Nonetheless, under the current evaluation, an increase in the standard of living does not increase the overall "welfare" measure. This is a violation of the monotonicity axiom. Further, this method also violates the transfer axiom, according to which, an increase in the standard of living of a country at the expense of a reduction in the standard of living of a poorer country should decrease the overall welfare. For example, consider the share of the lowest quintile in a country's income distribution, an indicator belonging to Goal 1. From equation (2.1), it is easy to see that for any two countries below the threshold, a pure transfer of income from the lowest quintile of a poor country to the lowest quintile of a relatively richer (or less poor) country will not reduce the overall welfare measure. Thus, the current method of evaluation as expressed by the above equation fails to satisfy certain crucial properties of a social welfare function.

We introduce a methodology to evaluate the progress towards the MDG that resembles the literature on poverty measurement. In particular, Foster, Greer, and Thorbecke (1984) introduced a class of poverty measures that satisfy the main properties of a social welfare function, including the monotonicity and transfer axiom mentioned above. As Deaton (1997) points out, poverty measures are special cases of welfare measures if we choose a social welfare function that assigns little or no weight to the welfare of non-poor. In this sense, social welfare is analogous to the (negative) measure of poverty. With regard to measurement of poverty, there typically exists a "poverty line", below which people are defined as poor, and above which they are non-poor. In terms of measurement of social welfare, this is analogous to assigning zero social welfare weights to marginal benefits of the non-poor i.e. those individuals who are above the poverty line. Likewise, the MDG focus entirely on poor countries; therefore, we are only concerned with those countries whose standard of living measure falls below the corresponding threshold z in the above equation. As such, this is equivalent to assigning zero weights to the developed countries with indicators above the prescribed thresholds.

Adapting this method results in the following equation:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N} \mathbb{1}(x_{i,j} \leq z_{i,j})\Big(\frac{z_{i,j} - x_{i,j}}{z_{i,j}}\Big)^{\alpha} \qquad \alpha \geq 0 \tag{2.2}$$

It is a well established result that the non-negative parameter α is a measure of "poverty aversion" in the classical poverty literature. The larger the value of α, the more does the measure penalize the gap between z and x. That is, higher values of α assign a higher weight to those at the bottom of the distribution of x. It is easy to see that when α is equal to zero, the measure collapses into the headcount ratio defined as the proportion of population below the threshold. In effect, this is the current method of evaluation by the UN and other international organizations where *success* or *failure* is defined as shown in equation (2.1).

When $\alpha = 1$, the measure is sensitive to the distance between x and the threshold z. This measure satisfies the monotonicity axiom but violates the transfer axiom since it is still insensitive to transfers among the poor. In that sense, this measure fares better than the off-track headcount in that P_1 will decrease when countries achieve a standard of living that is closer to z. Returning to our earlier example about primary completion rates, P_1 will *decrease* even though both the hypothetical countries failed to reach z since the country that has reached a 90 percent primary completion rate has increased the overall standard of living and thereby increased overall welfare.

Similar to the poverty literature, we will also explore P_2 as an alternative evaluation method as it assigns more weight to those at the bottom of the distribution and satisfies the transfer axiom (Foster, Greer, and Thorbecke, 1984). An additional advantage of using the Foster, Greer, and Thorbecke index (hereafter FGT) is the possibility to additively decompose P_α with population-share as weights. This will allow us to identify how the overall progress made towards the achievement of the MDGs, if any, is driven by a subgroup of countries. It is important to note here that our strategy evaluates the goals at the most recent time period for which data is available, i.e., *before* the 2015 deadline. This is expected to bias our results from evaluating the goals earlier. For countries that will make significant progress towards the goals by 2015, yet fall short of meeting the thresholds by a small margin, our measures evaluated earlier than 2015 will, in fact, underestimate the gains from using P_1 and P_2 compared to P_0; imposing 2015 thresholds to indicators that we observe prior to 2015 biases our results downward.

Our approach throughout the paper is to consider each indicator separately. A multidimensional monitoring system has been proposed by Chakravarty and Majumder (2008). However, their (axiomatically-derived) *index of progress* can be seen as a special case of P_α with $\alpha = 1$ for a vector $\boldsymbol{x}_i = (x_i^1, \ldots, x_i^j, \ldots, x_i^J)$ composed of the 48 (or fewer) MDG indicators. Their analysis is limited in the following ways: A multi-dimensional analysis requires that each country have observations for each indicator and each period. This dramatically reduces the size of their sample to 16 indicators and 13 countries. Further, these countries are not representative of the regions to which they belong. Moreover, they restrict their measure to P_α where $\alpha = 1$, which is at best a limited measure of poverty(welfare) since it violates the transfer axiom as explained earlier. Besides, the MDG were originally set as 8 distinct goals independent from each other and hence considering them in a multi-dimensional framework is impractical.

2.4 Data

The dataset used in this analysis is constructed from the publicly available dataset from the Global Data Monitoring Information System of The World Bank

Group. It consists of time-series data at the country-level for the 48 indicators from 1990 to 2006. At the national level, the data on various indicators have been collected from national household surveys such as the household budget surveys, Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and nutrition surveys. Based on data from these national surveys, the UNDP Inter-Agency Working Group has then compiled international data series and estimated regional and global figures into a complete metadata of all MDG indicators.

The original sample obtained from the World Bank dataset consists of panel data on 48 indicators for 150 countries across 16 years starting from 1990 up to 2006. However, several countries have missing observations not only across indicators, but also across time. This leads to an unbalanced panel that cannot be used to evaluate achievement of the goals over time. In order to map temporal progress of countries, we need a balanced panel that consists of countries that have data on a particular indicator in the early 1990s as well as in the mid 2000s. More specifically, for each indicator, we construct an "initial" period consisting of a union of available observations between 1990 and 1996 and an "end" period consisting of a union of available observations between 2000 and 2006. Each subsample specific to an indicator thus includes only those countries that have observations in the initial (early 1990) as well as end (mid 2000) periods. Besides, a few indicators have data for only one of the 16 years. For example, data on maternal mortality ratio (Goal 5) or prevalence of HIV in females (Goal 6) are available only for the year 2000 and 2005 respectively. Since a year of observations cannot help us track progress over time, such indicators must be excluded from the analysis. Moreover, in case of some indicators, specific thresholds that need to be met in order to track achievement towards a particular goal have not been clearly specified. For example, indicators such as proportion of land area covered by forest, Carbon-dioxide emissions, and energy use per $1 of GDP that belong to Goal 7 (environmental sustainability) do not have clearly defined thresholds and hence must be excluded from the analysis. Thus, the final dataset comprises of 20 indicators with an average of 91 countries for each indicator; the median number of countries is 87. These indicators span across all Goals from 1 to 4 and parts of Goals 6 and 7. The list of goals, targets, and indicators used in this paper is presented in Table 2.1 and Table 2.2. We then compare FGT estimates for each indicator's subsample between the 2 periods and assess progress/achievement toward the goal; a lower estimate in the end period implies an improvement in the indicator over time and thus increased welfare. The summary statistics of the unbalanced as well as balanced panel is presented in Table 2.3 and Table 2.4.

Table 2.3 and Table 2.4 provide the summary statistics of the raw data as well as the balanced panel as explained earlier for all indicators that can be included in the analysis. Column (1) shows the range of years used to construct the initial and the end periods. The range is specifically selected for each indicator so as to include maximum number of countries in the subsample. Column (2) shows the mean value of each indicator in the initial period (early 1990s) of the unbalanced panel with the number of countries included in the subsample shown in parentheses. Mean value of each indicator along with the number of countries in the subsample for the end period (mid 2000s) are indicated in column (3). As seen from columns (2) and (3), the number of countries in the early 1990s and the mid 2000s are not the same. More specifically, for 13 out of 20 indicators, the number of countries in the latter period is greater than the number of countries in the early 1990s, indicating an improvement in data availability over time. Moreover, it should be noted that both the initial and end samples may comprise of different countries, hence the need to construct a balanced panel such that both periods of analysis contain the same countries for a temporal evaluation of progress.

A comparison of the mean values of the 20 measures of living standards between the early 1990s and mid 2000s reveals that for 14 out of 20 indicators, the average value in the mid 2000s is greater vis-a-vis the average value in the early 1990s. Columns (4), (5) and (6) show the mean values in the initial period, the number of countries, and the mean values of the latter period respectively, for the balanced panel constructed as previously explained. The average values in the balanced panel follow the same pattern of change between the initial and the end periods as under the unbalanced panel; in that, 13 of the 14 indicators whose mean value increases between the periods in the unbalanced panel also reveal an increase in the means for the balanced panel. Likewise, indicators that show a decrease in the mean values over time for the unbalanced panel continue to show a decline for the balanced panel as well. The differences in the average values between periods are very similar across panels. This indicates that despite losing a few observations in constructing the balanced panel, our balanced panel reveals similar trends as the original unbalanced panel.

Furthermore, selection of countries into a particular subsample may not be random. We therefore regress the probability of a country being included in a subsample, conditional on certain observable characteristics of the countries such as their population, per capita GDP, life expectancy, population growth rates, GDP growth rates, and the region to which they belong. The estimation equation is as follows:

$$\mathbb{P}(\mathbb{Y} = \mathbb{1}|\mathbb{X}) = \mathbb{F}(\mathbb{X}, \beta) + \mathbb{U} \tag{2.3}$$

The regression results are presented in the following table. In Table 2.5, the columns represent the 4 main regressors; the rows represent the 17 indicator-specific subsamples constructed as explained above. We exclude 3 indicators for which more than 96 percent of the countries are retained in the subsamples. The point estimates indicate the probability that a marginal increase in the regressor leads to inclusion in the subsample. For example, for the subsample of poverty headcount, increase in the GDP per capita by $1 reduces the probability of being included in the subsample by 5 percent; likewise, increase in the 1990 population by 1 million increases the probability of being included in this subsample by 52 percent. Standard errors are indicated in parentheses. We find that very few estimates are statistically significant. In particular, increasing life expectancy by one year increases the probability of inclusion in the subsample for 3 out of 20 indicators; a marginal increase in population increases the probability of being in the subsample for 4 out of 20 indicators; these are indicators belonging to Goal 3 concerning gender equality. The region of SSA is overrepresented in 3 out of the 20 subsamples. Overall, the regression results suggest that our subsamples are largely unbiased and have characteristics similar to the original unbalanced panel; thus, despite attrition, there are no systematic differences in the way the countries were selected into the subsample.

2.5 Results

2.5.1 Overall Improvements

We compute FGT estimates for each indicator using 3 different values of the α parameter for the initial period (early 1990s) and the end period (mid 2000s). Smaller estimates in the latter period indicate better outcomes[1]. We compute bootstrapped standard errors of these estimates for statistical significance. For illustration, let us

[1]For relative goals that have negative indicators, we modify the formula in equation 2 by using reciprocals of the threshold(z) as well as the initial and end values of the living standard(x) for each indicator.

consider the evaluation of the second goal of universal primary education.

Table 2.6 shows the FGT point estimates and bootstrapped standard errors for all 4 indicators that track the progress toward Goal 2. As seen from the table, a comparison of the FGT estimates between the initial and end period for P_0 (the narrow method of evaluation that is currently used by the international agencies) shows no improvements for the indicators of youth literacy, persistence to grade 5 and school enrollment since the point estimates of P_0 do not change between the 2 periods for these 3 indicators. In case of the indicator of primary completion rate, the P_0 estimate becomes larger between the initial and end period, indicating a deterioration in the indicator over time. However, when we compare the estimates between the 2 periods for P_1 (i.e. for value of α equal to one such that we now account for distance of the indicator from its prescribed threshold), we see that the estimates in the latter period are significantly smaller than the initial period for all of the indicators. Comparing point estimates for P_2 between the 2 periods (such that we account for initial levels of the indicator) also reveals even smaller estimates in the latter period indicating better outcomes for all 4 indicators. FGT estimates and standard errors for all the 20 indicators in our dataset are presented in Appendix A. In general, our findings show that there are significant gains in worldwide welfare as indicated by smaller estimates in the latter period. Using the current method of evaluation, the FGT point estimates are significantly lower in the latter period of analysis for 14 of the 20 indicators. Accounting for distance from the threshold specific to each indicator, the point estimates reveal significantly larger gains in welfare. These improvements in welfare are even larger when initial conditions of the countries are taken into account, as shown by larger decreases in the point estimates when α is equal to 2. In other words, accounting for the progress made by poorest countries results in higher welfare gains.

In Table 2.7, we assess whether the absolute difference between the FGT estimates of the initial period versus the end period is statistically significant for all the three values of α. We see that these differences are statistically significant for all indicators across all values of α. However, it is important to note that by construction, the FGT point estimates decrease with values of the α parameter for absolute as well as relative goals. Hence, comparing the absolute difference between P_α in the end period and P_α in the initial period for different values of α is not a meaningful measure of progress since P_2 is smaller than P_1 which is smaller than P_0. We therefore present the percentage change between the point estimates in the initial and end periods for the 3 values of α.

We show the results here with the help of graphs. Figure 2.1 shows percentage change in the estimates between initial and end periods. A more negative value indicates greater improvement since smaller estimates in the latter period are "better" outcomes. For example, consider Goal 2; for each indicator belonging to this goal, we plot the percentage change over time for the 3 values of α.

As seen from Figure 2.1, using the narrow method of evaluation that the UN currently practises with ($\alpha = 0$), we see little improvement in the point estimates for Goal 2. When we account for distance from the threshold or the gap ($\alpha = 1$), the gains in welfare for all 4 indicators become larger. This is shown by the (grey) bar indicating the gap which is larger than the (white) bar that shows evaluation as a binary *yes* or *no* outcome. The gains are even larger when we account for initial conditions of the countries ($\alpha = 2$), as seen from the (black) bar which denotes the weighted gap from having assigned higher weights to countries with lower initial conditions. Thus, all indicators for Goal 2 reveal a hierarchy in the size of improvements, in that, the welfare gains get consistently larger as we increase the values of α i.e. as we give more weight to countries at the bottom of the distribution.

Graphs for the other goals are included in the Appendix B. We see a similar pattern for 16 out of 20 indicators. Indicators such as income share of the lowest quintile and poverty gap (Goal 1), and tuberculosis incidence (Goal 6) reveal a different pattern such that the hierarchy of gains is reversed between P_1 and P_2. This implies that most of the improvements are taking place among countries closer to the threshold. Countries at the bottom of the distribution do not show much improvement for the indicators in question and much of the gains accrue to countries that have relatively better initial conditions. Nevertheless, overall, for a wide majority of indicators we see that the FGT estimates are sensitive to distribution of the poor.

2.5.2 Regional Contributions

A salient feature of the FGT index is that it is decomposable for subgroups of population. This enables us to look at how the achievements are distributed by region. We therefore generate FGT estimates by region for each indicator and compute each region's contribution/share in the overall progress for each indicator weighted by the region's relative share in the total population of all the countries in the particular subsample. The overall improvement for each indicator is the sum of improvements by region. This is represented by the following formula:

$$P_{\alpha}^{0} - P_{\alpha}^{1} = \sum_{k=1}^{K} \left(\frac{n_k^0}{N^0} P_{\alpha,k}^{0} - \frac{n_k^1}{N^1} P_{\alpha,k}^{1} \right) \tag{2.4}$$

where superscripts 0 and 1 indicate initial and end periods respectively and k represents the region. It follows that region k's contribution or share in the overall progress is computed as follows:

$$\frac{1}{P_{\alpha}^{0}-P_{\alpha}^{1}}(\frac{n_{k}^{0}}{N^{0}}P_{\alpha,k}^{0}-\frac{n_{k}^{1}}{N^{1}}P_{\alpha,k}^{1}) \tag{2.5}$$

We present the results in Table 2.8. Table 2.8 shows the regional contributions to overall progress for 4 regions and all 20 indicators across the three values of α. The empty cells indicate that there has been no overall improvement in the indicator for that specific value of α and hence regional shares cannot be computed. As seen from the table, East Asia and Pacific(EAP) region clearly has the highest share in the overall progress for all indicators, thus confirming the region's role as the driving force of progress in the developing world. SA and SSA show relatively smaller contributions for some indicators and negative contributions for some others. However for 16 out of 20 indicators, shares of SA and SSA regions to the overall improvements increase with higher values of α.

It is important to note however that since we use the respective periods' population shares $\frac{n_k^0}{N^0}$ and $\frac{n_k^1}{N^1}$ as weights to calculate the regional contributions as in equation (2.4), changes in population shares between the 2 periods will affect the region's contribution to overall progress. For instance, for certain indicators, contributions of regions such as SSA may be underestimated due to population expansion despite significant progress. Values in bold typeface in Table 2.8 refer to such regions whose overall improvements are underestimated due to massive population growth; these are mostly restricted to SA and SSA. Looking at the relative regional contributions with variant population shares would thus undermine the actual progress achieved by these regions on the indicator per se. Hence, we look at regional contributions using 1990 population figures as fixed. This will enable us to determine whether the region's contribution, if negative(positive), is the result of negative(positive) improvements in the indicator or simply due to changes in its population share.

Table 2.9 indicates that the contribution of the SSA region in overall progress for an indicator improves when we keep the population figures fixed at the 1990 level. For example, for the share of women in employment in the nonagricultural sector, the SSA region shows negative shares of -25 percent and -11 percent for values of α equal to 1 and 2 respectively with varying population shares. However, when we fix the population to the 1990 levels, we see that the region's shares to overall progress improve to a positive 4 percent for both values of α. Moreover, for indicators where the SSA region's contribution toward overall progress is starkly negative, using fixed population reveals that the region's contribution becomes less negative. For example, for the poverty gap indicator, SSA's share is a negative 18 percent for $\alpha = 2$ with varying population. Fixing population improves the share to a negative 9 percent. We see similar patterns for the SA region. Overall, shares of SSA increase for 15 out of 20 indicators after fixing population levels whereas those of SA increase for 11 out of 20 indicators. This implies that for regions such as SSA and SA, true improvements toward an indicator may be thwarted by their characteristically high population growth rates. Such regions may therefore "appear" to make very little or no contribution toward achieving a goal despite significant progress[2].

2.6 Stochastic Dominance

So far we have proposed an alternative method of evaluating progress, conditional on the existing goals as they were originally designed by the UN in September 2000. In particular, we suggest the use of a social welfare function that satisfies certain

[2]Inferring that China may be the engine of progress in the EAP region, we recompute the FGT estimates and bootstrapped standard errors excluding China from the relevant subsamples and find that overall gains are significantly smaller. Nonetheless, we continue to see a hierarchy in welfare gains for different values of α.

important properties as discussed in the poverty measurement literature, to measure progress toward the MDG and evaluate overall improvements in welfare. In this section, we discuss whether these overall gains are entirely a result of the specific social welfare function we have employed for the analysis. Another way to understand this issue is to test whether our results remain robust to alternative specifications of the targets. In effect, we establish rankings of the welfare distributions in the initial and end periods and examine whether these rankings change in response to modifications of the targets. This especially addresses recent debates surrounding the "arbitrary" design of the MDG that makes them "unfair" for a subset of the developing countries. We use, as a tool, the concept of stochastic dominance to test this.

The strategy is two-fold: firstly, we check the robustness of welfare gains to redefining thresholds for the absolute goals. For example, modifying the target for school enrollment (an indicator belonging to Goal 2 - universal primary education) from an absolute 100 percent to an absolute 90 percent. Secondly, we redefine relative targets as absolute targets to check whether the rankings are preserved under such a hypothetical modification. For example, an *absolute* reduction in infant mortality rate (indicator belonging to Goal 3 - reduction in child mortality) instead of the originally stated relative target of *two-third reduction from the initial rate.* Another way to think about this, is to create "poverty orderings" in the sense of Foster and Shorrocks (1988)[3]. Such orderings allow us to estimate overall changes in welfare over time and help us evaluate whether the overall gains in welfare are sensitive to the way the thresholds are defined. To perform this analysis, we use the idea of stochastic dominance, which is a form of ranking welfare distributions. Consider two welfare distributions of a measure of

[3]See also Atkinson (1970), Atkinson (1987) and more recently Dutta (2002) and Davidson and Duclos (2000)

standard of living x with cumulative distribution functions (CDF) $F_1(x)$ and $F_2(x)$. We say that the distribution $F_1(x)$ first-order stochastically dominates distribution $F_2(x)$ if and only if:

$$\mathbb{F}_2(x) \geq F_1(x) \quad \forall x \tag{2.6}$$

Let us illustrate this with the help of the following graph. In Figure 2.2, we plot two distributions of the true data for the indicator of youth literacy belonging to Goal 2 (universal primary education) in the early 1990s Vs. the mid 2000s. Note that this is an example of a positive indicator in the sense that "more" is "better". Further, this indicator belongs to an *absolute* goal (Goal 2) where the target is to achieve a 100 percent youth literacy by 2015 regardless of the initial levels. By definition of stochastic dominance, we see that the distribution in the latter period first-order stochastically dominates the distribution in the early 1990s. Intuitively, the distribution of the early 1990s consistently has more mass in the lower part of the distribution; therefore, any monotonically increasing function ranks the distribution of the mid 2000s ahead of the initial distribution of the early 1990s. In that sense, the distribution of the mid 2000s is an improvement from the distribution of the early 1990s. More importantly, this ordering or ranking will not change in response to an alternative (absolute) threshold such as a 90 percent or 75 percent youth literacy by 2015. In Figures 2.3, 2.4, 2.5, and 2.6, we find that for all the other indicators belonging to absolute goals, the rankings of distributions are preserved under alternative thresholds indicating that the increase in welfare gains over time are not sensitive to arbitrarily set thresholds for the absolute goals.

