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DISSERTATION

Life, Livelihood, and Long Term Well-being

The Effect of Mortality Risks and Land Reforms on Human Capital Investments in India

Arkadipta Ghosh

This document was submitted as a dissertation in April 2008 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Emmett Keeler (Chair), Neeraj Sood, and David Evans.

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Abstract

Human capital investments in childhood have an important bearing on later life outcomes including long term health and well-being. Crucial factors that determine parental investments in childhood include household preferences, resource constraints, and background factors such as risks and economic shocks. This dissertation evaluates the role of some of these factors in determining childhood investments in rural India.

Chapter 2 reviews the existing literature on intrahousehold resource allocation in India. It specifically considers the case of gender discrimination in intrahousehold allocation, and discusses the roles of both economic and socio-cultural factors in determining household behavior.

Chapter 3 examines whether increased background mortality risks induce households to make differential health investments in their high- versus low-endowment children. Increases in background mortality risks may disproportionately affect the survival of the low-endowment sibling, consequently increasing the mortality gap between the high- and low-endowment siblings. This increase in mortality gap may induce households to invest more in their high-endowment children. This hypothesis is tested with nationally representative data from rural India. Birth size is used as a measure of initial health endowment, immunization & breastfeeding as measures of childhood investments, and infant mortality rate in the child's village as the measure of mortality risks. Findings suggest that in villages with high mortality risks, small-at-birth children in a family are 6 – 17 percent less likely to be breastfed or immunized compared to

their large-at-birth siblings. In contrast, there are no significant within-family differences in investments in villages with low mortality risks.

Chapter 4 evaluates the effect of India's extensive land reforms on long term health and well being as determined by human capital formation in childhood. India pursued one of the largest programs of land reforms on record since the 1950s. These reforms were aimed at securing access to land for the vast majority of rural households dependent on agriculture for their livelihoods. There is mixed evidence on the effect of these reforms on poverty. Moreover, the long run welfare consequences of these reforms have not been evaluated. Using across-state and across-cohort variation in the timing of reform legislations, this chapter examines the impact of India's extensive land reforms on height, a long term measure of health. I find that land reforms led to significant improvements in health and well-being for cohorts experiencing such reforms before age 18. Specifically, land ceiling legislations resulted in an increase of 3 centimeters in height for women. I also examine the impact of land reforms on education and find that abolition of intermediaries significantly increased schooling by an additional year for cohorts exposed to these reforms. There is also some evidence for intergenerational health benefits from land reforms with improved height-for-age performance of children whose mothers benefited from such reforms.

Chapter 5 concludes by discussing the main findings and the policy implications from this research, as well as directions for future work in this area.

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Chapter 1

Introduction and Research Questions

1.1 Introduction

Childhood health and nutrition are important determinants of later life outcomes, including adult health and socioeconomic status (Case, Fertig and Paxson, 2005). Indeed, human capital accumulation in the form of health and schooling is correlated with earnings in adulthood (Fogel, 1992 & 1994; Ashenfelter and Krueger, 1994; Steckel, 1995; Strauss and Thomas, 1995 & 1998; Card, 1999; Duflo 2001). Also, both health and schooling are crucial endowments that determine the capabilities of an individual as well as her quality of life, apart from affecting her earnings or SES. Hence, human capital investments in childhood play a critical role throughout the life course of an individual.

Some of the crucial factors that determine human capital accumulation in childhood are household income or socioeconomic status (SES), initial health endowments, parental preferences, background factors such as various risks, uncertainties, and economic shocks, as well as specific policies or programs that seek to improve child health or schooling. Among these various factors, the roles of household income, initial endowments, and parental preferences have been extensively studied in the existing literature (Becker and Tomes, 1976; Griliches, 1979; Behrman, Pollak and Taubman, 1982; Rosenzweig and Schultz, 1982; Behrman, 1988; Rosenzweig and Wolpin, 1988; Behrman and Deolalikar, 1990;

Pitt, Rosenzweig and Hassan, 1990; Behrman, Rosenzweig and Taubman, 1994; Behrman, Pollak and Taubman, 1995; Behrman, 1997; Ayalew, 2005; Datar, Kilburn and Loughran, 2006; Rosenzweig and Zhang, 2006). The effects of experiencing severe economic or health shocks in childhood on later life health and socioeconomic outcomes have also been explored (Dercon and Hoddinott, 2003; Alderman, Hoddinott and Kinsey, 2006; Almond, 2006; Chen and Zhou, 2007).