Furthermore, we also examine whether the overall welfare gains for relative goals as seen earlier are sensitive to redefining the *relative* goals as *absolute* ones. We establish rankings of distributions for indicators belonging to relative goals and assess whether the rankings are preserved in the event that the goals are redefined with absolute thresholds. For example, consider the indicator of infant mortality rate which belongs to Goal 4 of reduction in child mortality by two-thirds. Note that this is an example of a negative indicator such that "less" is "better". We plot the true distributions in the early 1990s versus mid 2000s in the following figure.

As is clear from Figure 2.7, the distribution in the latter period of mid 2000s first-order stochastically dominates the distribution in the early 1990s. Hence, redefining the target for Goal 4 from a relative two-third reduction in infant mortality rate to a hypothetical alternative target such as an absolute reduction in infant mortality would not reverse the orderings of the distributions. We present all the indicators for relative Goals 1 and 4 in Figure 2.8 and Figure 2.9 respectively.

Overall, we observe a clear and consistent first-order stochastic dominance of the latter period's distribution for all indicators except those belonging to Goal 1. These powerful results imply that the overall welfare gains over time observed earlier are robust to alternative specifications of the goals; the rankings of the distributions remain unanimous such that the latter period's distribution first order dominates the distribution of the initial period. Therefore, altering the thresholds for absolute goals or hypothetically redefining relative thresholds as absolute ones do not change or reverse the rankings for most indicators. This confirms that there are significant worldwide improvements in a majority of the indicators and more importantly, these are independent of the "arbitrary" designing of thresholds that Easterly (2008) refers to.

2.7 Conclusion

We use a social welfare based approach to evaluating the MDG. The United Nations Millennium Summit in 2000 led to the adoption of 8 Goals comprising of 18 targets and 48 indicators that are aimed toward improving the socio-economic conditions of poor countries. Previous literature on MDG has mainly focussed on the design of the Goals being unfair and unrealistic. The current method of evaluation used by the UN suffers from two main drawbacks; firstly, they use a narrow definition of *success* or *failure* toward achieving a goal and secondly, the current evaluation strategy does not take into account the initial conditions of the countries. Drawing from the discussion on poverty and social welfare, we point out that the current evaluation strategy violates two crucial properties of a social welfare function, namely, the monotonicity and the transfer axioms.

Our approach in this paper is two-fold. First, conditional on the current design of the goals, we propose a method of evaluating progress toward achievement of the MDG that is sensitive to initial conditions of the countries as of the early 1990s. In order to be able to map progress made by countries over time starting from the early 1990s up to the mid 2000s, we construct balanced panels specific to each indicator from the original unbalanced data on 150 countries across 16 years. We then compute FGT measures of welfare for each indicator for the initial and latter period of analysis. Welfare gains accruing to each indicator are then implied by a decrease in the FGT measures over time. We find that there are significant increases in overall welfare when the welfare measure is sensitive to the distribution of the poor. A decomposition of the overall gains by region reveals that although the region of EAP has the greatest share in the worldwide gains among the poor countries, a welfare-based evaluation of poorer regions such as SSA and South Asia shows considerably larger contributions for many of the indicators.

Second, to address the arguments in the MDG literature regarding the fundamental design of the goals, we establish welfare rankings for the indicator-specific distributions of the true data in the early 1990s and the mid 2000s. Using the concept of stochastic dominance, we then ascertain whether the rankings are sensitive to the original design of the goals. More specifically, we test whether changing the targets for absolute goals or changing the relative goals to absolute goals reverses the orderings. We find that for a vast majority of the indicators, the distribution of the mid 2000s first-order stochastically dominates that of the early 1990s, assuring welfare gains that are robust to the alternative specification of some of the goals. In general, these results have important policy implications if, as believed in the literature, the MDG are meant to be a tool to galvanize greater development effort in and for poor countries (Easterly, 2008). If the MDG are to be considered a measure of performance, our evaluation results imply that the narrow evaluation strategies being currently considered to measure the performance of each country or region need to be revised to take into account the distribution of the poor countries. Criticisms of the MDG center around the claim that the MDG, as currently conceived, run the risk of converting potential development success stories into imaginary failures. However, a welfare-based evaluation methodology highlights significant improvements in well-being of poorer countries, contradicting reports of these countries as "failures".

Table 2.1: Summary of the Millennium Development Goals

Goal	Target	Indicator
1. Eradicate Extreme Hunger and Poverty	1. Halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day	1. Proportion of population below $1 (1993 PPP) per day 2. Poverty gap ratio 3. Share of poorest quintile in national consumption
	2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger	4. Prevalence of underweight children under five years of age 5. Proportion of population below minimum level of dietary energy consumption
2. Achieve Universal Primary Education	3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	6. Net enrollment ratio in primary education 7. Proportion of pupils starting grade 1 who reach grade 5 8. Literacy rate of 15-24 year-olds 9. Primary Completion Rate
3. Promote Gender Equality and Empower Women	4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015	10. Ratio of girls to boys in primary, secondary and tertiary education 11. Ratio of literate women to men, 15-24 years old 12. Share of women in wage employment in the non-agricultural sector 13. Proportion of seats held by women in national parliament

Source: UN Millennium Project - Goals, targets and indicators. Note: The list only includes those indicators that are relevant to this analysis. For a complete list of all goals, targets, and indicators, please see: `http://www.unmillenniumproject.org/goals/gti.htm`.

Table 2.2: Summary of the Millennium Development Goals (continued)

Goal	Target	Indicator
4. Reduce Child Mortality	5. Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate	14. Under-five mortality rate 15. Infant mortality rate 16. Proportion of 1 year-old children immunized against measles
6. Combat HIV/AIDS, Malaria and other diseases	6. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	17. Prevalence of death rates associated with TB 18. Proportion of TB cases detected and cured under DOTS (internationally recommended TB strategy)
7. Ensure Environmental Sustainability	Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	19. Proportion of population with sustainable access to improved sanitation, rural and urban 20. Proportion of population with access to secure tenure

Source: UN Millennium Project - Goals, targets and indicators. Note: The list only includes those indicators that are relevant to this analysis. For a complete list of all goals, targets, and indicators, please see: `http://www.unmillenniumproject.org/goals/gti.htm`.

Table 2.3: Summary Statistics

Indicator	Years included: initial,end	Unbalanced Panel		Balanced Panel		
		Mean Values Initial period	Mean Values End period	Mean Values Initial period		Mean Values End period
	(1)	(2)	(3)	(4)	(5)	(6)
Poverty headcount	1990-1994,2000-2004	19.09	15.49	17.02		14.63
		(69)	(70)		(50)	
Poverty gap	1990-1994,2000-2004	7.17	5.39	6.23		5.26
		(68)	(70)		(49)	
Income share of the lowest 20%	1990-1994,2000-2004	5.82	5.92	5.94		5.70
		(69)	(49)		(29)	
Malnutrition prevalence	1994-1996,2000-2005	20.34	19.93	23.03		19.75
		(78)	(98)		(60)	
Undernourishment prevalence	1992,2004	20.90	17.81	20.90		17.82
		(134)	(135)		(134)	
Youth literacy	1990,2006	80.02	85.21	80.54		85.72
		(107)	(96)		(78)	
Persistence to grade 5	1991,2004	74.57	80.16	75.22		78.60
		(65)	(100)		(55)	
Primary completion rate	1990-1994,2002-2005	65.22	83.39	66.06		77.83
		(94)	(129)		(87)	
School enrollment rate	1991,2005	71.95	85.57	73.29		84.19
		(102)	(111)		(79)	

Notes: Number of countries in the indicator-specific subsample are included in parentheses. Unbalanced panel consists of raw data from the World Bank metadata. Balanced panel consists of countries that have data on a particular indicator in the early 1990s as well as in the mid 2000s. Initial period comprises of union of observations from 1990 to 1996. End period comprises of union of observations from 2000 to 2006.

Table 2.4: Summary Statistics (continued)

Indicator	Years included: initial,end	Unbalanced Panel		Balanced Panel		
		Mean Values Initial period	Mean Values End period	Mean Values Initial period		Mean Values End period
	(1)	(2)	(3)	(4)	(5)	(6)
Sex ratio in primary and secondary education	1991,2002-2005	89.19	95.75	89.39		96.28
		(56)	(130)		(55)	
Sex ratio of literate youth (ages 15-24)	1990,2006	86.27	91.66	86.28		92.41
		(107)	(96)		(78)	
Women's share in nonagricultural sector	1990,2004	33.04	37.72	35.13		37.72
		(126)	(89)		(89)	
Women's share in national parliament	1990,2004-2005	9.29	14.37	9.29		14.44
		(101)	(145)		(101)	
Under-5 child mortality rate	1990,2005	91.76	71.47	92.05		71.47
		(146)	(145)		(145)	
Infant mortality rate	1990,2005	62.29	48.70	62.45		48.70
		(146)	(145)		(145)	
Share of 1-year olds immunized against measles	1990-1992,2005	74.04	83.31	74.04		83.11
		(139)	(147)		(139)	
Incidence of tuberculosis (TB) (per 100,000)	1990,2005	133.58	175.29	134.08		175.29
		(149)	(148)		(148)	
Proportion of TB cases detected and cured	1995-1996,2005	44.61	61.86	44.15		62.97
		(83)	(129)		(82)	
Share of population with access to water source	1990,2004	73.96	78.76	73.94		80.39
		(114)	(142)		(112)	
Share of population with access to sanitation	1990,2004	54.53	62.17	53.97		62.01
		(104)	(140)		(102)	

Notes: Number of countries in the indicator-specific subsample are included in parentheses. Unbalanced panel consists of raw data from the World Bank metadata. Balanced panel consists of countries that have data on a particular indicator in the early 1990s as well as in the mid 2000s. Initial period comprises of union of observations from 1990 to 1996. End period comprises of union of observations from 2000 to 2006.

Table 2.5: Marginal Effects: Probability of Inclusion in the Subsample per Indicator

	PCGDP (1)	Life Expectancy (2)	Population (3)	SSA (4)
Poverty headcount	-0.052	0.021*	0.521	-0.008
	(0.076)	(0.010)	(0.301)	(0.137)
Poverty gap	-0.035	0.013	0.017	-0.100
	(0.068)	(0.009)	(0.049)	(0.120)
Income share of the lowest 20%	-0.038	0.005	-0.006	-0.041
	(0.059)	(0.007)	(0.020)	(0.106)
Malnutrition prevalence	-0.155	-0.002	0.016	-0.120
	(0.071)	(0.010)	(0.043)	(0.129)
Undernourishment prevalence	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Youth literacy	-0.118	0.020	0.440*	0.208
	(0.070)	(0.011)	(0.201)	(0.121)
Primary completion rate	-0.002	0.014	0.194	0.330*
	(0.073)	(0.010)	(0.131)	(0.112)
Persistence to grade 5	-0.066	0.017	-0.040	0.505*
	(0.073)	(0.010)	(0.030)	(0.121)
School enrollment rate	-0.080	0.014	-0.045	0.130
	(0.072)	(0.010)	(0.026)	(0.136)
Sex ratio in education	-0.088	0.025*	0.115	0.409*
	(0.079)	(0.012)	(0.065)	(0.142)
Sex ratio among literate youth	-0.118	0.020	0.440*	0.208
	(0.070)	(0.011)	(0.201)	(0.121)
Women's share in nonagriculture	-0.036	0.021	0.640*	-0.012
	(0.064)	(0.021)	(0.184)	(0.065)
Women's share in parliament	0.072	-0.008	0.058	-0.098
	(0.062)	(0.008)	(0.048)	(0.102)
Immunization against measels	-0.007	0.001	0.045	0.004
	(0.010)	(0.001)	(0.030)	(0.006)
Proportion of TB cases cured	-0.145	0.001	0.190	0.090
	(0.073)	(0.010)	(0.137)	(0.135)
Proportion without access to water	-0.005	0.000	0.272	0.013
	(0.016)	(0.002)	(0.221)	(0.027)
Proportion without access to sanitation	-0.036	-0.000	0.514*	0.035
	(0.040)	(0.004)	(0.085)	(0.059)

Notes: Columns represent the 4 main regressors used in equation 2.3; rows represent 17 indicator-specific subsamples. We exclude 3 indicators for which more than 96 percent of the countries are retained in the subsamples. The point estimates indicate the probability that a marginal increase in the regressor leads to inclusion of the country in a particular indicator's subsample. Standard errors are in parentheses.

Table 2.6: FGT Estimates for Goal 2: Universal Primary Education

Indicator	Initial			End		
	P_0	P_1	P_2	P_0	P_1	P_2
	(1)	(2)	(3)	(4)	(5)	(6)
Youth literacy	1.000	0.168	0.056	1.000	0.114	0.029
N = 78	(0.000)	(0.009)	(0.004)	(0.000)	(0.005)	(0.001)
Persistence to grade 5	1.000	0.192	0.061	1.000	0.177	0.051
N = 55	(0.000)	(0.003)	(0.002)	(0.000)	(0.004)	(0.002)
Primary completion rate	0.665	0.187	0.079	0.879	0.105	0.033
N = 87	(0.033)	(0.010)	(0.005)	(0.011)	(0.005)	(0.002)
School enrollment rate	1.000	0.216	0.100	1.000	0.130	0.031
N = 79	(0.000)	(0.006)	(0.004)	(0.000)	(0.003)	(0.001)

Notes: Bootstrapped standard errors of the FGT estimates are in parentheses. N denotes the number of observations (countries) per indicator. Initial period refers to the early 1990s. End period refers to the mid 2000s. Smaller estimates in the end period indicate better outcomes. For each indicator, a comparison of P_0 estimates between initial and end periods reveals no gains in welfare for 3 out of 4 indicators (since P_0 estimates do not change) and welfare deterioration for the indicator of primary completion rate (since P_0 estimate increases between initial and end periods). Comparison of P_1 estimates between the two periods reveals significant welfare gains for each indicator. The P_2 measure accounts for initial conditions of the countries and assigns greater weights to countries at the bottom of the distribution. Comparison of P_2 estimates between the two periods reveals higher welfare gains as represented by smaller values in the end period.

Table 2.7: Overall Improvements: Difference in FGT estimates over time

Indicator	P_0 (1)	P_1 (2)	P_2 (3)
Poverty headcount	0.409	0.250	0.124
N = 50	(0.031)	(0.014)	(0.008)
Poverty gap	0.115	0.101	0.044
N = 49	(0.014)	(0.008)	(0.008)
Income share of the lowest 20%	0.019	0.025	0.001
N = 29	(0.002)	(0.004)	(0.002)
Malnutrition prevalence	0.047	0.205	0.132
N = 60	(0.005)	(0.009)	(0.007)
Undernourishment prevalence	0.016	0.135	0.097
N = 134	(0.001)	(0.002)	(0.002)
Youth literacy	0.000	0.054	0.027
N = 78	(0.000)	(0.010)	(0.004)
Persistence to grade 5	0.000	0.015	0.010
N = 55	(0.000)	(0.005)	(0.002)
Primary completion rate	-0.214	0.082	0.046
N = 87	(0.036)	(0.010)	(0.004)
School enrollment rate	0.000	0.086	0.069
N = 79	(0.000)	(0.008)	(0.006)
Sex ratio in primary and secondary education	0.030	0.113	0.036
N = 55	(0.021)	(0.007)	(0.003)
Sex ratio of literate youth (ages 15-24)	0.055	0.046	0.019
N = 78	(0.017)	(0.008)	(0.003)
Women's share in nonagricultural sector	0.000	0.023	0.033
N = 89	(0.000)	(0.008)	(0.011)
Women's share in national parliament	0.000	0.031	0.053
N = 101	(0.000)	(0.005)	(0.009)
Under-5 child mortality rate	0.813	0.289	0.098
N = 145	(0.010)	(0.002)	(0.001)
Infant mortality rate	0.566	0.277	0.097
N = 145	(0.022)	(0.002)	(0.001)
Share of 1-year olds immunized against measles	0.026	-0.028	-0.035
N = 139	(0.003)	(0.005)	(0.004)
Incidence of tuberculosis (TB) (per 100,000)	0.036	0.042	0.001
N = 148	(0.003)	(0.003)	(0.004)
Proportion of TB cases detected and cured	0.007	0.499	0.608
N = 82	(0.002)	(0.009)	(0.011)
Share of population without access to water source	0.315	0.272	0.158
N = 112	(0.023)	(0.008)	(0.003)
Share of population without access to sanitation	0.046	0.166	0.124
N = 102	(0.003)	(0.002)	(0.002)

Notes: Each row represents, for each indicator, the absolute difference in the FGT estimates between the initial and end periods for the corresponding values of α. Bootstrapped standard errors of the differences in the FGT estimates over time are in parentheses. N denotes the number of observations per indicator.

Table 2.8: Regional Decomposition with Variable Population

Indicator	EAP			LAC			SA			SSA		
	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2	P_0	P_1	P_2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Poverty headcount	100%	83%	85%	0%	6%	-1%	-4%	7%	15%	-1%	-2%	-4%
Poverty gap	70%	46%	57%	4%	-18%	-70%	-7%	61%	115%	1%	-6%	-18%
Income share of lowest 20%	40%	63%	843%	22%	37%	-367%	-36%	-43%	-706%	20%	20%	148%
Malnutrition prevalence	62%	83%	86%	1%	3%	4%	-28%	0%	2%	-39%	0%	2%
Undernourishment prevalence	115%	58%	58%	42%	13%	11%	-89%	16%	22%	-95%	5%	5%
Youth literacy		25%	3%		7%	2%		55%	78%		**-4%**	1%
Persistence to grade 5		114%	39%		123%	57%		9%	14%		-145%	**-20%**
Primary completion rate	-118%	-2%	1%	**-20%**	15%	7%	-8%	67%	60%	-8%	8%	25%
School enrollment rate		-5%	0%		15%	6%		21%	29%		53%	57%
Sex ratio in education	73%	44%	23%	99%	1%	0%	-61%	45%	64%	-47%	5%	8%
Sex ratio among literate youth	41%	31%	4%	45%	2%	1%	**-23%**	43%	67%	7%	7%	8%
Women's share in non-agriculture		82%	54%		15%	16%		**-17%**	22%		**-25%**	**-11%**
Women's share in national parliament		63%	33%		30%	32%		**-5%**	19%		**-9%**	6%
Under-5 mortality rate	43%	41%	41%	12%	12%	11%	28%	28%	28%	0%	3%	3%
Infant mortality rate	62%	43%	41%	16%	12%	12%	4%	25%	28%	0%	3%	3%
Measels immunization	65%	-76%	-25%	-7%	-44%	-28%	-58%	-77%	-43%	23%	-43%	-37%
Tuberculosis incidence	47%	97%	3247%	80%	77%	1998%	-41%	-10%	-102%	-55%	-105%	-4967%
Tuberculosis cases detected and cured	358%	59%	52%	-44%	0%	0%	-214%	34%	40%	-208%	1%	2%
Proportion without access to water	15%	27%	33%	9%	12%	13%	65%	43%	38%	-5%	3%	5%
Proportion without access to sanitation	93%	51%	49%	32%	15%	12%	**-24%**	24%	28%	-44%	**-2%**	1%

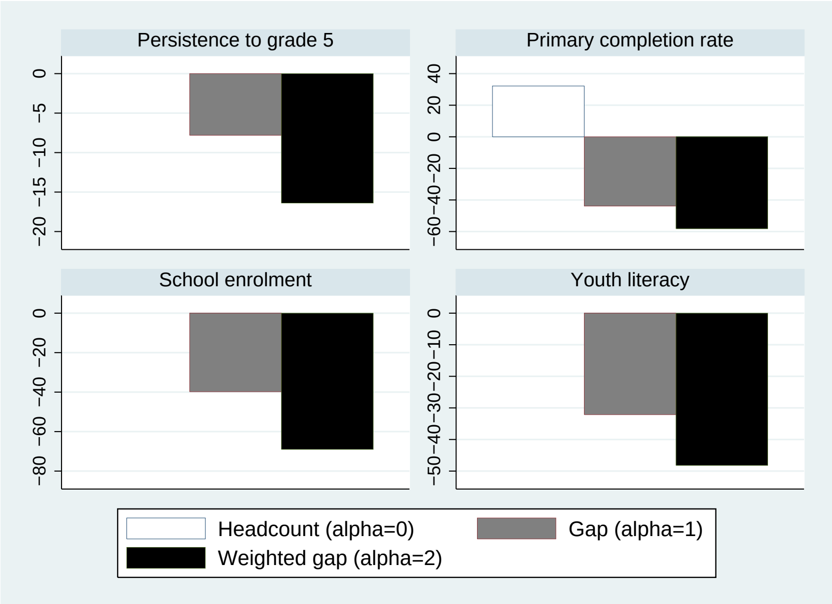
Notes: We exclude results for the regions of Europe and Central Asia (ECA) and Middle East and North Africa (MENA). Each cell indicates the contribution of a particular region to the overall improvement with respect to the corresponding indicator as calculated by equation 2.4. Empty cells indicate no overall improvements in the particular indicator between the initial and end periods and hence regional shares cannot be computed using equation 2.4. Values in bold typeface indicate regions whose contribution to the overall improvements toward an indicator are underestimated due to massive population growth.

Table 2.9: Regional Decomposition with Fixed Population

Indicator	EAP			LAC			SA			SSA		
	P_0 (1)	P_1 (2)	P_2 (3)	P_0 (4)	P_1 (5)	P_2 (6)	P_0 (7)	P_1 (8)	P_2 (9)	P_0 (10)	P_1 (11)	P_2 (12)
Poverty headcount	95%	80%	81%	0%	6%	0%	0%	10%	17%	1%	0%	-1%
Poverty gap	68%	45%	54%	3%	-18%	-67%	0%	62%	114%	11%	0%	-9%
Income share of lowest 5%	0%	55%	389%	0%	33%	-193%	0%	-33%	-311%	99%	37%	146%
Malnutrition prevalence	16%	81%	87%	9%	4%	4%	0%	3%	4%	0%	4%	5%
Undernourishment prevalence	0%	53%	56%	50%	14%	11%	0%	20%	25%	21%	10%	9%
Youth literacy		21%	3%		6%	2%		55%	74%		**3%**	6%
Persistence to grade 5		108%	38%		119%	57%		13%	17%		-72%	**21%**
Primary completion rate		-2%	2%		13%	6%		64%	54%		16%	24%
School enrollment rate		-4%	0%		14%	6%		23%	28%		57%	55%
Sex ratio in education	0%	41%	22%	70%	1%	0%	0%	45%	63%	-1%	6%	9%
Sex ratio among literate youth	8%	27%	4%	39%	2%	1%	**7%**	45%	65%	25%	11%	12%
Women's share in non-agriculture		32%	28%		16%	14%		**38%**	46%		**4%**	**4%**
Women's share in national parliament		5%	6%		33%	32%		**37%**	39%		**21%**	19%
Under-5 Mortality	42%	41%	41%	12%	12%	11%	28%	28%	28%	2%	3%	3%
Infant mortality rate	61%	43%	41%	16%	12%	12%	6%	25%	28%	3%	3%	3%
Measels immunization	0%	-70%	-24%	0%	-46%	-29%	0%	-60%	-38%	99%	-18%	-28%
Tuberculosis incidence	0%	77%	973%	85%	77%	672%	0%	7%	85%	0%	-68%	-1284%
Tuberculosis cases detected and cured	0%	57%	51%	-40%	0%	0%	0%	35%	40%	55%	3%	3%
Proportion without access to water	10%	25%	32%	9%	13%	13%	69%	44%	39%	1%	6%	7%
Proportion without access to sanitation	50%	48%	48%	33%	15%	12%	**9%**	27%	29%	0%	**3%**	4%

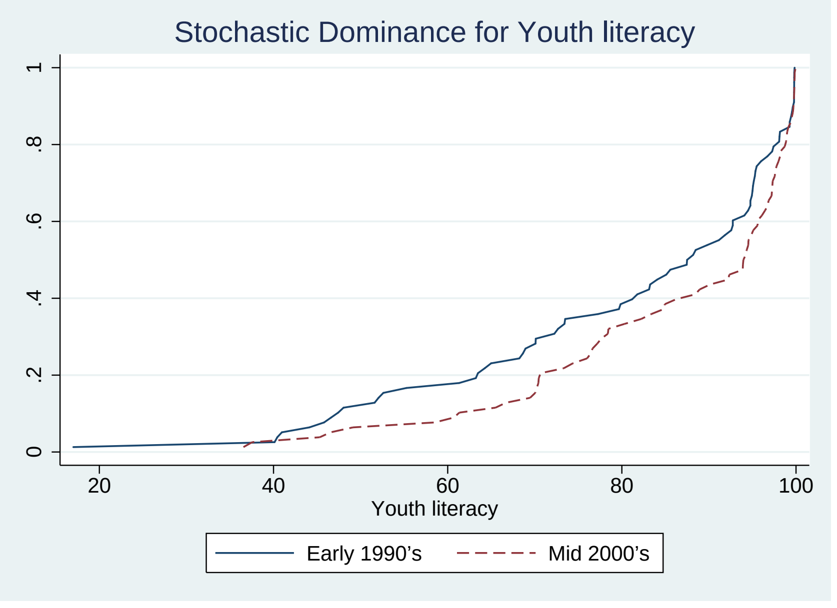
Notes: We exclude results for the regions of Europe and Central Asia (ECA) and Middle East and North Africa (MENA). Each cell indicates the contribution of a particular region to the overall improvement with respect to the corresponding indicator as calculated by equation 2.4 but holding the region's population constant. Empty cells indicate no overall improvements in the particular indicator between the initial and end periods and hence regional shares cannot be computed using equation 2.4. Values in bold typeface indicate regions whose contribution to the overall improvements toward an indicator are underestimated due to massive population growth.

Figure 2.1: Proportional Change in FGT Estimates for Goal 2: Universal Primary Education



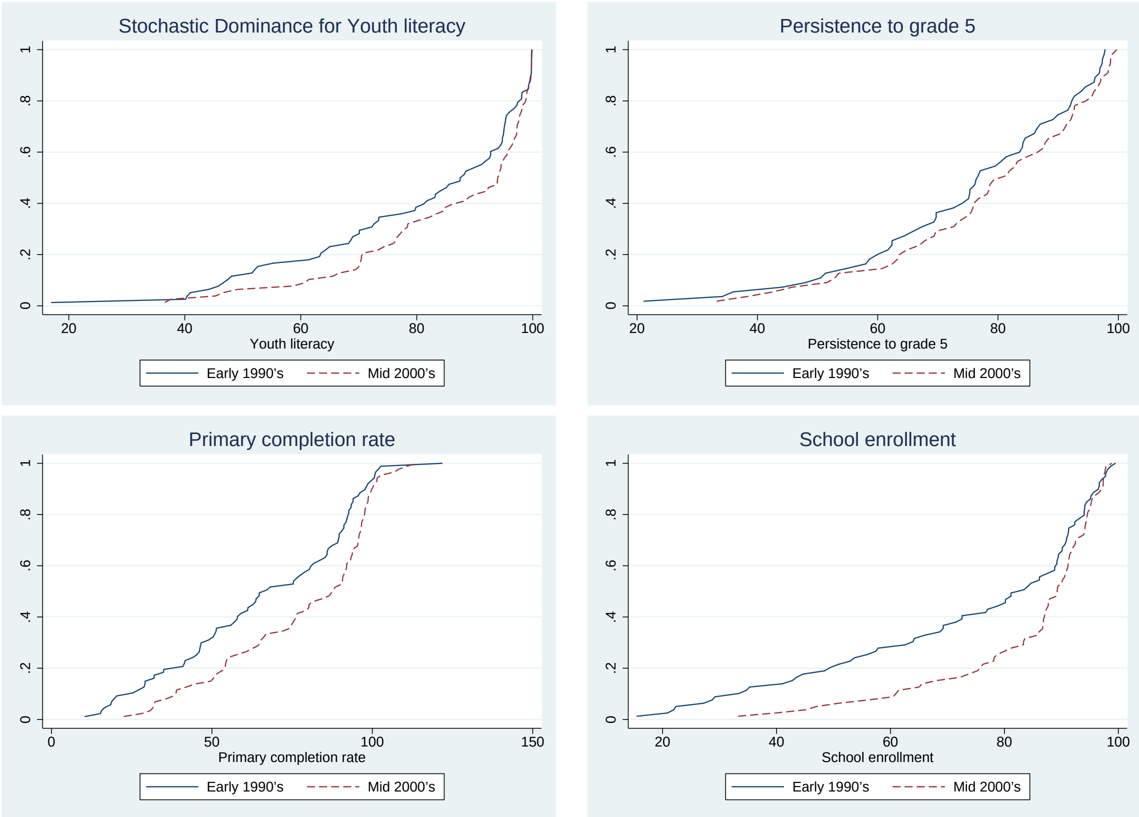
Notes: Figure 2.1 shows percentage change in the FGT estimates between initial and end periods for indicators of Goal 2. The three colors correspond, respectively, to the percentage changes in estimates computed for three different values of the α parameter ranging from zero to two. For some indicators, we cannot compute percentage change in FGT estimates for value of α equal to zero if there has been no change in the estimates between the initial and end periods. A more negative value indicates greater improvement since smaller estimates in the end period imply "better" outcomes in the form of higher welfare gains.

Figure 2.2: Stochastic Dominance for Indicator: Youth Literacy (Goal 2)



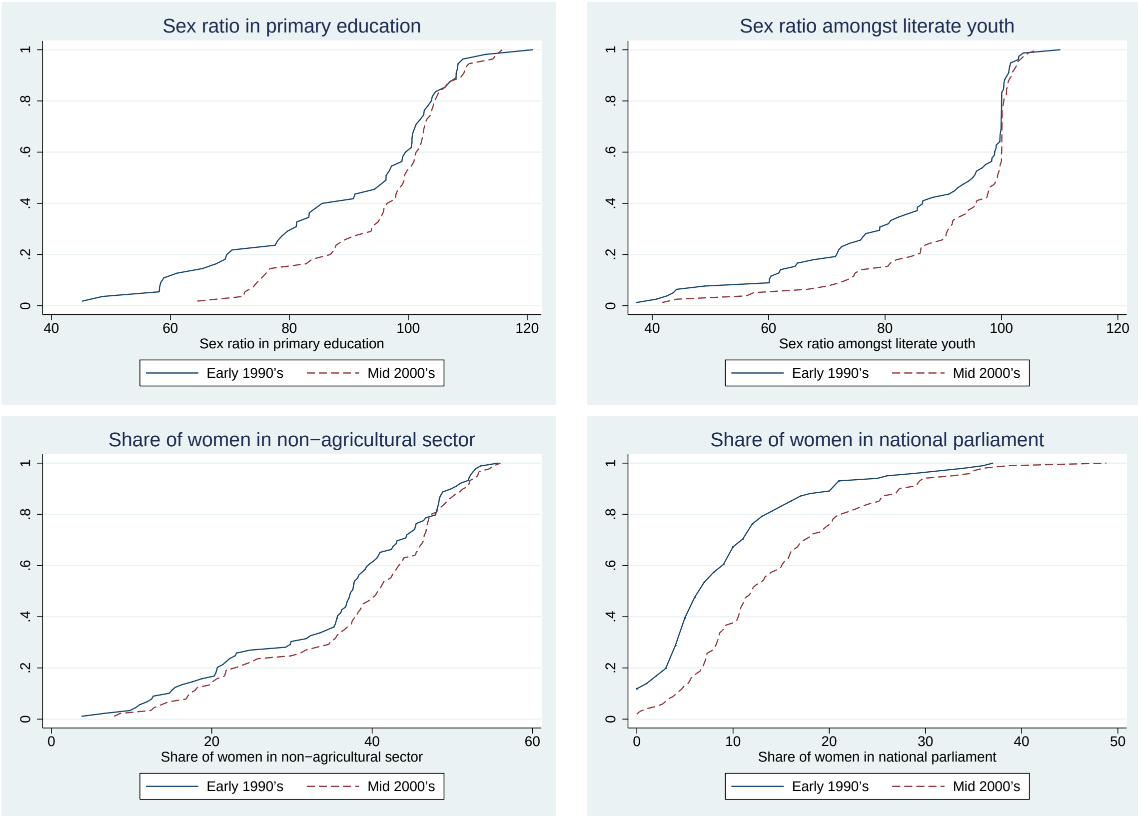
Note: Figure 2.2 plots true distributions from the early 1990s vis-à-vis the mid 2000s for the indicator of youth literacy (a positive measure) belonging to Goal 2 (an absolute goal).

Figure 2.3: Stochastic Dominance for Goal 2: Universal Primary Education



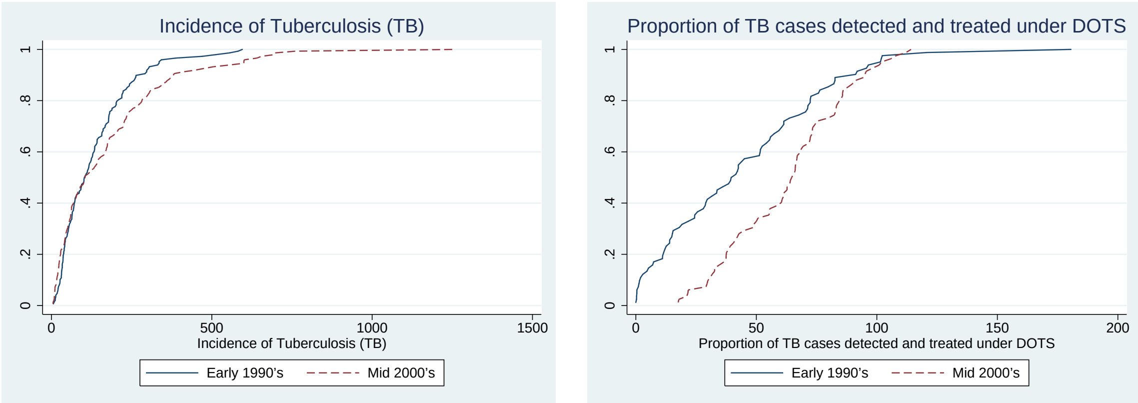
Note: Figure 2.3 plots true distributions from the early 1990s vis-à-vis the mid 2000s for all indicators (positive measures) of Goal 2 (an absolute goal).

Figure 2.4: Stochastic Dominance for Goal 3: Gender Equality and Women Empowerment



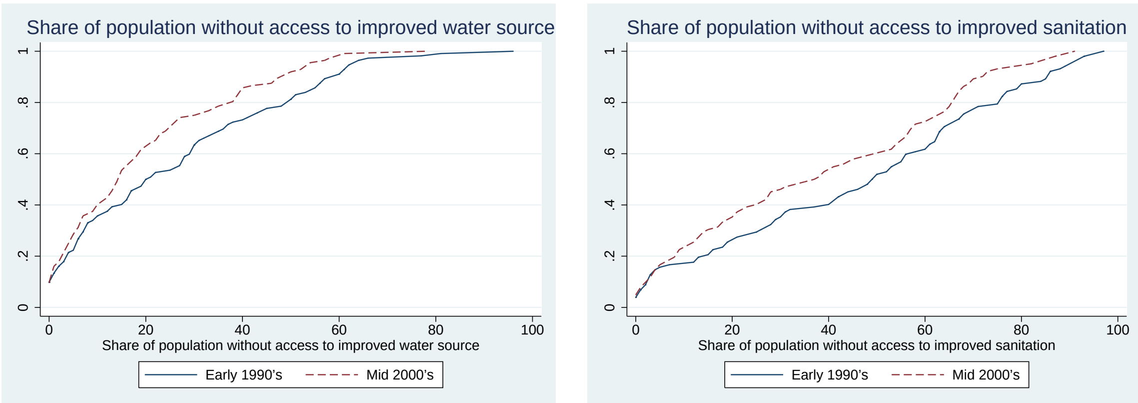
Note: Figure 2.4 plots true distributions from the early 1990s vis-à-vis the mid 2000s for all indicators (positive measures) of Goal 3 (an absolute goal).

Figure 2.5: Stochastic Dominance for Goal 6: Combat HIV/AIDS, Malaria and Other Diseases



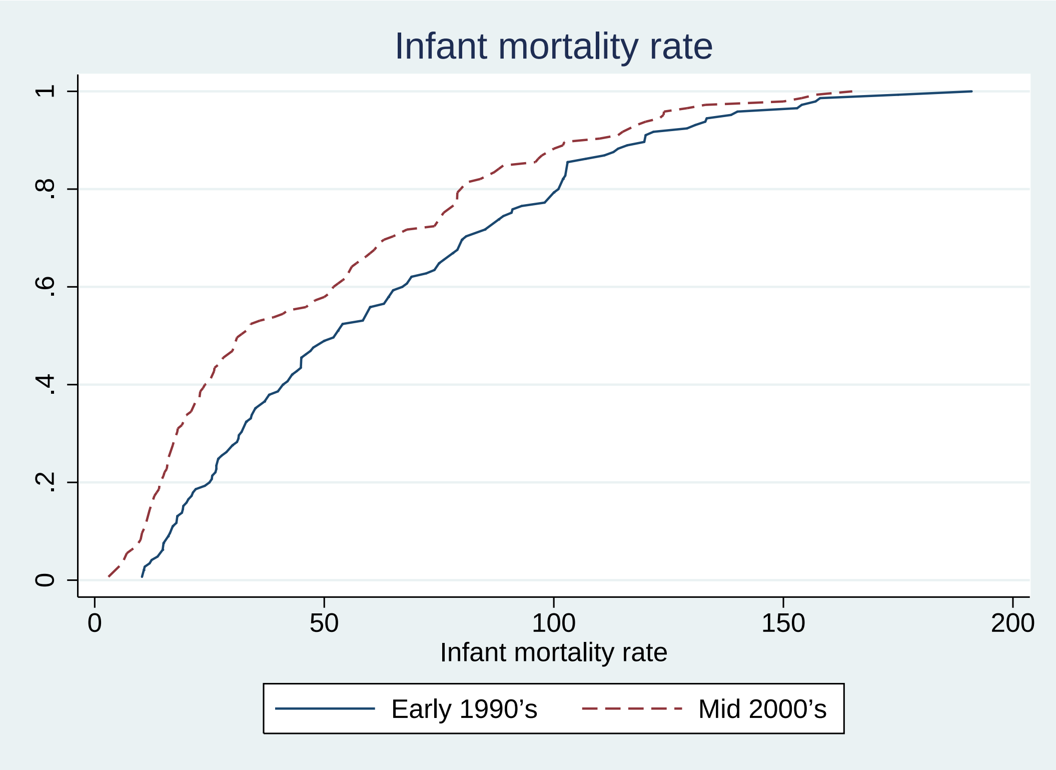
Note: Figure 2.5 plots true distributions from the early 1990s vis-à-vis the mid 2000s for all indicators of Goal 6 (an absolute goal). While TB incidence (per 100,000) is a negative measure such that "less" is "better", proportion of TB cases treated and cured is a positive measure.

Figure 2.6: Stochastic Dominance for Goal 7: Ensure Environmental Sustainability



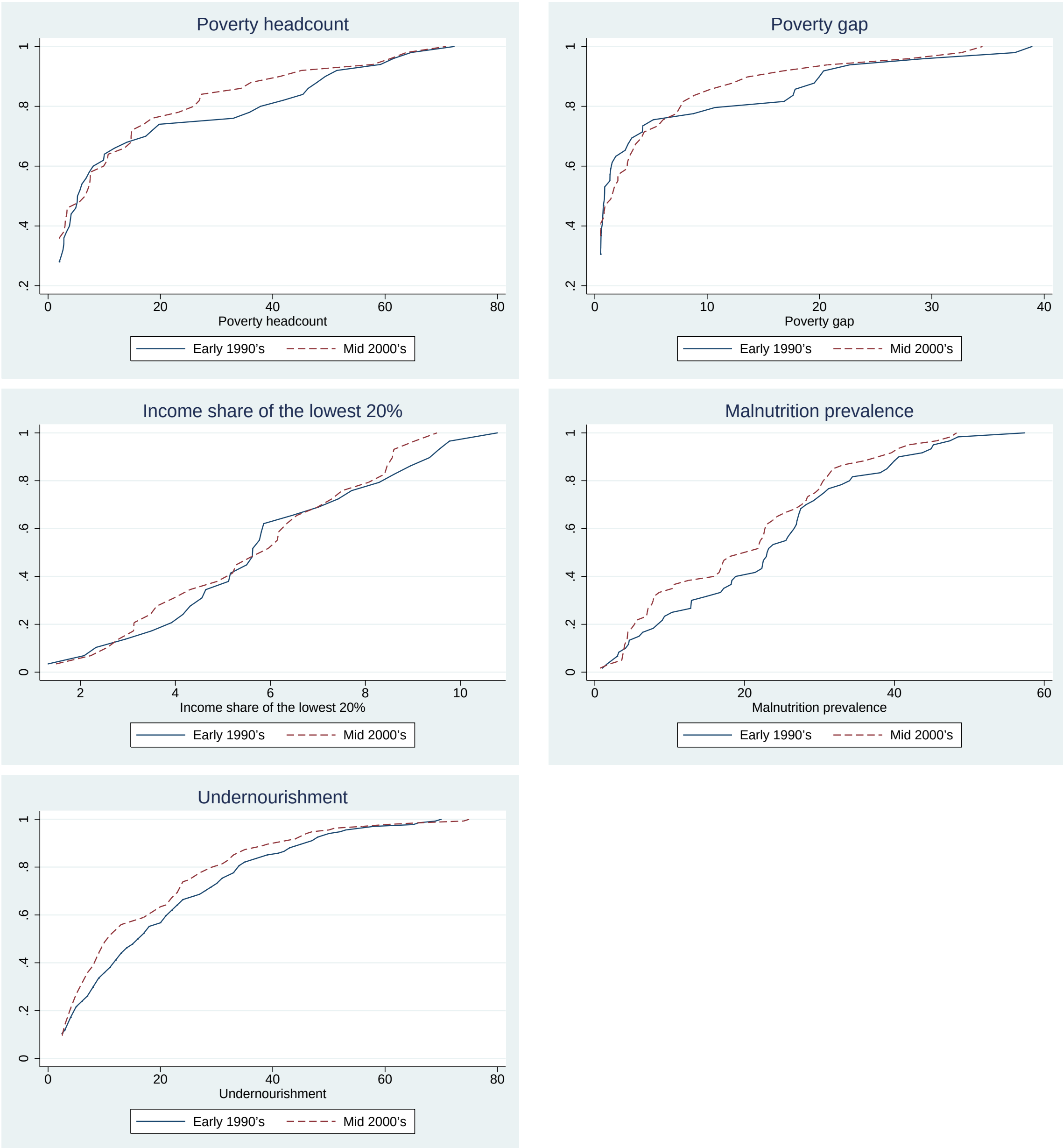
Note: Figure 2.6 plots true distributions from the early 1990s vis-à-vis the mid 2000s for all indicators (negative measures) of Goal 7 (an absolute goal).

Figure 2.7: Stochastic Dominance for Indicator: Infant Mortality Rate (Goal 4)



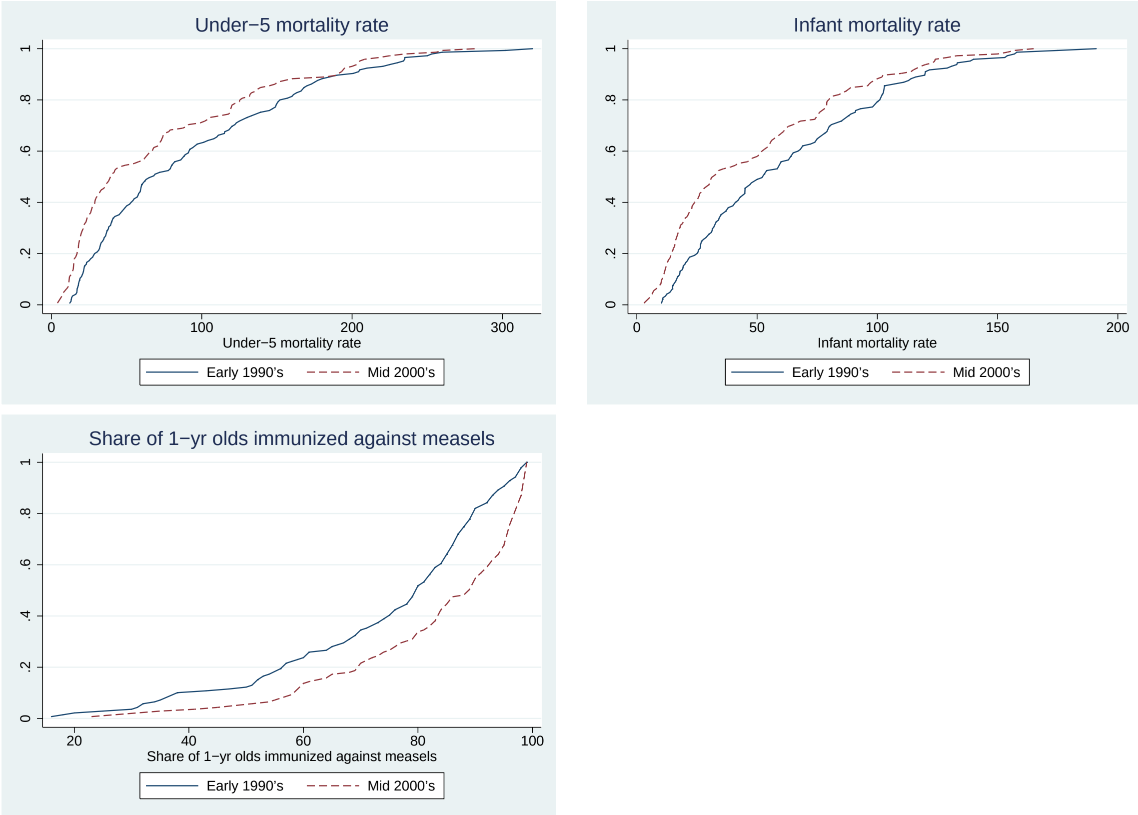
Note: Figure 2.7 plots true distributions from the early 1990s vis-à-vis the mid 2000s for the indicator of infant mortality rate (a negative measure) belonging to Goal 4 (a relative goal).

Figure 2.8: Stochastic Dominance for Goal 1: Eradication of Extreme Poverty and Hunger



Note: Figure 2.8 plots true distributions from the early 1990s vis-à-vis the mid 2000s for all indicators of Goal 1 (a relative goal). While poverty headcount, poverty gap, malnutrition prevalence, and undernourishment are negative measures such that "less" is "better", income share of the lowest quintile is a positive measure.

Figure 2.9: Stochastic Dominance for Goal 4: Reduction in Child Mortality



Note: Figure 2.9 plots true distributions from the early 1990s vis-*à*-vis the mid 2000s for all indicators of Goal 4 (a relative goal). While under-5 mortality rate and infant mortality rate are negative measures such that “less” is “better”, share of 1-year olds immunized against measles is a positive measure.

2.8 Appendix A: FGT Estimates of All Goals

Appendix A presents FGT estimates for each indicator using 3 different values of the α parameter for the initial period (early 1990s) and the end period (mid 2000s) using the following equation:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N} \mathbb{1}(x_{i,j} \leq z_{i,j})\Big(\frac{z_{i,j} - x_{i,j}}{z_{i,j}}\Big)^{\alpha} \qquad \alpha \geq 0 \tag{2.7}$$

Smaller estimates in the latter period indicate better outcomes[4]. We compute bootstrapped standard errors of these values for statistical significance.

[4]For relative goals that have negative indicators, we modify the formula in equation 2 by using reciprocals of the threshold(z) as well as the initial and end values of the living standard(x) for each indicator.

Table 2.1: FGT Estimates for Goal 1: Reduction in Global Poverty and Hunger by 50%

Indicator	Initial P_0 (1)	Initial P_1 (2)	Initial P_2 (3)	End P_0 (4)	End P_1 (5)	End P_2 (6)
Poverty headcount	1.000	0.500	0.250	0.591	0.250	0.126
N = 50	(0.000)	(0.000)	(0.000)	(0.034)	(0.016)	(0.009)
Poverty gap	1.000	0.500	0.250	0.885	0.399	0.206
N = 49	(0.000)	(0.000)	(0.000)	(0.013)	(0.008)	(0.008)
Income share of the lowest	1.000	0.333	0.111	0.981	0.308	0.110
20%; N = 29	(0.000)	(0.000)	(0.000)	(0.003)	(0.004)	(0.003)
Malnutrition prevalence	1.000	0.500	0.250	0.953	0.295	0.118
N = 60	(0.000)	(0.000)	(0.000)	(0.006)	(0.008)	(0.006)
Undernourishment prevalence	1.000	0.500	0.250	0.984	0.365	0.153
N = 134	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)	(0.002)

Note: Bootstrapped standard errors in parentheses.

Table 2.2: FGT Estimates for Goal 2: Universal Primary Education

Indicator	Initial P_0 (1)	Initial P_1 (2)	Initial P_2 (3)	End P_0 (4)	End P_1 (5)	End P_2 (6)
Youth literacy	1.000	0.168	0.056	1.000	0.114	0.029
N = 78	(0.000)	(0.009)	(0.004)	(0.000)	(0.005)	(0.001)
Persistence to grade 5	1.000	0.192	0.061	1.000	0.177	0.051
N = 55	(0.000)	(0.003)	(0.002)	(0.000)	(0.004)	(0.002)
Primary completion rate	0.665	0.187	0.079	0.879	0.105	0.033
N = 87	(0.033)	(0.010)	(0.005)	(0.011)	(0.005)	(0.002)
School enrollment rate	1.000	0.216	0.100	1.000	0.130	0.031
N = 79	(0.000)	(0.006)	(0.004)	(0.000)	(0.003)	(0.001)

Table 2.3: FGT Estimates for Goal 3: Gender Equality and Women Empowerment

Indicator	Initial P_0 (1)	Initial P_1 (2)	Initial P_2 (3)	End P_0 (4)	End P_1 (5)	End P_2 (6)
Sex ratio in primary and	0.864	0.180	0.045	0.834	0.067	0.009
secondary education; N = 55	(0.016)	(0.006)	(0.002)	(0.015)	(0.004)	(0.001)
Sex ratio of literate youth	0.849	0.127	0.036	0.794	0.081	0.017
(ages 15-24); N = 78	(0.014)	(0.006)	(0.002)	(0.016)	(0.005)	(0.001)
Women's share in non-	1.000	0.700	0.508	1.000	0.677	0.475
agricultural sector; N = 89	(0.000)	(0.005)	(0.008)	(0.000)	(0.006)	(0.009)
Share of women in national	1.000	0.883	0.785	1.000	0.852	0.732
parliament; N = 101	(0.000)	(0.005)	(0.009)	(0.000)	(0.004)	(0.006)

Table 2.4: FGT Estimates for Goal 4: Reduction in Child Mortality by Two-Thirds

Indicator	Initial			End		
	P_0	P_1	P_2	P_0	P_1	P_2
	(1)	(2)	(3)	(4)	(5)	(6)
Under-5 child mortality rate	1.000	0.333	0.111	0.187	0.044	0.013
N = 145	(0.000)	(0.000)	(0.000)	(0.011)	(0.003)	(0.001)
Infant mortality rate	1.000	0.333	0.111	0.434	0.056	0.014
N = 145	(0.000)	(0.000)	(0.000)	(0.020)	(0.003)	(0.001)
Share of 1-year olds immunized	1.000	0.333	0.111	0.974	0.361	0.146
against measles; N = 139	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.004)

Table 2.5: FGT Estimates for Goal 6: Combat HIV/AIDS, Malaria, and Other Diseases

Indicator	Initial			End		
	P_0	P_1	P_2	P_0	P_1	P_2
	(1)	(2)	(3)	(4)	(5)	(6)
Incidence of tuberculosis (TB)	1.000	0.500	0.250	0.964	0.458	0.249
(per 100,000); N = 148	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)
Proportion of TB cases detected	0.992	0.853	0.765	0.985	0.354	0.157
and cured; N = 82	(0.001)	(0.007)	(0.010)	(0.003)	(0.006)	(0.005)

Table 2.6: FGT Estimates for Goal 7: Ensure Environmental Sustainability

Indicator	Initial			End		
	P_0	P_1	P_2	P_0	P_1	P_2
	(1)	(2)	(3)	(4)	(5)	(6)
Population share without access	1.000	0.500	0.250	0.685	0.228	0.092
to a water source; N = 112	(0.000)	(0.000)	(0.000)	(0.019)	(0.007)	(0.003)
Population share without access	1.000	0.500	0.250	0.954	0.334	0.126
to sanitation; N = 102	(0.000)	(0.000)	(0.000)	(0.004)	(0.002)	(0.001)

2.9 Appendix B: Percentage Change in FGT Estimates

By construction, the FGT point estimates decrease with higher values of the α parameter as seen in Table 2.7 i.e., P_2 is smaller than P_1 which is smaller than P_0. Hence, comparing the absolute difference between P_α in the end period and P_α in the initial period for different values of α is not a meaningful measure of progress. We therefore use percentage change between the point estimates in the initial and end periods for all 3 values of α. In Appendix B, we graphically illustrate the percentage change in the estimates between initial and end periods for all goals. The three colors correspond, respectively, to the percentage changes in estimates computed for three different values of the α parameter ranging from zero to two. For some indicators, we cannot compute percentage change in FGT estimates for value of α equal to zero if there has been no change in the estimates between the initial and end periods. A more negative value indicates greater improvement since smaller estimates in the latter period are "better" outcomes.

Figure 2.1: Proportional Change in FGT Estimates for Goal 1: Reduction in Global Poverty and Hunger by 50%

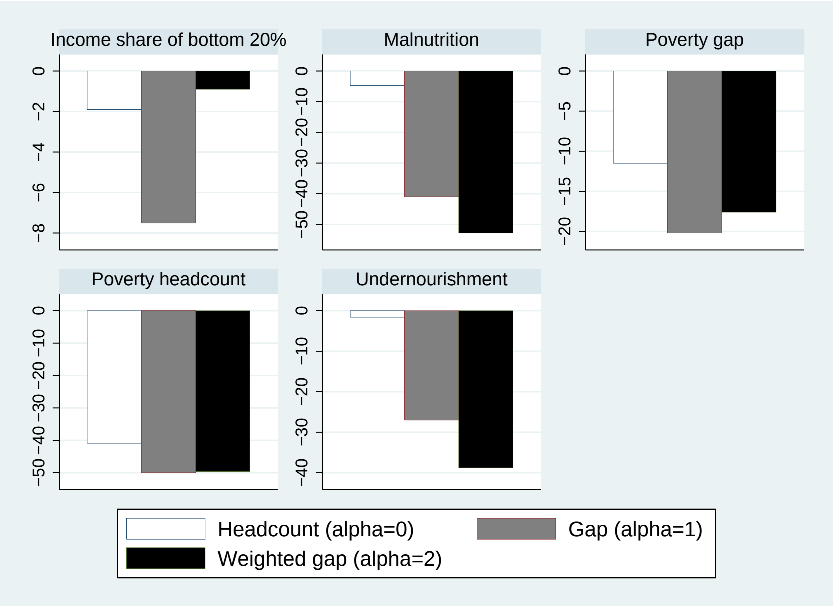


Figure 2.2: Proportional Change in FGT Estimates for Goal 2: Universal Primary Education

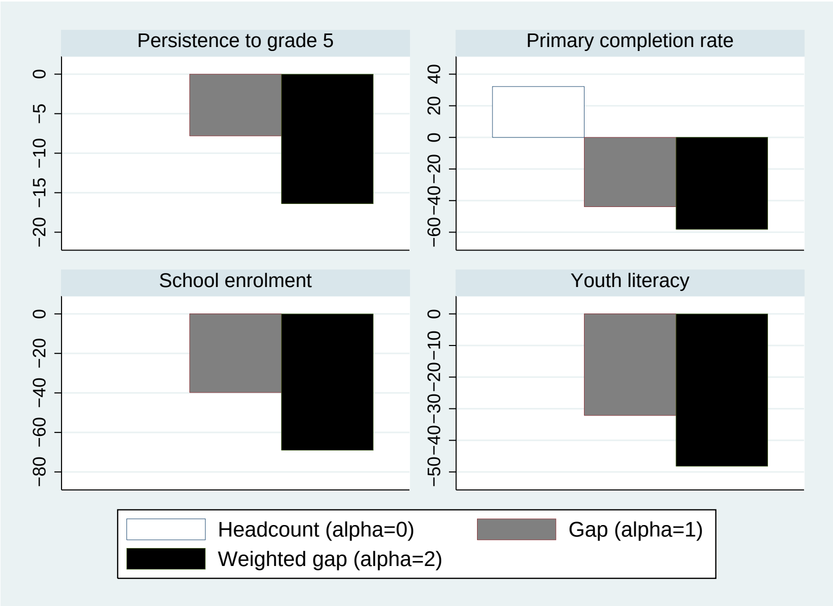


Figure 2.3: Proportional Change in FGT Estimates for Goal 3: Gender Equality and Women Empowerment

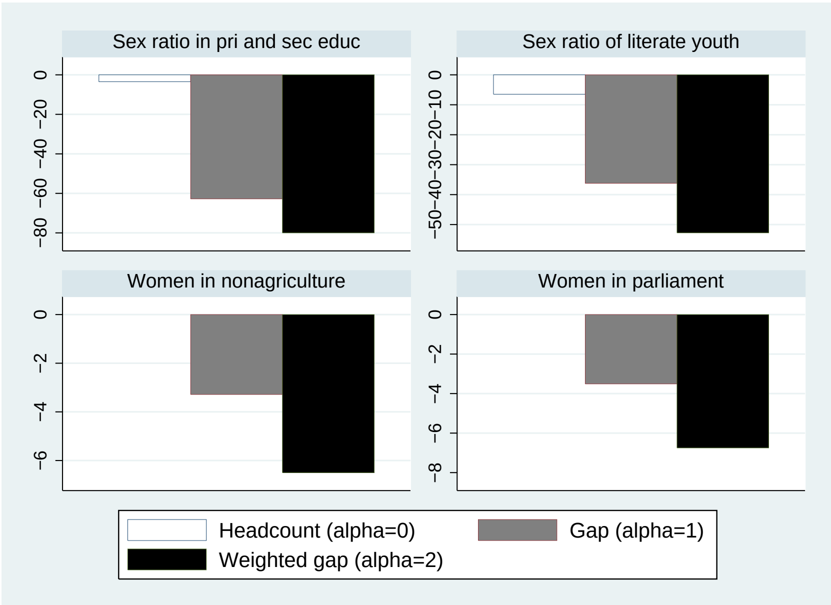


Figure 2.4: Proportional Change in FGT Estimates for Goal 4: Reduction in Child Mortality by Two-Thirds

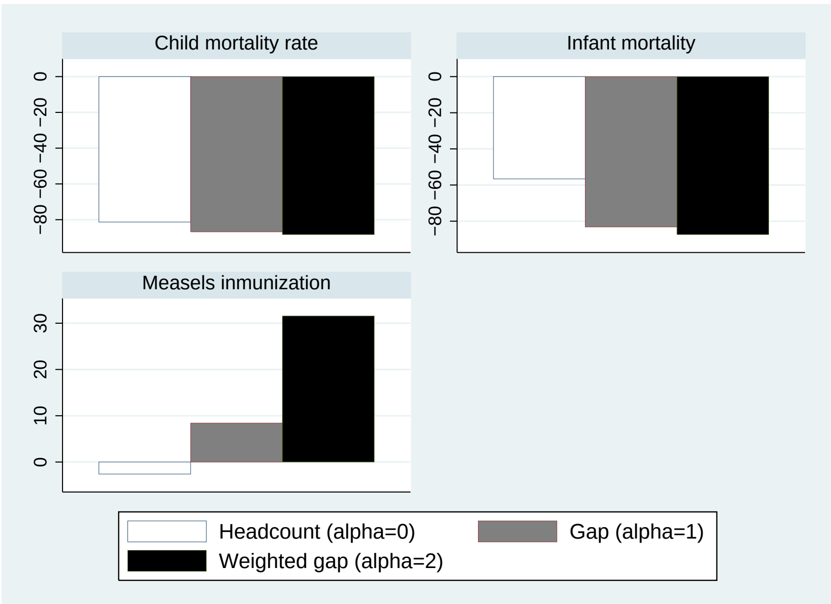


Figure 2.5: Proportional Change in FGT Estimates for Goal 6: Combat HIV/AIDS, Malaria, and Other Diseases

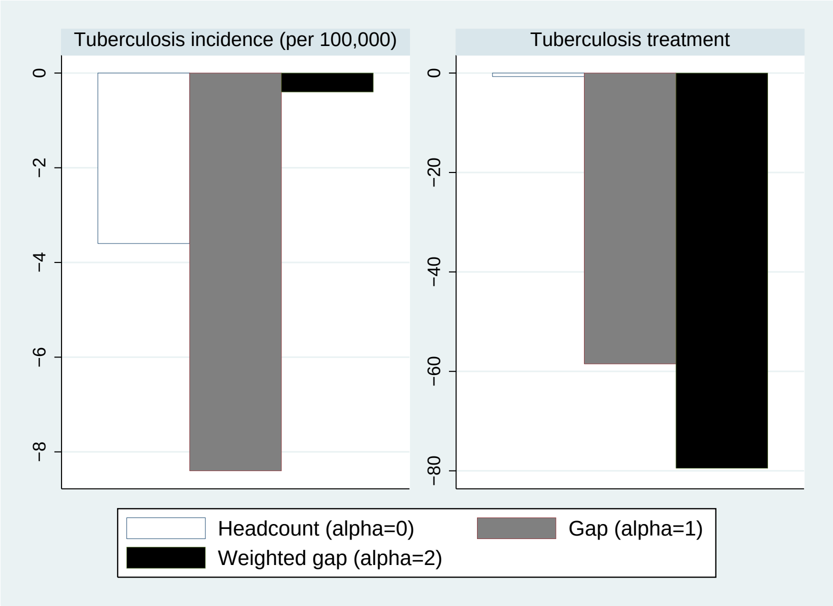
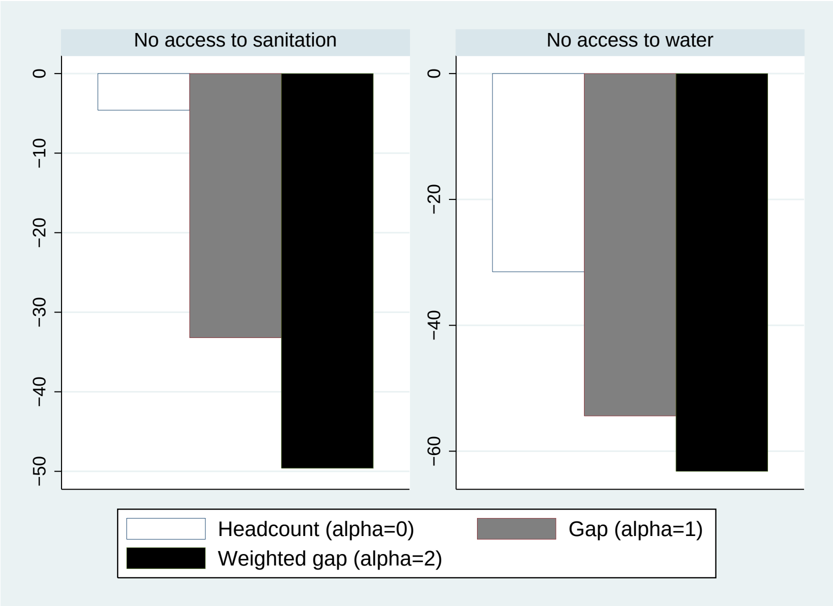


Figure 2.6: Proportional Change in FGT Estimates for Goal 7: Ensure Environmental Sustainability



Chapter 3

Measuring the Impact of the Education Guarantee Scheme on Schooling Outcomes for Women in India

Abstract: In 1997, the state government of Madhya Pradesh (MP), India, launched a unique initiative known as the Education Guarantee Scheme to support establishment of primary schools in the state's rural areas through community participation. Implemented as an alternative to government schools, this scheme led to the rapid set up of over 25 thousand schools in a span of 5 years - an average of over 2 schools per 1000 rural children in MP between the ages of 6 to 15 in 1997. Exposure of an individual to the scheme was jointly determined by her state of residence as well as her age at the time of the intervention. Using the 2005-2006 round of the National Family Health Survey, this paper combines the two sources of exogeneity to estimate the impact of this unusual policy experiment on educational outcomes of women using a difference-in-differences estimation strategy. My findings reveal substantial and robust effects of the program on rural women's completed years of schooling and their probability of attending secondary school. Further, this increase in educational attainment is largely driven by the youngest cohorts of women in my sample, implying that the scheme was most effective in reducing the private costs of schooling for women who were just young enough to start primary school.

3.1 Introduction

The potential contribution of education in stimulating growth and improving welfare in the developing world has been widely recognized by development policymakers and economists alike. Two of the eight Millennium Development Goals adopted by the United Nations Millennium Summit in September 2000 focus on universal primary education and gender equality at all levels of education by 2015. Macroeconomic literature emphasizes on the positive correlation between human capital development and economic growth amidst debate over the causal relationship between the two (Barro, 1991; Mankiw et al., 1992; Pritchett, 1996; Bils and Klenow, 2000; Krueger and Lindahl, 2001). A vast body of microeconomic literature empirically estimates the impact of investments in education on educational attainment as well as evaluates returns to education in developing countries using Ordinary Least Squares estimation, or more recently, using randomized trials and natural experiments [1]. Governments in developing countries have increasingly recognized the large returns to education, acknowledged the need for educational reform, and consequently incurred huge investments in education through various programs that reduce the private costs of schooling, provide incentives to encourage school attendance, or improve the quality of existing schools.

A common hindrance to educational attainment in the developing countries is the long distance that students often travel in order to attend school. A potential policy intervention is, therefore, to build additional schools to improve accessibility of the disadvantaged students and thereby reduce the private costs of schooling. Several empirical studies try to estimate the impact of distance to school on quantity of schooling using non-experimental variation in schools and households [2]. Such a methodology

[1] See Glewwe (2002) for a detailed review of the literature

[2] Glewwe and Jacoby (2002) and Bommier and Lambert (2000) estimate the impact of distance to school on years of schooling in Ghana and Tanzania respectively and find a negative relationship between

raises concerns about a potential omitted variable bias from unobserved factors, such as parental desire, that influence both distance to school as well as years of schooling attained. Recent studies that use "natural experiments" address this issue to some extent[3].

This paper uses variation arising from a unique policy intervention in a state of India to evaluate the impact of a rapid increase in the number of primary schools on women's educational outcomes. In 1997, the state government of Madhya Pradesh launched the Education Guarantee Scheme (EGS) whereby the state guaranteed to set up a school upon receiving a written demand from communities that did not have a school within 1 kilometer of habitation as long as there were at least 25 children between 6 to 14 years of age in tribal areas(at least 40 children in non-tribal areas). Although there have been several other centrally sponsored programs aimed at universalizing primary education at the national level, the EGS was unique to the state of MP in 1997. Between 1997 and 2003, 26,571 primary schools were started under the EGS. Population figures in Census of India 2001 suggest this was an average of over 2 schools per 1000 rural children in MP between the ages of 6 to 15 in 1997. Moreover, this rapid expansion of schools brought about by the scheme was an unusual experiment in improving schooling infrastructure with the hitherto untapped potential of community participation. Exposure of an individual to the EGS was jointly determined by her state of residence and by her age when the program was launched. Using the 2005-2006 cross-sectional wave of the National Family Health Survey (NFHS), I exploit variation arising from these two sources to measure the impact of the scheme on educational indicators

the two

[3]Duflo (2001) uses as a natural experiment, a rapid school construction intervention in Indonesia to evaluate the impact of increased schools on quantity of schooling and labor market outcomes by using variations in the exposure to the program across regions and cohorts of age. Also see Glewwe and Kremer (2006) for a review of related studies

for women. The main outcome variables considered in this paper are completed years of schooling and the probability of attending secondary school (grade 6 or above).

It must be noted that while the EGS was implemented for all children, boys and girls, of primary school-going age, there are two main reasons why the focus of my study is the girl child in particular. Firstly, while the impact of a school construction program on educational attainment and labor market returns for men has been extensively analyzed in the seminal paper by Duflo (2001), the impact of a similar intervention on women's educational gains, their returns to education, and other broader outcomes related to their welfare has not been previously studied. Secondly, in the context of the EGS, assessment of the scheme's performance has been restricted to field surveys and descriptive reports, with mixed evidence of its effects on educational status of women and other socially disadvantaged groups that were, prima facie, intended to be the largest beneficiaries of the scheme. To the best of my knowledge, there has been no study in the existing literature that offers a rigorous evaluation that would permit causal inferences of the scheme's impact on educational attainment of these historically marginalized groups. Moreover, as the related literature on developing countries suggests, I expect distance to school to be a larger impediment to education for the girl child vis-a-vis her male counterpart, hence the focus on women.

Evidence of robust program effects found in this paper is important in the context of other federal programs in the developing world aimed at improving educational outcomes of the poor. While the effects of conditional cash transfer programs on education such as those in Mexico (Progresa), Brazil (Bolsa Familia), and Nicaragua (Social Protection Network) have been widely studied, success of unconditional interventions in human capital development such as the INPRES program in Indonesia, Fundescola in Brazil, and the EGS in India could also be viewed as effective policy experiments for future educational policies. Moreover, this paper finds a large, positive effect of the scheme on poor rural women of MP - a finding that has testable implications for their non-labor market returns to schooling.

3.2 Institutional Background

Since India's independence, improving educational outcomes as the means to poverty alleviation, has been one of the foremost priorities of Indian policy makers. An important step in this direction came in the form of legislation in the 1950s and 1960s that decentralized the role of the central government through the establishment of Panchayats (local self-governments) in various states, whereby the village was empowered as the unit of administration. In 1992, the 73rd Amendment Act of the Indian Constitution provided constitutional status to the Panchayati Raj Institutions (PRI) and introduced a three-tier system of governance at village, block, and district levels to ensure people's participation in rural reconstruction. The state of Madhya Pradesh (MP) was one of the first states to enact the new system and form the PRI; the state government transferred powers and duties to these local institutions in areas such as primary education. Moreover, in 1994, the Government of India (GOI) launched the centrally-sponsored, donor-supported District Primary Education Program (DPEP)with a view to make primary schooling accessible to all children, and improve drop-out rates and enrollment gaps across gender and socioeconomic groups[4]. The DPEP was launched in two phases in the state of MP, and it fostered, among other things, the policy environment for further reforms in the area of primary education[5]. Further, in August 1994,

[4]Under the program, districts with female literacy below the national average received DPEP funds for school construction, other amenities such as drinking water and toilets, teacher training, textbook revision, etc.

[5]For a detailed description of the DPEP, see Clarke(2003) and Jalan and Glinskaya (2005). For a general overview of educational trends in India, see Kingdon (2007)

the government of MP launched the Rajiv Gandhi Shiksha (Education) Mission headed by the chief minister of MP to supplement the state government's efforts to universalize primary education in the state. One of the first tasks of the Mission was to undertake a door-to-door survey and a mobilization campaign across the state in order to estimate the number of children enrolled in school and identify the reasons for large dropout rates in the state. The survey, conducted in 1996, called as the Lok Sampark Abhiyan (LSA), revealed large gaps in the outreach of schooling infrastructure, especially to the remote tribal areas of MP that were untouched by the school network. It also identified that the large number of dropouts could be attributed to students never being enrolled in school. It was the LSA's finding that an adequate primary school was absent in 32 percent of the state's villages that impelled the state government to launch the Education Guarantee Scheme (EGS) on January 1, 1997. The main objective of the Scheme was to make primary schooling accessible, especially to children belonging to the socio-economically deprived sections of the population. Moreover, the Scheme was devised with the aim to forge a collaboration between the government and the people to cooperatively undertake the responsibility of providing education.

The EGS rests on the idea of community demand and stimulates a 3-way partnership between the community, local government (Panchayat), and the state government. The Scheme allows communities in remote areas to submit a written request to the Panchayat demanding a school so long as there is no schooling facility available within one kilometer of the habitation. Under the Scheme, whenever there is a demand from such a tribal area with at least 25 children (or from a non-tribal area with at least 40 children) belonging to the age group of 6 to 14 years, the state government guarantees to provide a primary schooling facility within 90 days of the receipt of such a request. The community provides the physical start-up space for learning, identifies a local resident to be the teacher, and participates in the day-to-day functioning of schools through Village Education Committees (VEC) and Parents Teachers Associations (PTA). The local government overlooks the appointment of the teacher, while the state government provides for the teacher's remuneration, training and the teaching-learning material. EGS has been acknowledged as an innovative breakthrough in social sector planning. Within one year of launching the Scheme, 15,568 EGS schools came up in MP; as of June 30, 2003, the number of EGS schools has gone up to 26,571, catering to over 1.2 million children, 91 percent of which belong to socially disadvantaged groups residing in rural areas of the state.

Several descriptive and field studies in MP have corroborated the increased enrollment rates, lower drop-out rates, and increased literacy levels attributed to the success of the EGS. Gopalakrishnan and Sharma (1998) acknowledge the EGS as a cost-effective alternative to other centrally sponsored programmes aimed at universalizing primary education, and assert from a sample of 31 districts that, within a year since its launch, the Scheme helped increase enrollment rates of girls and children belonging to scheduled castes and scheduled tribes (SC-ST). According to the LSA household survey conducted in 2002-03 to assess the performance of EGS, the Gross Enrollment Rate (GER) in MP has increased from 76.5% in 1996 to 101.7% in 2002-2003, while the percentage of out of school children in MP has dropped from 29.3% to 6.2% between the same period [6]. Jalan and Glinskaya (2005), while evaluating Phase-I of the DPEP, acknowledge significant improvements in the states of MP and Rajasthan and suggest that MP's success with educational outcomes could be attributed to the EGS. Clarke (2003) conducts a field study in 2 districts of MP and observes that the EGS schools

[6] GER is the number of children currently enrolled in school, irrespective of their age, as a percentage of the total population of official schooling age. Ratios greater than 100 indicate a high number of over-aged students currently enrolled in school.

were qualitatively comparable to regular government schools and had the advantages of community participation, and parental and teacher motivation. Leclerque (2003) based on a field study acknowledges the progress in enrollment rates in MP owing to the EGS, however, raises doubts over the quality of education and teacher incentives. Despite the controversial success of the EGS, to the best of my knowledge, there has not been a rigorous evaluation of the EGS that would assess and quantify the causal impact of the Scheme on direct educational outcomes. My objective is to evaluate the effectiveness of the Scheme by exploiting the inter-state variation in program placement as well as the variation in exposure to treatment across cohorts induced by the timing of the intervention.

3.3 Empirical Framework

3.3.1 Identification Strategy and Data

Exposure to the scheme is jointly determined by the individual's state of residence and date of birth. After controlling for the state of current residence and the cohort of birth effects, the interaction between dummy variables for whether the individual was young enough to benefit from the scheme at the time of its launch in 1997, and whether the individual resides in the state of MP, should reflect the impact of the scheme on the outcome variable. Indian children typically attend 12 years of schooling; consisting of 5 years of primary school from 6-11 years of age, 3 years of middle school from 11-14 years of age, followed by 2 years of high school and higher secondary school each. Under the EGS, setting up a primary school in a community was conditional on a required number of children between 6-14 years of age. This implies that most children older than 14 years at the time of the program launch were too old to be affected by the program, although a few could benefit from late enrollment or grade repetition. Accounting for such irregularities, exposure to the program is a decreasing function of the student's age in 1997. As such, the scheme should have maximum impact on the youngest cohort of children who were 6 years old, and no impact on children who were older than 14 years in 1997. The control group therefore comprises of women who were 15 years or older at the time of the program launch.

The second source of variation in this strategy is the state of current residence of the women. It must be noted here that using the state of birth would be the ideal variable instead, as long as it is highly correlated to the state of educational attainment [7]. The NFHS dataset does not record individual's state of birth, making it impossible to identify differences, if any, between the women's current state of residence and the state where they were born. However, according to the 2001 Census of India, women from MP constitute about 4% of the total inter-state migrant population in India. Besides, 40% of women in my sample are never married and 43% report as having "always" lived in the current place of residence, indicating a fairly high correlation between the current state of residence and the state of birth. Therefore, I consider MP as the treated state and compare the educational achievements of women in MP vis-a-vis women in states that share geographical borders with MP[8]. Figure 3.1 shows the political map of India from the 2001 Census. As of 1997, the centrally located state of MP shared geographical borders with 7 other states: Uttar Pradesh (UP) on the north, Rajasthan and Gujarat on the west, Maharashtra and Andhra Pradesh (AP) on the south, and Orissa and Bihar

[7] The advantage of using the state of birth over the state of educational attainment is that if all women in the sample are born before the launch of the program, the state of birth is exogenous to placement into the program.

[8] MP was split into two states - MP and Chattisgarh - in the year 2000. Therefore, the NFHS round of 2005-2006 records data for MP and Chattisgarh separately. However, since the state was still integrated at the time of the launch of the EGS, I treat both Chattisgarh and MP as one state - MP. The EGS was still prevalent in Chattisgarh after the split.

(including the state of Jharkhand which was then a part of Bihar) on the east.

In this paper, I use cross-sectional data from Phase V of the Demographic Health Survey (DHS), also called as the National Family Health Survey (NFHS) in India. This is a nationally representative household survey dataset collected between 2005 and 2006. The survey collects information from women between the ages of 15 and 49 about educational attainment and marital status among other socio-economic characteristics, contraceptive use, fertility preferences, reproductive history, and anthropometric measures. Typically, the NFHS data is available at both, the individual as well the household level[9]. Individuals' record of the NFHS has two main variables for identifying educational status of the women interviewed. More specifically, women report their highest year of education completed and the highest educational level attended, based on which, the NFHS imputes two additional variables - completed years of education (based on the specific educational pattern of India) and educational achievement (categories that account for complete/incomplete educational levels). I use these two recoded variables as my main outcomes of interest.

As preliminary evidence of the impact of EGS on educational attainment, Figure 3.2 compares the general trends in average completed years of schooling for MP women between two independent cross-sectional rounds of the NFHS - Phase IV in 1998-1999 and Phase V in 2005-2006. While there is significant improvement in educational attainment of women for all age-groups up to 40 years across the two surveys, there is a sharp increase in completed years of schooling for the youngest cohort of women who were 15-19 at the time of the respective surveys. The average completed years of schooling for this cohort increases almost three times within a span of 7 years -

[9]Information on year of birth, state of current residence, and other socio-economic control variables is obtained from the individual records; these records are then matched with the household for household-level controls.

a probable effect of the EGS intervention that affected the youngest cohort of women in Phase V who were of primary school-going age at the time of the intervention in 1997.

Further, the identification strategy relies on the assumption that there were no systematic differences with respect to educational patterns across the comparison groups in the absence of the program. As preliminary evidence of pre-program parallel trends in educational attainment between the two comparison groups, I plot completed years of schooling against women's age in 1997 for MP and its neighboring states in Figure 3.3. As seen in the figure, in general, completed years of schooling for women in MP are lower than in the neighboring states. Amongst the treated group of women who were young enough (younger than 14 years in 1997) to be benefitted by the EGS, we see that for cohorts aged 6 to 8 years in MP, the completed years of schooling are above the average values for the corresponding cohorts in the neighboring states. Further, for the control group of women belonging to cohorts older than 14 years in 1997, the trends in completed years of schooling are largely parallel between MP and its neighboring states, except for cohorts in MP that were 19, 20, or 23 years old in 1997. This validates the identification strategy explained above. Moreover, it is also a preview of the impact of the EGS on the youngest cohorts of women in MP. To enthuse more confidence in the assumption that trends with regard to the main socio-economic indicators were parallel between MP and its neighboring states, I present descriptive statistics of some relevant socio-economic variables, both at the state level as well as the individual level obtained from the NFHS sample. The former are obtained from several official reports such as Central Statistical Organization (2001), Economic Survey of India (2001), Census of India (1991), and National Human Development Report (2001). The descriptive statistics from the relevant NFHS sample refer to women of ages 15 to 30 at the time of the survey.

State-wise comparisons in the key indicators relevant to the identification assumption are presented in Table 3.1. Column (1) shows the performance of MP (treated group) compared to the average performance of the states that share a geographical border with it (control group) in column (2). The decennial population growth rate in MP is similar to the average population growth rate in its neighboring states. MP has a larger share of SC-ST population (37.8%) compared to the average share in the neighboring states. As of 1991, MP fares poorer than its neighbors with respect to Human Development Index, Female Infant Mortality Rate, Female Literacy Rate and Age-Specific Enrollment Ratio of girls belonging to the 6-11 age-group. It must be noted that of the 7 neighboring states, Maharashtra, Gujarat, and Andhra Pradesh perform better on most socio-economic indicators compared to the others. Historically, MP belongs to the group of "backward" states, that include Bihar, Rajasthan, UP, and Orissa. Next, I present the mean, standard deviations, and t-values of relevant variables in the NFHS sample of women between 15 to 30 years used in the rest of the analysis. The average age at the time of the survey is 21 years in both groups. The share of the never married women in the entire sample is 36% in MP and 39% in the neighboring states. Proportion of Hindus is 90% in the treated group and 70% in the control group. 45% of the MP women in the sample live in urban areas whereas this share is 49% in the neighboring states. These statistics suggest that MP and its neighboring states are similar on an average with regards to the main demographic indicators. With regards to educational indicators of the women, 53% of the MP women between the ages of 15 and 30 have completed primary education. In the control group on an average, 58% of the women have completed primary education. The average completed years of schooling is 6 years in both the groups. The mean age of the household head (male of female) is about 44 years and 45 years in the treated and control group respectively, whereas the average completed years of schooling of the household head are 4.7 in MP and 4.9 years in the neighboring states. T-values in column (3) are large and statistically significant for all indicators except one; although this implies that the means between the comparison groups are significantly different from each other, in magnitude, the means are very similar as seen in columns (1) and (2).

Table 3.2 illustrates the basic idea underlying the identification strategy. This table compares, between MP and its neighboring states, the average completed years of schooling of the young cohort of girls aged 6 to 11 years in 1997 who could avail the primary schools set up under EGS, vis-a-vis girls older than 14 in 1997 who had little or no exposure[10]. The average completed years of schooling has increased over time; younger cohorts have more years of schooling than the older cohorts on an average. Moreover, educational attainment has increased more between cohorts in MP compared to its neighboring states. Besides, for both cohorts, the average number of years of schooling are lower in MP than in its neighboring states. This reflects the evidence that at the time of the launch of EGS, MP was one of the poorest states with regard to educational outcomes. The difference in differences can then be interpreted as the causal impact of the EGS, based on the assumption that in the absence of EGS, there would be no systematic differences in the educational attainment patterns between MP and the neighboring states. From the table, it can be seen that the EGS, on an average, added 0.4 years of schooling for a young girl residing in MP. This difference-in-differences value is significant at the 10% level. The assumption underlying the identification strategy could be violated if educational patterns vary systematically across states or if other government schemes implemented during the same period of analysis systematically

[10]Girls between 1 and 6 years of age in 1997 would have been a better treatment group since they would be fully exposed to the scheme; however, the youngest cohort in the 2005-2006 NFHS is 6 years old in 1997. In that respect, my results could, at best, be a lower bound of the actual impact of the program.

influence education of younger women in MP. These and other possibly confounding effects on the scheme's impact will be addressed in the following sections of the paper.

3.3.2 Model Specification

To allow for other sources of variation associated with educational attainment, we can generalize the above strategy using a regression framework.

$$Y_{ij} = \alpha + \beta S_j + \gamma C_i + \delta(S_j C_i) + \theta X_{ij} + \epsilon_{ij} \tag{3.1}$$

where Y_{ij} is the educational attainment of individual i in state j, S_j is dummy indicating whether the individual belongs to state j, C_i is a dummy indicating whether the individual i belongs to the "young" cohort between 6 to 11 years in 1997. Coefficient of δ can be interpreted as the causal impact of EGS on educational outcomes; assuming the identification assumption is true, the δ coefficient is the average change in educational attainment that can be directly attributed to the scheme. ϵ_{ij} is the error term. X_{ij} is a vector of individual's time-invariant background characteristics such as education of the household head, type of residence, religion, caste, and the number of years respondents have lived in the current place of residence. Education of the household head is a proxy for the household's income; for instance, if household's socio-economic level as represented by the education of the household head, is positively (negatively) correlated to the likelihood of availing the EGS and positively correlated to the educational attainment of its women, omitting this variable could bias my estimates upward (downward). Similarly, if belonging to the SC-ST group is positively correlated to the likelihood of receiving EGS schools and negatively correlated to educational attainment, omitting the individual's caste from the regressions could bias the estimate downward, resulting in misleading conclusions about the true impact of the program. Such background characteristics are therefore included as covariates in the reduced-form estimation equation described above.

One of the limitations of the above specification is that it captures the combined effect of the program on all ages between 6 to 11 years that are "young" enough to be influenced by the scheme, vis-a-vis all ages that belong to the "old" cohort. However, it is of interest to analyze the age-group for which the scheme was most effective. To test this, the above equation can be generalized for a cohort-by-cohort analysis as following:

$$Y_{ij} = \alpha + \beta S_j + \gamma C_i + \sum_{k=6}^{20} \delta_k (S_j C_{ik}) + \theta X_{ij} + \epsilon_{ij} \tag{3.2}$$

where C_{ik} is now a dummy for each year of birth indicating whether the age of the individual i is k years in 1997. There are 15 such year-of-birth dummies for the individuals' ages in 1997. Individuals who are 21 years of age in 1997 belong to the omitted control group. This specification allows me to study the differential impact of the scheme on each cohort separately. The coefficient of interest is δ_k for each cohort k.

3.4 Results

3.4.1 Main Findings

The key result of this paper is shown in Table 3.3 which presents estimates of equation 1 for two outcome variables: completed years of schooling and the probability of secondary school attainment. While the former is a continuous variable, I define the probability of attending secondary school as a variable that takes the value of one if the woman's reported educational achievement at the time of the survey is either incomplete secondary, complete secondary or higher education, and takes the value zero otherwise. In this table, I compare girls aged 6 to 11 in the year 1997 with those aged 15 to 21 in 1997 across MP and its neighboring states. It must be noted that although the eligibility for requesting an EGS school was to have a specified number of children between 6 and 14 within the community, the EGS schools were essentially primary schools catering to ages between 6 and 11; as such the impact of these schools on ages 12 to 14 is ambiguous. For instance, it could be argued that ages between 12 and 14 could benefit from the scheme if there are concerns about late enrollment and grade repetition for these ages and hence must be included in the treated group for true estimates of the scheme's impact on schooling. In my sample, only 2% of all the household members are reported as being "repeaters" at the time of the survey, although I have no information on late enrollment. It could also be argued that ages 12 to 14 are past the age for primary schooling and must therefore be excluded from the treated group of cohorts. I omit these ages in the initial set of results; however, as robustness checks, I include these cohorts in the treated group and then in the control group for 2 different experiments as shown in Section 6.1. Table 3 reports the estimated coefficients of the interactions between the cohort dummy and the dummy for whether the woman resides in MP at the time of the survey. Models 1, 2, and 3, as explained below, refer to the different sets of control variables used for each of the regressions. I present OLS estimates of completed years of schooling and the marginal effects of probit estimates of the probability of attending secondary school. Robust standard errors are clustered at the age level[11].

Column (1) of Table 3.3 shows that without including any other controls for background characteristics X_{ij} in equation (1), exposure to the scheme increased average

[11]In results not shown here, I have clustered the standard errors by age*state with no significant changes in the results.

years of completed schooling by approximately half a year and increased the probability of secondary school attainment by around 7 percentage points. Both the estimates are statistically significant. Model 2 adds controls for background characteristics such as caste, religion, education of the household head, and a dummy for whether the household is located in a rural area. Coefficients in column (2) suggest that after controlling for the background characteristics, the average completed years of schooling for women in MP who were young enough to be exposed to the program in 1997 increased by over 4 months while the probability of attending secondary school increased by 6 percentage points. While the estimated coefficients for completed years of schooling are not significantly different from zero, the estimates for the probability of attending secondary school are significant at the 5% level and can be interpreted as the causal impact of the EGS on the probability of attending a grade above grade 5. One concern is that the women's state of educational attainment may be different from their current state of residence at the time of the survey; the gains in educational attainment being attributed to the EGS could be overestimated if the women belonging to the "treated" group are, in fact, migrants who completed primary education in a state different from MP. Although the NFHS collects no information about the women's state of residence at birth, women do report the number of years lived in their current place of residence. I use this variable as a rough measure of migration and include it as a covariate along with other background characteristics in Model 3. As seen from column (3) which adds this covariate to Model 2, exposure to EGS increases completed years of schooling by 0.3 years (not statistically different from zero) and the probability of attending secondary school by 5.5 percentage points (statistically significant at 5%).

Finding a statistically insignificant impact of the EGS on completed years of schooling for the average woman in MP is not surprising. The main goal of the EGS was to make primary schooling accessible to the remote rural areas of MP, largely occupied by the socio-economically disadvantaged castes and tribes that did not have access to a primary school and were thus disconnected from the state's existing school network. Hence, there is strong reason to believe that the impact of the EGS on women differed across the rural-urban divide as well as the caste divide within the state of MP. I therefore split the sample, first between rural and urban and then between SC-ST and non-SC-ST. Panel A of Table 3.4 reports the OLS estimates of the interaction term between the cohort dummy and state of residence dummy for completed years of schooling. As expected, the estimated coefficients of the interaction term are large and statistically significant for the rural sample across all 3 model specifications. After including the full set of controls as in column (3), exposure to the EGS increases completed years of schooling by 0.41 years for rural women in MP. This estimate is similar to the raw difference-in-difference value obtained in Table 2, clearly implying that the entire gain in the educational attainment of MP women could be attributed to the causal impact of the EGS in the *rural* areas of the state. Given that the average years of schooling is about 6 years in MP, this implies a 7 percent increase in completed years of schooling. On the other hand, the scheme has no significant impact on the urban sample of 11 thousand women. This is because the EGS was primarily designed to include rural areas into the state's school network.

As previously stated, documented achievements of the EGS also emphasize on the scheme's effect on the educational attainment of the socio-economically disadvantaged groups in the state, namely the SC-ST. Typically, EGS schools are set up at the community level and the socio-economic composition within the rural communities is largely homogenous; this implies that each school is attended and supported by a different socio-economic group that is dominant within the community (Clarke, 2003). As such, beneficiaries of the EGS are heterogenous by their socio-economic status. To test this, I now split the original sample across the caste divide. About a third of the sample belongs to the SC-ST category, while the rest include "Other Backward Castes", other Hindus, and non-Hindus. Estimated coefficients of the interaction term show that, after including the full set of controls, the scheme increased completed years of schooling by 0.4 years for the marginalized group of SC-ST women in MP who were young enough to be exposed to the scheme in 1997; however, these estimates are not statistically different from zero. The scheme has a negligible and statistically insignificant impact on the non-SC-ST sample. Panel B repeats the analysis to estimate the marginal effects of exposure to the EGS on the probability of attending secondary school. A similar pattern emerges. Exposure to the EGS increases the probability of attending grade 6 or above for rural MP women by approximately 6 percentage points, after controlling for the full set of background characteristics, whereas there is no significant effect on the urban sample. Further, dividing the sample between the SC-ST and non-SC-ST shows that exposure to the EGS had no significant impact on the probability of attending secondary school for SC-ST women in MP. Overall, Table 3.4 suggests that there is strong evidence of educational improvements for women in the rural areas of MP that can be attributed to the EGS. It must also be noted that due to data limitations, I cannot exactly identify the women who received treatment in the form of access to an EGS school. Clearly, not all women in the rural areas of MP were treated by the intervention. These results should therefore be interpreted as the impact of intention to treatment and at best, are a lower bound of the true impact of the program.

3.4.2 Heterogenous Effects

The results so far show the estimated impact of the EGS on average education of the collective group of young women aged 6 to 11 years in 1997 compared to women who were too old to be exposed to the program. In this subsection, I focus on the impact of the scheme on each cohort so as to identify the cohort(s) for which the scheme was most effective. In particular, I estimate equation (2) above, which, in effect, is a generalized extension of equation (1) to enable a cohort-by-cohort analysis. If the identification strategy is credible, the impact of the program should be a decreasing function of the women's age; as such, estimated coefficients of the interaction term should fluctuate around zero for cohorts that are older than the primary school-going age. To obtain more precise estimates of the program's impact, I employ a restricted estimation of the heterogenous effects of the program by redefining the control group as all individuals aged 15 to 21 in 1997. This strategy can be expressed in the form of the following modification of equation (2) described earlier:

$$Y_{ij} = \alpha + \beta S_j + \gamma C_i + \sum_{k=6}^{14} \delta_k (S_j C_{ik}) + \theta X_{ij} + \epsilon_{ij} \tag{3.3}$$

Instead of testing for whether the δ_k coefficients are zero for each cohort older than 14 years in 1997, this equation is a more efficient way to analyze heterogenous effects of the program across cohorts (Duflo, 2001). Results for the outcomes of completed years of schooling and the probability of attending secondary school for the rural sample are presented in Table 3.5. This table shows the coefficients of the interaction term between the dummy for being a given age in 1997 and the state of residence dummy for the full set of controls used in section 5.1. The coefficients of interactions between being a given age in 1997 and the state dummy are the largest for the youngest rural cohort of 6 year old girls and the effects are statistically significant at the 1% level for both outcomes. Exposure to the EGS in the rural areas of MP increased the average completed years of schooling by over 1.5 years and the probability of attending secondary school by 25 percentage points for the youngest cohort of rural girls aged 6 years at the time of the program launch. The effects of the program on completed years of schooling as well as the probability of attending secondary school become smaller for older cohorts and become statistically insignificant for cohorts older than 8 years in 1997. The coefficients generally decrease with age except for an increase at the age of 13. The effect is negative for the cohort that is 12 years old in 1997. These results indicate that the identification strategy is valid. Moreover, these effects imply that the costs of starting primary school are highly non-linear; first-time enrollment into primary school becomes very costly at older ages for this sample of women in rural India. This is an important observation for policy action since this suggests that providing increased access to primary schools may not have the desired impact on enrollment of women who are slightly older than the first couple of grades of primary school.

3.5 Robustness Checks and Discussion

3.5.1 Pre-existing Trends

In this subsection, I present a few falsification tests that confirm the validity of the identification strategy such that increases in educational outcomes as observed in the previous section can be attributed to the EGS alone rather than to pre-existing trends across states. The identification strategy relies on the assumption that educational patterns do not vary systematically across states. For instance, evidence of rapid increases in education in MP vis-a-vis its neighboring states before the EGS was launched, would invalidate the impact of the EGS as causal. Although there has been evidence that MP was one of the most backward states with regard to educational indicators prior to this scheme, I can conduct a control experiment to test the above concern. Rural cohorts that are older than 14 years of age in 1997 were not exposed to the program. Thus, if I compare educational attainment of cohorts that are 15 to 20 years of age versus cohorts 21 to 25 years in 1997, in the absence of such trends, the educational increments between these 2 groups should not systematically differ across the states. Table 7 shows the results from this control experiment for both outcomes across three sets of controls.

In Table 3.6, rural cohorts between the ages of 15 to 20 in 1997 form the pseudo "treated" group whereas cohorts between 21 to 25 form the control group. Models 1, 2, and 3 refer to the three sets of controls as discussed earlier. If, prior to the launch of the EGS, temporal growth in educational attainment was systematically higher in MP vis-a-vis its neighboring states, the coefficients of the interaction between the cohort dummy and the state dummy must be positive and statistically different from zero for both outcomes across the three specifications. In Table 7, coefficients in Model 1 (without controls) reveal a very small but statistically insignificant "effect" for both outcomes. Adding more controls, coefficients in Models 2 and 3 reveal negligible "effects" (even negative in case of completed years of schooling) that are never statistically significant, suggesting that there are no systematic inter-state differences in educational patterns prior to the scheme.

The difference-in-difference estimates above can be interpreted as the impact on educational attainment of exposure to the EGS for women residing in MP vis-a-vis women residing in MP's neighboring states that collectively form the control group. However this control group consists of a heterogenous mix of 7 states that differ significantly from each other on socio-economic grounds. In particular, MP is similar in characteristics to the states of Bihar, Rajasthan, and UP. Historically, these four states were together termed as BIMARU ("sick") states due to their characteristically low levels of GDP and other socio-economic indicators. Later, the state of Orissa was also added to this list. On the other hand, the states of Gujarat, Maharashtra, and AP fare better then these states on most outcomes. Therefore, as a robustness check, I now use those neighboring states that are similar to MP as a collective control group to measure the performance of EGS. Results for the two main outcome variables are presented in columns (1) and (2) of Table 3.7. Each row refers to the group of states that has been used as the control group and each cell in columns (1) and (2) represents a separate regression estimating the coefficient of the interaction term between the cohort dummy and the state of residence dummy for the full set of controls described earlier. The analysis is restricted to the rural sample and the number of observations are presented in column (3). Results are generally consistent with previous findings of educational improvements attributable to the EGS. For instance, as seen from columns (1) and (2), exposure to the EGS for young rural women in MP has a positive and statistically significant impact on their completed years of schooling and their probability of attending secondary school vis-a-vis their counterparts in Bihar, Rajasthan, and UP together. The point estimates are very similar to the original findings for the rural sample in Table 3.4. Adding Orissa to the control group increases the point estimates for both outcomes. Next, I include all the other states together as a control group. The point estimates are still large and statistically significant, implying that the results are large and robust to alternative specifications of the control group.

Finally, I examine whether the identification strategy is sensitive to alternative definitions of the treatment group. Table 3.8 presents the main findings in Section 5.1 by redefining the age-group that is exposed to the EGS to individuals who were 12 to 14 years old in 1997. Once again, the analysis is restricted to the rural sample. In panel A, I redefine the cohort dummy to be equal to one if the individual is between 6 to 14 years of age in 1997, and is equal to zero otherwise. As before, the control group comprises of individuals between 15 to 21 years in 1997. In Panel B, cohort dummy is equal to one if the individual is between 6 to 11 years of age in 1997, and is equal to zero otherwise. The control group is redefined to comprise of individuals between 12 to 21 years in 1997. The magnitude of the estimated coefficients of interaction in Panel B are similar to the main findings in Table 4 for both outcomes of interest for the rural sample, indicating that rural women who were 12 to 14 years at the time of the launch of EGS were too old to be exposed to the treatment and therefore including them in the treatment group as in Panel A would underestimate the true impact of the scheme. This justifies excluding these cohorts from the treated group; it also reinforces the earlier findings that first-time entry into primary school made available by such a scheme, becomes costlier for older cohorts who were previously never enrolled.

3.5.2 Discussion

In summary, the results suggest that the EGS increased educational attainment of rural women exposed to the scheme in MP. However, to avoid misinterpreting the results in a more general context, certain caveats must be considered. As previously mentioned, in the decade of the 1990s, India witnessed several initiatives by the central government in partnership with the state governments aimed at universalizing primary education. If such an educational intervention ran simultaneously with the EGS during my period of analysis, differentially benefitting younger women in MP, my results will be confounded by the correlation between such a program and the EGS. One such scheme was the DPEP launched in 1994 by the central government of India. Although the

DPEP was nationally introduced at the district level, MP received a larger share of the DPEP funds owing to its poor educational records. Since the dataset I use in this paper offers no retrospective information on what type of school the women attended, I cannot disentangle the effects of the EGS from the DPEP. However, evidence from existing government reports suggests that in MP, funds received from the DPEP were diverted to build EGS schools, thus leading the 2 schemes to merge into the EGS [20]. Further, compared to the 26,571 EGS schools that were set up between 1997 and 2003, the number of regular primary (non-EGS) schools opened in MP was a mere 4209 between 1994 and 1998; this clearly suggests that the EGS was, more aggressive and intensive in approach, and can account for the large effects on educational attainment seen in this paper. More importantly, since the DPEP was launched in 1994 and the EGS in 1997, if the results in this paper were driven by the DPEP instead of the EGS, the impact should have been evident on older girls between 9 and 12 years of age in 1997 who were benefitted by the launch of DPEP in 1994. My results show that the increase in educational attainment only persisted up to the cohort aged 8 in 1997, which confirms that these improvements were a result of the EGS and not the DPEP.

The EGS relies heavily on community participation besides the state government's assistance in providing educational infrastructure. Therefore, the apparent success of the EGS hinges largely on the motivation and responsibility of the communities that initially request for a school and later manage and supervise its functioning. If communities in the state of MP have been systematically more motivated and responsible than their counterparts in the other states, the effects on educational attainment in MP could be erroneously attributed to the EGS rather than to the characteristics of its communities. The aim of this paper is to assess the impact of the EGS experiment in MP, while acknowledging that such an experiment may be unique to this state and its effects may not be generalized to other less favorable settings.

As suggested earlier, the NFHS round of 2005-2006 does not provide any information on migration of the individuals interviewed. Therefore, it does not allow the identification of the state where the individuals were born and/or educated, which could be distinct from the reported state of current residence. This implies that my identification strategy is based on the assumption that there is no significant inter-state migration of women. This is not entirely implausible; according to the Census of India 2001, women from MP constitute about 4% of the total inter-state migrant population in India. Further, as seen from my findings, using a rough measure of migration does not significantly alter the impact of the EGS on the educational attainment of the "treated" group, indicating that migration may not be of a critical concern. Another important caveat is that the NFHS data is not available at the district level, thus making it impossible to identify individuals living in districts located along the borders of MP. If children residing in a neighboring state gain access to an EGS school situated in close proximity across the border in MP, it would imply that there are individuals in the comparison group who are possible beneficiaries of this scheme. Excluding them from the treated group in the current analysis implies that the apparent gains in educational attainment seen in the previous sections are, in fact, a lower bound.

This paper offers no measure of the qualitative gains in education from the scheme. The NFHS dataset does not record information on any indicators of qualitative educational achievement; I cannot ascertain whether the increase in quantity of education attributed to the EGS is matched with qualitative improvements, if any. Existing field studies on the EGS provide mixed evidence on the standards of education in the EGS schools based on indicators such as student-teacher ratios, teacher motivation, and textbook curriculum (Leclerque, 2003; Clarke, 2003). This paper's contribution to the existing literature is to rigorously evaluate the effect of a policy aimed at reducing the cost of primary education on the *quantitative measures* of women's education. Finally, this paper does not consider the long-run impact of the EGS. Large changes in educational attainment in the state of MP could potentially increase the supply of educated women in the labor market, decrease the returns to education and thereby alter the demand for education. This paper ignores the general equilibrium effects of the scheme.

3.6 Conclusion

In this paper I exploit a unique policy experiment in India to evaluate the impact of investments in educational infrastructure on educational attainment of women. The EGS was an unusual initiative by the state government that led to rapid growth of primary schools in the rural areas of MP - an average of over 2 schools per 1000 rural children of ages 6 to 15 in 1997 - in collaboration with communities and local self-governments. Using cross-sectional data from the 2005-2006 round of the NFHS, I find a positive effect of the EGS on women's completed years of schooling as well as the probability of attending secondary school. On average, the estimates suggest that exposure to the scheme in the rural areas of the state increased completed years of schooling by a quarter of a year and increased the probability of attending secondary school by around 6 percentage points. The program effects are driven by the youngest cohorts of women who were 6-8 years old at the time of the program launch, suggesting that the EGS played a crucial role in reducing the private costs of primary school for women who were just young enough to start schooling. This suggests that the costs of schooling in these rural areas may be highly non-linear in nature; starting school at older ages is very costly in these rural areas of MP despite the provision of new schools. A battery of robustness checks confirm the interpretation of the estimates as the causal impact of the EGS on educational attainment; although these results must be interpreted with caution in a more general setting.

These results are especially important in the Indian context. Since 1960, Indian policy makers have endeavored at providing free and compulsory education to all children up to the age of 14 and recently recognized it, in 2009, as a constitutional right of every child. However, this goal is still elusive despite the enactment of a wide array of schemes and allocation of large financial resources by governments at the central as well as state level. India's budgetary allocation for education forms 3.8% of its Gross Domestic Product (GDP) as of 2005-2006. The National Policy on Education established in 1986 envisages an increase in this share to 6% of the GDP in order to meet the country's educational targets. Amidst debate over the adequacy of financial resources toward universalizing primary education, assessment of existing policies becomes crucial to policy makers. This paper evaluates the impact of one such scheme introduced in the state of MP, the EGS, which was uniquely premised on decentralized management based on community participation. While the existing literature on such programs is largely of a descriptive nature, rigorous evaluation that would permit causal inferences about the effectiveness of such alternative interventions could contribute toward paving the way for designing potent educational policies in the future.

Positive and robust effects of the EGS on educational attainment of poor women in rural areas of MP suggest that building primary schools with the assistance of community participation can be a profitable exercise in improving schooling infrastructure, especially for marginalized women. Existing empirical literature suggests evidence of higher returns to schooling for women vis-a-vis men - an inference that has testable implications for this paper. A relatively less explored area of research is the use of a natural experiment to evaluate returns to schooling for non-labor market outcomes for poor women who do not participate in the formal labor market. Moreover, it is also of interest to assess the positive spillover effects of increased educational attainment on a broader range of outcomes related to women's welfare. For instance, increased education may affect marital and/or fertility decisions of women or may have intergenerational effects on outcomes related to their children. Analyzing these indirect consequences of the EGS will be the scope of future research.

Table 3.1: Descriptive Statistics

	Madhya Pradesh (1)	Neighboring States (2)	t-values (3)
Background Indicators at the State Level:			
Decennial Growth Rate of Population (1990-2001)	24.34	22.48	
Proportion of SC-ST in Total Population (1991)	37.81	25.22	
Human Development Index (1991)	0.328	0.368	
Female Infant Mortality Rate (1991)	136	85	
Female Literacy Rate (1991)	28.85	53.86	
Age-Specific Enrollment of Girls in 1991 (6-11 years)	40.90	42.59	
Household Survey Indicators: Women aged 15-30 at the time of survey			
Current age	21.81	21.62	2.797
	(4.46)	(4.37)	
Proportion of women never married	0.36	0.39	-4.074
	(0.48)	(0.49)	
Proportion of Hindus	0.90	0.79	22.357
	(0.30)	(0.41)	
Proportion living in urban areas	0.45	0.49	-5.234
	(0.50)	(0.50)	
Proportion of women without schooling	0.30	0.30	0.000
	(0.46)	(0.46)	
Proportion above primary education	0.53	0.58	-6.565
	(0.50)	(0.49)	
Completed years of schooling	6.02	6.41	-5.433
	(4.60)	(5.13)	
Age of the household head	43.69	45.06	-6.456
	(13.87)	(13.95)	
Household head's completed years of schooling	4.76	4.90	-2.424
	(3.75)	(3.91)	
Observations	5,185	24,536	

Notes: Age-Specific Enrollment Ratio = (Estimated enrollment in an age group ÷ Estimated child population in that age group) × 100. State-level background indicators are obtained from official reports by Central Statistical Organization (2001), Economic Survey of India (2001), Census of India (1991), and National Human Development Report (2001). Household-level indicators are obtained from the NFHS sample of women aged 15 to 30 at the time of the survey. Standard deviations are in parentheses.

Table 3.2: Average completed years of schooling by state and cohort

	Treated State (1)	Neighboring (Control) States (2)	Difference (3)
Cohort aged 6 to 11 in 1997	6.53	6.61	-0.088
	(0.084)	(0.043)	(0.100)
Cohort aged 15 to 21 in 1997	5.44	5.96	-0.524
	(0.116)	(0.054)	(0.129)
Difference	1.09	0.65	0.44
	(0.145)	(0.069)	(0.165)

Notes: Standard errors are in parentheses.

Table 3.3: Impact of EGS on Educational Attainment: Coefficients of interactions between cohort dummy and the state of residence dummy: Women aged 6-11 or 15-21 years in 1997

	Model 1 (1)	Model 2 (2)	Model 3 (3)
Panel A: Completed years of schooling			
OLS estimates	0.546*	0.363	0.305
	[0.272]	[0.222]	[0.209]
(R-squared)	0.03	0.37	0.39
Panel B: Probability of secondary school attainment			
Marginal effects	0.068**	0.062**	0.055**
	[0.027]	[0.029]	[0.028]
Control Variables:			
Individual age dummies	Yes	Yes	Yes
Household Characteristics†	No	Yes	Yes
No. of years in current residence	No	No	Yes
Observations	23,749	23,749	23,749

Notes: Robust standard errors are in brackets and are clustered at the age level. * denotes significance at 10%; ** at 5% and *** significance at 1%. Treatment group: cohorts aged 6 to 11 in 1997; Control group: cohorts aged 15 to 21 in 1997. Each cell represents a separate regression. † include type of residence(urban/rural), religion, caste, and education of the household head.

Table 3.4: Heterogenous Effects of the Education Guarantee Scheme: Coefficients of Interaction between the cohort dummy and the state of residence dummy

	Model 1 (1)	Model 2 (2)	Model 3 (3)	Observations (4)
	Outcome: Completed years of schooling			
Rural Sample	0.497*	0.485**	0.414*	12,289
	[0.233]	[0.215]	[0.202]	
Urban Sample	0.326	-0.116	-0.143	11,460
	[0.526]	[0.432]	[0.420]	
SC-ST Sample	0.595*	0.562*	0.366	6,542
	[0.302]	[0.270]	[0.265]	
Non-SC-ST Sample	0.407	0.100	0.098	17,207
	[0.345]	[0.290]	[0.277]	
	Outcome: Probability of secondary school attainment-marginal effects			
Rural Sample	0.072***	0.067**	0.058**	12,289
	[0.026]	[0.028]	[0.026]	
Urban Sample	0.043	0.013	0.011	11,460
	[0.038]	[0.037]	[0.034]	
SC-ST Sample	0.066*	0.061	0.039	6,542
	[0.035]	[0.038]	[0.037]	
Non-SC-ST Sample	0.068**	0.047	0.047	17,207
	[0.033]	[0.036]	[0.033]	
Control Variables:				
Individual age dummies	Yes	Yes	Yes	
Household Characteristics†	No	Yes	Yes	
No. of years in current residence	No	No	Yes	

Notes: Robust standard errors are in brackets and are clustered at the age level. * denotes significance at 10%; ** at 5% and *** significance at 1%. Treatment group: cohorts aged 6 to 11 in 1997; Control group: cohorts aged 15 to 21 in 1997. Each cell represents a separate regression. Non-SC-ST include "Other Backward Castes", other Hindus, and non-Hindus. † include type of residence(urban/rural), religion, caste, and education of the household head.

Table 3.5: Heterogenous effects of the EGS on Completed Years of Schooling for the Rural Sample: Coefficients of the Interaction between Age in 1997 and the State of Residence Dummy

Age in 1997	Completed years of schooling (1)	Probability of attending secondary school (2)
6	1.547***	0.252***
	[0.193]	[0.022]
7	0.613**	0.08***
	[0.252]	[0.023]
8	0.517**	0.038
	[0.215]	[0.028]
9	0.06	0.038
	[0.384]	[0.055]
10	0.33	0.037
	[0.329]	[0.034]
11	0.221	0.047
	[0.204]	[0.036]
12	-0.241	-0.014
	[0.279]	[0.022]
13	0.463*	0.074**
	[0.254]	[0.029]
14	0.179	-0.018
	[0.344]	[0.024]
Control Variables:		
Household Characteristics†	Yes	Yes
No. of years in current residence	Yes	Yes
Observations	15,302	15,302

Notes: Robust standard errors are in brackets and are clustered at the age level. * denotes significance at 10%; ** at 5% and *** significance at 1%. Omitted control group: rural cohorts aged 15 to 21 in 1997. Regressions for both outcomes include the full set of controls. † include religion, caste, and education of the household head.

Table 3.6: Control Experiment for Rural Women Aged 15-25 in 1997: Coefficient of Interaction between Cohort Dummy and the State of Residence Dummy

	Model 1 (1)	Model 2 (2)	Model 3 (3)
Youngest Cohort: Women 15 to 20 years old in 1997			
Outcome:			
Completed years of schooling	-0.04	-0.126	-0.130
	[0.303]	[0.243]	[0.242]
Probability of secondary school attainment (marginal effects)	0.012	0.000	0.000
	[0.032]	[0.025]	[0.025]
Control Variables:			
Individual age dummies	Yes	Yes	Yes
Household Characteristics†	No	Yes	Yes
No. of years in current residence	No	No	Yes
Observations	18,599	18,599	18,599

Notes: Robust standard errors are in brackets and are clustered at the age level. * denotes significance at 10%; ** at 5% and *** significance at 1%. † include religion, caste, and education of the household head.

Table 3.7: Robustness Check with Each Neighboring State as the Control Group

States	Completed years of schooling (1)	Probability of attending secondary school (2)	N (3)
Bihar + Raj. + UP	0.423*	0.058**	8,112
	[0.203]	[0.027]	
Bihar + Raj. + UP + Orissa	0.565**	0.076***	9,388
	[0.196]	[0.027]	
All India	0.498*	0.075**	28,109
	[0.236]	[0.030]	

Notes: Robust standard errors are in brackets and are clustered at the age level.* denotes significance at 10%; ** at 5% and *** significance at 1%. Each row indicates the difference-in-difference estimates using the corresponding state as the control group and MP as the treatment group; Cohorts aged 6-11 or 15-21 in 1997. Estimation is restricted to the rural sample. Estimation includes full set of controls including household characteristics (religion, caste, and education of the household head) and number of years lived in current place of residence. "Raj." refers to Rajasthan. "All India" includes all states except MP and Chattisgarh as the control group.

Table 3.8: Robustness Checks for Alternative Definitions of Treatment and Control Groups

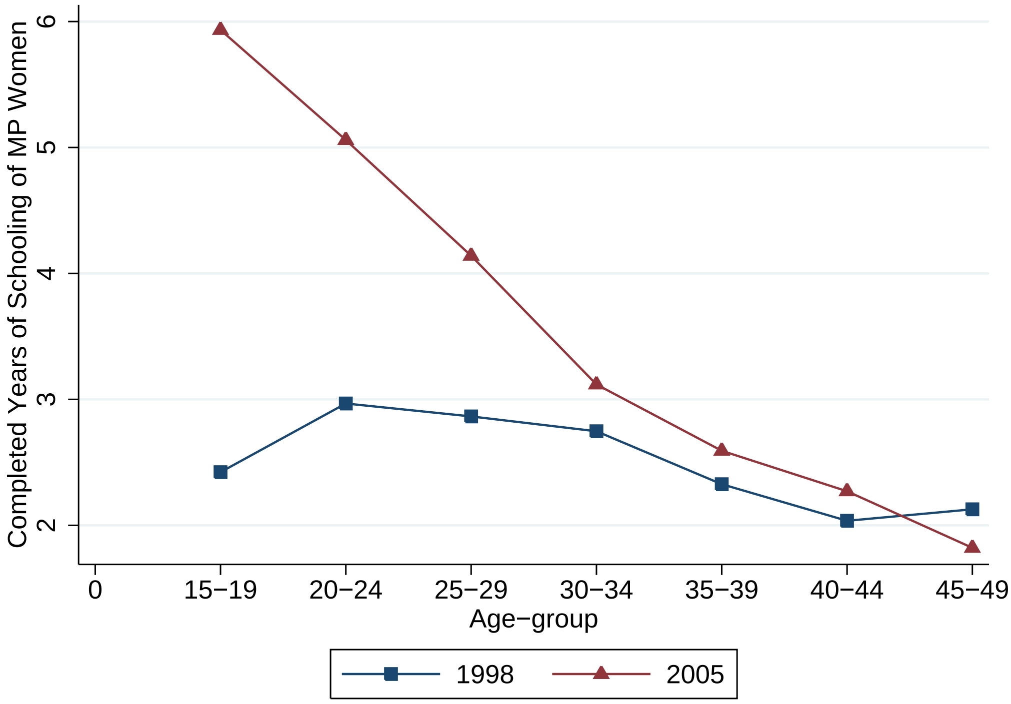
	Model 1 (1)	Model 2 (2)	Model 3 (3)
Panel A: including cohorts 12 to 14 in the treatment group			
Outcome:			
Completed years of schooling	0.352	0.332	0.300
	[0.257]	[0.222]	[0.204]
Probability of secondary	0.052*	0.046*	0.042*
school attainment (marginal effects)	[0.027]	[0.026]	[0.024]
Panel B: including cohorts 12 to 14 in the control group			
Outcome:			
Completed years of schooling	0.480**	0.468**	0.369**
	[0.205]	[0.177]	[0.161]
Probability of secondary	0.069***	0.064***	0.053**
school attainment (marginal effects)	[0.021]	[0.023]	[0.021]
Control Variables:			
Individual age dummies	Yes	Yes	Yes
Household Characteristics†	No	Yes	Yes
No. of years in current residence	No	No	Yes
Observations	15,302	15,302	15,302

Notes: Robust standard errors are in Brackets and are clustered at the age level. * denotes significance at 10%; ** at 5% and *** significance at 1%. Estimation is restricted to the rural sample. Each cell represents a separate regression. † include religion, caste, and education of the household head.

Figure 3.1: Political Map of India

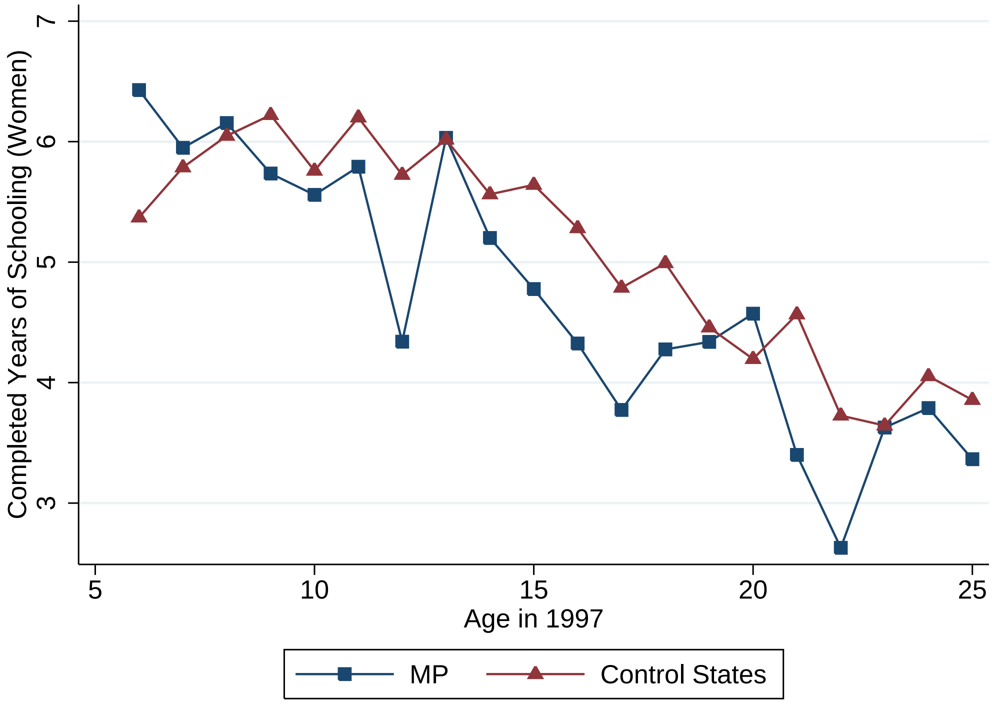
Source: Census of India, 2001

Figure 3.2: Trends in completed years of schooling (MP)



Source: NFHS 1998, 2005. Note: Figure 3.2 shows women's completed years of schooling for age-groups of five for the state of MP across two rounds of the NFHS.

Figure 3.3: Trends in completed years of schooling - MP versus control states



Source: NFHS 2005-2006. Note: Figure 3.3 shows the completed years of schooling for different cohorts of women in 1997 for the treated state of MP as well as control states that comprise of seven states that share a geographical border with MP.

Chapter 4

Impact of Schooling on Measures of Women's Welfare: A Literature Review of Nonmarket Returns to Education

Abstract: As an extension of the previous essay, this chapter examines the literature on the effects of increased educational attainment on some of the nonmarket outcomes for women. Low levels of female education have strong implications on a wide range of outcomes related to women's health, fertility, intergenerational transmission of education and health, and intra-household allocation of resources. This essay presents an overview of the literature on the nonmarket returns to educational attainment, with particular focus on age at first marriage and use of contraceptives as outcomes that are relevant to the sample of young women who, as shown in the previous essay, were beneficiaries of the an educational intervention called the Education Guarantee Scheme (EGS) launched in the Indian state of Madhya Pradesh in 1997. In general, the literature reviewed in this essay makes a case for employing an Instrumental Variable (IV) approach to studying nonmarket returns to education to address issues regarding endogeneity of educational attainment.

4.1 Introduction

The impact of human capital investments on educational attainment has been widely discussed in development economics. A large body of literature further investigates the returns to increased educational attainment measured in the form of increased earnings in the labor market[1]. Similarly, it is also well documented in developing country studies that education has a significant impact on nonmarket outcomes related to adult health, marriage, fertility, child health, intergenerational transmission of education, and intra-household allocation of resources[2]. Further, several of these studies suggest that female education is a stronger determinant of these outcomes than male education. However, a large majority of the existing studies on both market and nonmarket returns to education are based on simple correlations between educational attainment and the relevant outcomes. Such an approach makes it difficult to disentangle the effects of human capital accumulation in school from the effects of unobserved factors such as family or community characteristics that are often highly correlated to both schooling as well as the outcomes being studied. Thus, estimates that treat educational attainment as an exogenous determinant of market or nonmarket outcomes will suffer from an omitted variable bias. As Strauss and Thomas (1995) point out, most studies address the issue of biased estimates either by attempting to measure and include a subset of omitted variables at the family, community, or school level, or by using control groups or fixed effects estimations. More recently, Duflo (2001) uses a dramatic policy change in Indonesia to evaluate the impact of school construction on educational attainment and labor market earnings of men; Breierova and Duflo (2004) use the same strategy to analyze the impact of the Indonesian policy on fertility and child mortality. Such an approach

[1] Pscharopoulos (1994) presents comprehensive survey of literature on market returns to education

[2] See Thomas and Strauss (1995) for a comprehensive survey of the literature on nonmarket effects of education

uses 2SLS estimation strategy that supports a causal interpretation of the estimates of educational attainment on the outcomes under study, thus addressing the problem of omitted variables and endogeneity concerns in general.

This essay reviews the existing studies on nonmarket returns to education in the developing countries as a build-up to future work intended to exploit exposure to a unique policy intervention launched in the Indian state of Madhya Pradesh (MP) to evaluate the effect of a rapid expansion of primary schools on rural women's nonmarket returns[3]. In 1997, the state government of MP launched the Education Guarantee Scheme (EGS) with a view to universalize access to primary schooling, especially in the remote, poor interiors of the state. Under this scheme, the state government of MP guaranteed to set up a primary school upon receiving a written demand from communities that did not have a school within 1 kilometer of habitation as long as there were at least 25 children between 6 to 14 years of age in tribal areas(at least 40 children in non-tribal areas). Although there have been several other national initiatives aimed at universalizing primary education in the entire country, the EGS was unique to the state of MP in 1997. Between 1997 and 2003, 26,571 primary schools were started under the EGS. Population figures in Census of India 2001 suggest this was an average of over 2 schools per 1000 rural children in MP between the ages of 6 to 15 in 1997. Exposure of an individual to the EGS was jointly determined by her state of residence and by her age when the program was launched. Using the 2005-2006 cross-sectional wave of the National Family Health Survey (NFHS), I exploit variation arising from these two exogenous sources to measure the impact of the scheme on educational attainment of women in the previous essay.

[3]This is particularly relevant in low-income countries where rural women do not actively participate in the formal labor markets, and yet, improvements in their educational attainment could potentially have large private as well as social returns

From results presented earlier, I find significant and robust program effects on education of poor rural women of MP. On average, the estimates suggest that exposure to EGS in the rural areas of the state increased completed years of schooling by a quarter of a year and increased the probability of attending secondary school by around 6 percentage points. These effects are largest for the youngest cohorts of rural women in my sample who were 6-8 years old at the time of the program launch. Moreover, these increments were driven by women who were never enrolled in primary school prior to the scheme, thus affecting cohorts on the extensive margin of primary education. A battery of robustness checks confirm the interpretation of the estimates as the causal impact of the EGS on educational attainment. Thus, beneficiaries of the scheme comprise of young rural women in 2005-2006 - a finding that has testable implications for their non-labor market returns to schooling. The results thus far, can be viewed, in effect, as the first stage of the 2SLS estimation strategy that evaluates the impact of education on nonmarket outcomes of women. To this end, the interaction between the two exogenous variables determining exposure to EGS - the state of residence and cohort of birth of the women - can be employed as an instrument for educational attainment in the second stage of the 2SLS estimation. This strategy is similar to the approaches used in Card and Krueger (1992) to determine the impact of school quality on returns to education of men using the US Census data, in Card and Lemieux (1998) to estimate the impact of a college subsidy program in Canada on education and earnings of men, or in Duflo (2001) and Breierova and Duflo (2004) to estimate the impact of a school construction program in Indonesia on labor market earnings of Indonesian men and fertility of Indonesian women respectively. It must be noted that since the cohorts of women in my sample who were most impacted by the EGS were only 6-8 years old in 1997, these cohorts are 15-17 years old in the latest 2005-2006 round of the NFHS. These cohorts are thus too young to allow observation of their fertility decisions or health outcomes of their children. I therefore restrict my analysis to two nonmarket outcomes relevant to my sample: age at first marriage and use of contraceptives. This essay therefore reviews the literature on women's nonmarket returns to education, with particular focus on these two outcomes.

4.2 Literature Review

In order to consider the full impact of educational investments, especially on the girl child, it is also important to evaluate the nonmarket benefits of education which are both private (its impact of one's health, family's health, fertility choices, consumption choices, intergenerational transmission of education, etc.) and social (its impact on dissemination of technology, physical capital accumulation, democratization, etc.)(McMahon, 2009). Such evaluation is particularly important to argue for investments in education as a policy priority in low-income countries where female labor force participation rates in the formal labor markets are low. This chapter views the existing empirical literature on some of the nonmarket effects of education, focusing on outcomes that I can exploit based on my previous findings in Chapter 3, and given the data limitations as explained in the previous section, namely, age at first marriage and use of contraceptives.

The relationship between women's education and fertility has been a concurrent topic of empirical research in the developing countries. Effects of female education can be classified into two broad approaches: the human capital approach which views women's education as an input in economic production such that increases in human capital investment increases the economy's production of goods and services, and alternatively, the capabilities approach that views education as a means to enhance the well-being and empowerment of women[4]. These approaches are consistent with the view that education not only enables information-processing and cognitive development, but also increases exposure to new ideas, changes attitudes and existing values, all of which, indirectly influence women's fertility behavior within the household. The human capital approach posits that lower fertility will result in higher investments in children's human capital (through the quantity-quality tradeoff as pointed by Becker (1981)); the capabilities approach posits that lower fertility improves women's well-being by enhancing their substantive choices and freedom (Sen, 1997).

Nevertheless, economists consider the following main pathways through which education influences fertility decisions. Firstly, education raises the opportunity cost of child-rearing and thereby reduces the demand for children; it could also lead to postponement of marriage in order to delay the onset of childbearing. Secondly, as the quantity-quality tradeoff predicts, highly educated women may prefer fewer children so as to invest in more schooling her child. Thirdly, the negative association between maternal education and child mortality documented in several studies suggests that more educated women are likely to have healthier children with lower mortality rates (Caldwell, 1979; Cleland and Ginneken 1988; Thomas et al., 1990, 1991). Educated women may therefore produce fewer children if their survival chances are high (Schultz, 1994). Lastly, educated women are more likely to know and use contraception more effectively than uneducated women and may therefore be able to control fertility better (Shapiro and Tambashe, 1994; Castro Martin, 1995; Ainsworth et al., 1996). In addition, education also alters women's intra-household bargaining position, thereby allowing them

[4]The former approach is usually held by the World Bank and growth economists such as Todaro (1997) that view human capital as an input in the productive process, while the capabilities approach is advocated by Amartya Sen (1997)

greater control in matters concerning fertility and family planning (Bertrand et al., 1993).

This essay concentrates on studies that focus on two of these possible channels through which education influences fertility. The first one is the relationship between education and the age at first marriage which in turns influences family size. In most societies where childbearing is largely through marital union, early marriage usually implies early childbearing as well as higher completed fertility from longer exposure to pregnancy. Thus, timing of first marriage strongly influences fertility behavior. How does education influence the timing of first marriage? Firstly, school enrollment is an impediment to marriage, since more years in school implies postponement of marriage. In the context of my results in the previous essay, exposure to the EGS increased the average completed years of schooling by 0.4 years; this effect is much larger - almost 2 additional completed years of schooling - for the youngest cohort of women who were 6 years old at the time of the scheme's launch. Given that the average completed years of schooling as well as the average age at first marriage are very low in a developing country like India, these additional years of schooling due to the EGS should have a significant impact on the timing of marriage of these women. Moreover, these effects are observed on the extensive margin of primary education, suggesting that girls who were never enrolled prior to the scheme were now entering primary school. In this context, the impact of educational attainment on the timing of marriage for women who would have otherwise not received *any* schooling in the absence of EGS is an interesting empirical question.

Another channel through which education can impact timing of marriage is that school attendance also offers exposure to new ideas and values that challenge traditional systems. Caldwell et al. (1983) find in south India, that the average age at marriage has increased for women partly because of attitudinal changes arising from awareness of the risks associated with early marriage and early pregnancies. In addition, education also alters societal perceptions about early marriage and childbearing, especially in traditional societies such as those in Sub-Saharan Africa (Caldwell and Caldwell, 1987). Castro Martin (1995) uses Demographic Health Surveys (DHS) from 26 countries to find that although marital behavior is highly influenced by cultural norms and traditions, even in African societies that traditionally encourage early marriage, educational attainment can still explain considerable differentials in age at marriage. [5].

Next, I turn to the impact of education on fertility regulation through increased use of modern contraceptive practices. Since education creates more opportunities for women, better-educated women are likely to be more motivated about controlling their family size through contraception. Further, education can lead to attitudinal changes about contraceptive practices; especially in traditional societies where contraception may not be socially approved, education can change attitudes about family planning and legitimize contraceptive use. Education also gives women more autonomy and authority within the household to exert greater control over their reproductive choices[6]. Lastly, more educated women are also better informed about the availability of contraceptive options and their appropriate use, and are more likely to use them more effectively, reducing chances of discontinuation or misuse.

Overall, studies largely report a strong positive association between education and rates of contraceptive prevalence. Shapiro and Tambashe (1994) finds that employment and education strongly influence the use modern contraceptives and induced

[5]See also Westoff (1992) for an analysis of marital and fertility decisions in Africa and Keeley (1979) for an analysis of the determinants of age pattern of first marriage in the US.

[6]Moursund and Kravdal (2003) uses the 1998-1999 round of the NFHS in India to test whether differences in women's autonomy can explain the relationship between education and contraceptive use. They find that a woman's contraceptive use is strongly influenced by the average educational level of other women within her community, over and above her own education.

abortion in Zaire. Further, all levels of schooling, including primary schooling, significantly increase contraceptive use[7]. Castro Martin (1995) studies trends in contraceptive prevalence rates in 26 countries using DHS and finds that better-educated women reveal higher rates of contraceptive use in each country, including countries where the overall national contraceptive prevalence rates are low. Additionally, reliance on modern contraceptive methods vis-à-vis traditional methods rises sharply with educational levels. There is also evidence that educational differentials in contraceptive use are the largest in countries with low overall contraceptive prevalence; these differentials become smaller in societies where fertility regulation is no longer considered innovative but is commonly practiced among women. Most importantly, overall patterns of contraceptive use suggest that in societies with low prevalence rates, breaking the barrier of entrance into the schooling system can lead to significant changes in contraceptive behavior. This finding is particularly important in the context of my analysis; given that the EGS is most effective in breaking the barrier of entry into primary school, its effect on changing women's attitudes and behavior toward fertility regulation is of empirical interest.

Although there is a vast body of literature on the relationship between education and contraceptive use or fertility in general, as pointed out earlier, a large number of such studies rely on simple correlations between education and the outcome of interest, say, contraceptive use. Such approaches suffer from two main sources of bias in the estimates. Firstly, the presence of potentially confounding effects of other variables (such as income) that are correlated to education as well as contraceptive use could lead to biased estimates of educational effects. Secondly, a majority of these studies include potentially endogenous regressors such as the women's marital status, current enrollment status, labor force participation, etc., all of which are jointly determined

[7]See Ainsworth et al. (1996) for a review of similar studies in SSA.

with contraceptive use and hence will lead to biased estimates. Further, most studies on contraceptive prevalence, use samples of currently married women, currently married women with children, currently married nonpregnant women, etc., all of which lead to a potential sample selection bias in favor of women who have a higher demand for children. Overall, findings from the existing studies in the developing world must be interpreted with caution due to the limitations pointed above. This also highlights the importance of using an instrumental variable strategy as one of the estimation techniques that can allow inference of a causal estimate of education.

4.3 Conclusion

This essay reviews the literature on the effects of education on two main variables of interest: age at first marriage and contraceptive use. These outcomes are of particular interest as they explain some of the pathways through which education impacts fertility and family size in general. As pointed out in the earlier section, the existing literature that estimates educational effects on these outcomes suffers from limitations due to sample selection and endogeneity biases. Future work is aimed at using an instrumental variable approach to estimate the impact of educational attainment on these outcomes by exploiting variation in the exposure to a school expansion scheme in India as an instrument for educational attainment.

In terms of policy implications, this research question is important in the context of poor rural women who overcame the barrier of entry into primary school with a scheme like the EGS. As results from the previous essay suggest, the scheme benefitted rural women who were just young enough to start primary school. The impact of the scheme was negligible for cohorts that were older than 8 years at the time of the scheme's launch in 1997, indicating that entering primary school was costly beyond the age of 8 years. Thus, results from the instrumental variable strategy will reflect the impact of educational attainment on the above outcomes for those women who went from absolutely no schooling in the absence of the EGS to some years of primary schooling attainment due to the scheme, an important result for governments and policymakers devising policies to increase school enrollment.

Chapter 5

Conclusion

In this chapter, I summarize the three essays that comprise my dissertation. My dissertation deals with achievement of human development goals in low-income countries and the evaluation of public policies that address these goals.

In chapter 2 we review the current method of evaluating the MDG and propose an alternative method that is based on the theoretical tools of social welfare analysis. Using this approach of measuring achievement towards the goals, we find significant gains in worldwide welfare over time. The gains are considerably larger when we assign appropriate weights to the initial conditions of the poorest countries. Further, a decomposition of these gains by region suggests that although Asia has the largest share in the overall improvements, a welfare-based evaluation of Sub-Saharan Africa shows significant improvements on a majority of the indicators, thus contradicting the view of the region as a "failure" as widely reported by the international agencies that monitor progress towards the MDG. Additionally, these gains in welfare remain robust to an alternative specification of the targets prescribed for the goals, thus addressing debates over the arbitrary design of the goals making countries in Sub-Saharan Africa appear as failures. If the MDG are to be considered as an effective tool to measure and track the performance of developing countries, our welfare-based evaluations results show that the narrow evaluation strategies being currently implemented to measure the performance of each country or region need to be revised to take into account the distribution of the poor countries. Further, if the current evaluation methods run the risk of converting potential development success stories into imaginary failures as shown earlier, our results have important policy implications for disbursement of international aid among the developing countries.

Chapter 3 evaluates the impact on women's educational attainment, of a unique, demand-driven school expansion program launched in the Indian state of Madhya Pradesh to improve access to primary schools through community participation. Women's exposure to the EGS was jointly determined by her state of residence and by her age when the program was launched. Using the 2005-2006 round of the National Family Health Survey, I exploit the variation arising from these two exogenous sources to measure the impact of the scheme on women's educational indicators. I find large and robust program effects of the EGS on rural women's completed years of schooling and the probability of attending secondary school. The largest effects of exposure to the scheme are observed on cohorts of rural women that were 6 to 8 years old at the time of the scheme's launch. In the Indian context, this essay presents a rigorous treatment-effect type of evaluation of a public policy regarding universal primary education. Despite being recognized as a constitutional right of every child in India, this goal is still elusive despite the enactment of a wide array of schemes and allocation of large financial resources by governments at the central as well as state level. India's budgetary allocation for education forms 3.8% of its Gross Domestic Product (GDP) as of 2005-2006. The National Policy on Education established in 1986 envisages an increase in this share to 6% of the GDP in order to meet the country's educational targets. Amidst debate over the adequacy of financial resources toward universalizing primary education, assessment of existing policies becomes crucial to policy makers. In the global context, evaluation of unconditional interventions in education such as the EGS offers an alternative policy perspective against the backdrop of the widely executed and studied conditional interventions such as the Mexico's Progresa.

In chapter 4 I review the literature on nonmarket benefits of education to women in the developing countries, with a particular focus on two outcomes: age at first marriage and use of contraceptives that are important pathways that affect fertility behavior in general. Existing studies are largely based on simple correlations between education and the outcome of interest. There could be several family and community background characteristics that are correlated to both schooling and the nonmarket outcomes of interest, leading to biased estimates of educational effects. Current literature makes a case for using an alternative estimation strategy such as the instrumental variables approach that could eliminate some of the biases arising from omitted variables. Using the positive and robust program effects from chapter 3 to instrument for educational attainment, my future work aims to estimate the effect of education on women's age at first marriage and contraceptive use.

Bibliography

[1] Martha Ainsworth, Kathleen Beegle, and Andrew Nyamete. The impact of women's schooling on fertility and contraceptive use: A study of fourteen sub-saharan african countries. *The World Bank Economic Review*, 10(1):85–122, 1996.

[2] Joshua D. Angrist and Guido W. Imbens. Two-stage least squares estimation of average causal effects in models with variable treatment intensity. *Journal of the American Statistical Association*, 90(430):431–442, June 1995.

[3] Mary Arends-Kuenning and Sajeda Amin. Womens capabilities and the right to education in bangladesh. *International Journal of Politics, Culture and Society*, 15(1):125–142, September 2001.

[4] Anthony B. Atkinson. On the measurement of inequality. *Journal of Economic Theory*, 2(3):244–263, September 1970.

[5] Anthony B. Atkinson. On the measurement of poverty. *Econometrica*, 55(4):749–64, July 1987.

[6] Robert Barro. Economic growth in a cross-section of countries. *Quarterly Journal of Economics*, 106(2):407–443, 1991.

[7] Timothy Besley and Robin Burgess. Halving global poverty. *Journal of Economic Perspectives*, 17(3):3–22, Summer 2003.

[8] Mark Bils and Peter J. Klenow. Does schooling cause growth. *American Economic Review*, 90(5):1160–1183, 2000.

[9] Antoine Bommier and Sylvie Lambert. Education demand and age at school enrollment in tanzania. *Journal of Human Resources*, 35(1):177–203, 2000.

[10] Lucia Breierova and Esther Duflo. The impact of education on fertility and child mortality: Do fathers really matter less than mothers? *NBER Working Paper Series*, 10513:1–32, May 2004.

[11] J. C. Caldwell. Education as a factor in mortality decline: An examination of nigerian data. *Population Studies*, 33(3):395–413, November 1979.

[12] J. C. Caldwell, P. H. Reddy, and Pat Caldwell. The causes of marriage change in south india. *Population Studies*, 37(3):343–361, November 1983.

[13] John C. Caldwell and Pat Caldwell. The cultural context of high fertility in sub-saharan africa. *Population and Development Review*, 13(3):409–437, September 1987.

[14] David Card and Alan B. Krueger. Does school quality matter? returns to education and the characteristics of public schools in the united states. *Journal of Political Economy*, 100(1):1–40, February 1992.

[15] David Card and Thomas Lemieux. Education, earnings, and the "canadian g.i. bill". *Canadian journal of economics*, 34(2):313–344, May 2001.

[16] David E. Card and Alan B. Krueger. Minimum wages and employment: A case study of the fast-food industry in new york and pennsylvania. *American Economic Review*, 84:772–93, 1994.

[17] David E. Card and Alan B. Krueger. Schools, teachers, and educational outcomes in developing countries. *Handbook of the Economics of Education*, edited by Eric A. Hanushek and Finis Welch. Amsterdam: North Holland:943–1017, 2006.

[18] Central Statistical Organization. *National Accounts Statistics*. CSO, New Delhi, 2001.

[19] Satya R. Chakravarty and Amita Majumder. Millennium development goals: Measuring progress towards their achievement. *Journal of Human Development*, 9(1):109–129, 2008.

[20] Prema Clarke. Education reform in the education guarantee scheme in madhya pradesh, india, and the fundescola program in brazil. *World Development Report*, 26948, 2004.

[21] J. Cleland and J. van Ginneken. Maternal education and child survival in developing countries: The search for pathways of infiuence. *Social Science and Medicine*, 27(12):1357–1368, 1988.

[22] Michael Clemens and Todd Moss. What's wrong with the millennium development goals? Brief, Center for Global Development, Washington DC, September 2005.

[23] Michael A. Clemens, Charles J. Kenny, and Todd J. Moss. The trouble with the mdgs: Confronting expectations of aid and development success. *World Development*, 35(5):735–751, May 2007.

[24] Paul Collier and David Dollar. Can the world cut poverty in half? how policy reform and effective aid can meet international development goals. *World Development*, 29(11):1787–1802, November 2001.

[25] Russell Davidson and Jean-Yves Duclos. Statistical inference for stochastic dominance and for the measurement of poverty and inequality. *Econometrica*, 68(6):1435–1464, November 2000.

[26] Angus Deaton. *The Analysis of Household Surveys*. The Johns Hopkins University Press, 1997.

[27] Esther Duflo. Schooling and labor market consequences of school construction in indonesia: Evidence from an unusual policy experiment. *American Economic Review*, 91(4):795–814, 2001.

[28] Bhaskar Dutta. Inequality, poverty and welfare. In Kenneth J. Arrow, Amartya K. Sen, and Kotaro Suzumura, editors, *Handbook of Social Choice and Welfare*, volume 1, pages 597–633. Elsevier, 2002.

[29] William Easterly. How the millenium development goals are unfair to africa. *World Development*, forthcoming, 2008.

[30] James Foster, Joel Greer, and Erik Thorbecke. A class of decomposable poverty measures. *Econometrica*, 52(3):761–66, May 1984.

[31] James E Foster and Anthony F Shorrocks. Poverty orderings. *Econometrica*, 56(1):173–77, January 1988.

[32] Paul Glewwe. Schools and skills in developing countries: Education policies and socioeconomic outcomes. *Journal of Economic Literature*, 40(2):436–482, 1996.

[33] Paul Glewwe and Hanan Jacoby. Student achievement and schooling choice in low-income countries: Evidence from ghana. *Journal of Human Resources*, 29(3):843–864, 1994.

[34] R. Gopalakrishnan and Amita Sharma. Education guarantee scheme in madhya pradesh: Innovative step to universalise education. *Economic and Political Weekly*, 33(39):2546–2551, 1998.

[35] Government of India. *Census of India 1991.* Office of the Registrar General, New Delhi, 1991.

[36] Government of India. *Economic Survey 2000-2001.* Ministry of Finance, New Delhi, 2001.

[37] Government of India. *National Human Development Report 2001.* Planning Commission of India, New Delhi, 2001.

[38] Robert H. Haveman and Barbara L. Wolfe. Schooling and economic well-being: The role of nonmarket effects. *Journal of Human Resources*, 19(3):377–407, Summer 1984.

[39] David Hulme. The millennium development goals (mdgs): A short history of the world's biggest promise. 2009.

[40] Lawrence D. E. Ikamari. The effect of education on the timing of marriage in kenya. *Journal of the American Statistical Association*, 12(1):1–28, February 2005.

[41] Jyotsna Jalan and Elena Glinskaya. Improving primary school education in india: An impact assessment of dpep-phase i. *World Bank, Washington D.C.*, Poverty Analysis - Key Readings, 2005.

[42] Michael C. Keeley. An analysis of the age pattern of first marriage. *International Economic Review*, 20(2):527–544, June 1979.

[43] Geeta Gandhi Kingdon. The progress of school education in india. *Oxford Review of Economic Policy*, 23(2):168–195, 2007.

[44] Alan B. Krueger and Mikael Lindahl. Education for growth: Why and for whom? *Journal of Economic Literature*, 39(4):1101–1136, 2001.

[45] François Leclerque. Education guarantee scheme and primary schooling in madhya pradesh. *Economic and Political Weekly*, 38(19):1855–1869, 2003.

[46] Robert Lucas. On the mechanics of economic development. *Journal of Monetary Economics*, 22:3–42, 1988.

[47] N. Gregory Mankiw, David Romer, and David Weil. A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107(2):407–437, 1992.

[48] Teresa Castro Martin. Women's education and fertility: Results from twenty demographic and health surveys. *Studies in Family Planning*, 26(4):187–202, 1995.

[49] Anne Moursund and Øystein Kravdal. Individual and community effects of women's education and autonomy on contraceptive use in india. *Population Studies*, 57(3):285–301, June 2003.

[50] Lant Pritchett. Where has all the education gone? *World Bank Policy Research Working Paper*, 1581, 1996.

[51] George Psacharopoulos. Returns to investment in education: A global update. *World Development*, 22(9):1325–1343, September 1994.

[52] Vimala Ramachandran. Education guarantee scheme: Community-government partnership that gets millions into school in madhya pradesh. *Paper presented at the Conference on Scaling Up Poverty Reduction: A Global Learning Process, Shanghai*, May 25-27, 2004.

[53] David E. Sahn and David C. Stifel. Progress toward the millennium development goals in africa. *World Development*, 31(1):23–52, January 2003.

[54] Amartya Sen. Editorial: Human capital and human capability. *World Development*, 25(12):1959–1961, December 1997.

[55] Amartya K Sen. Poverty: An ordinal approach to measurement. *Econometrica*, 44(2):219–31, March 1976.

[56] David Shapiro and B. Oleko Tambashe. The impact of women's employment and education on contraceptive use and abortion in kinshasa, zaire. *Studies in Family Planning*, 25(2):96–110, March 1994.

[57] David Shapiro and B. Oleko Tambashe. Education, employment, and fertility in kinshasa and prospects for changes in reproductive behavior. *Population Research and Policy Review*, 16(3):259–287, June 1997.

[58] John Strauss and Duncan Thomas. Human resources: Empirical modeling of household and family decisions. In Jere Behrman and T.N. Srinivasan, editors, *Handbook of Development Economics*, volume 3(A), pages 1885–2023, 1995.

[59] UN Millennium Project. *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals*. Earthscan, London, 2005.

[60] J. Vandemoortele. The mdgs: m for misunderstood? volume 27, pages 6–7. World Institute for Development Economics Research, 2007.

[61] J. Vandemoortele. The mdg conundrum: Meeting the targets without missing the point. *Development Policy Review*, 27(4):355–371, 2009.

[62] Walter W. McMahon. *Higher Learning, Greater Good : The Private and Social Benefits of Higher Education*. Johns Hopkins University Press, 2009.

[63] Charles F. Westoff. Age at marriage, age at first birth and fertility in africa. *World Bank Technical Paper*, No. 169, 1992.

[64] Barbara L. Wolfe and Samuel Zuvekas. Nonmarket outcomes of schooling. volume 1065-95. Institute for Research on Poverty Discussion Paper Series, May 1995.