However, the role of mortality risks that impose a high degree of uncertainty on parental returns from investing in child health – especially in the context of developing countries – has not been investigated in detail. Similarly, while policies that directly seek to promote human capital investments have been quite extensively studied and evaluated, much less is known about possible spill-over effects of redistributive policies on human capital accumulation in childhood. This dissertation hopes to address some of these issues by offering a better understanding of the determinants of childhood investments in the context of a developing country – namely India – where poor, rural households typically face a high risk of infant mortality, and an important redistributive policy in the form of land reforms have been extensively implemented.

1.2 Research objectives

This dissertation aims to evaluate the role of two important factors that can affect human capital investments in childhood, namely mortality risks and redistributive policies. First, it seeks to analyze the effect of mortality risks in the form of the high risk of infant mortality faced by many households in developing countries on childhood health investments. Next, it aims to analyze the effect of an important

redistributive policy – land reforms – on long run health and well-being. In particular, this research seeks answers to the following questions –

1. How does the risk of infant mortality affect parental investments in siblings with different initial health endowments?

2. Can within-family differences in childhood investments in villages with high versus low mortality risks be explained by differences in preferences or access to health infrastructure across high and low mortality areas?

3. How did extensive land reforms in India affect long term health – as captured by height – for women who were likely to benefit from their households' improved access to land during childhood or adolescence?

4. Did land reforms also improve schooling for birth cohorts exposed to these reforms before reaching adulthood?

5. Did land reforms have any intergenerational health benefits in the form of improved health or nutritional status for children whose mothers benefited from these reforms?

While the direct health benefits of reducing infant mortality are obvious, such reductions in mortality might also have indirect effects that are less well understood. For instance, reductions in mortality risks could affect parental investments in children, consequently affecting children's long term health and economic well being. Dow et al. (1999) find that the reduction in mortality risks due to the Expanded Programme on Immunization of the World Health Organization increased parental health investments unrelated to immunization.

Similarly, Estevan and Baland (2007) show that the level of child labor could be inefficiently high when survival is uncertain and parents expect cash transfers from their children.

In seeking answers to research question 1 and 2, as described above, this research therefore adds to the existing literature by examining how mortality risks affect intra-household childhood investments in siblings with different initial health endowments. This also has important implications for policies that seek to improve overall population health as well as reduce health disparities. If reductions in mortality affect less endowed and weaker children more than healthy children, then that could create unique incentives for parents to invest in weaker children, consequently reducing health disparities. On the other hand, a persistent level of high infant mortality risk could lead to greater health disparities in the long run, if parents respond to such risks by investing more in their better endowed child.

Redistributive policies continue to be of relevance for most countries where a significant fraction of the population lives in hunger and poverty. This is because economic growth alone is unlikely to eradicate hunger and malnutrition (Behrman and Deolalikar, 1987 and 1989). While prior research shows that redistributive policies such as land reforms that involve a reallocation of property rights in land in favor of poor and landless households can reduce poverty, there is no evidence on the effect of land reforms on long term measures of well-being such as health, nutrition, and schooling. Research questions 3 – 5 – as described above – aim to fill this void by looking at the effect of land reforms on human capital formation in childhood and adolescence, and also by exploring possible intergenerational health benefits arising from land reforms.

Greater human capital formation in childhood can not only lead to better long run health and improved well-being, but is also correlated with adult earnings and SES. Hence, if land reforms do lead to increased human capital

accumulation in childhood, these can be part of an effective mechanism for preventing the intergenerational transmission of poverty. Also, given the causal relationship between health and education on the one hand, and labor productivity and income on the other, significant long term improvements in health and education brought about by land reforms can also lead to faster economic growth. Hence, the findings from this research could be useful for policymakers interested in designing effective social protection mechanisms that can both reduce poverty and promote greater human capital investments.

1.3 Organization of the dissertation

The remainder of this dissertation is organized as follows. Chapter 2 reviews the existing literature on intrahousehold resource allocation in India. Specifically, it considers the case of gender discrimination in intrahousehold allocation, and summarizes important findings. Chapter 3 examines whether increased background mortality risks induce households to make differential health investments in their high- versus low-endowment children. First, it presents a theoretical model of parental investments in childhood vis-à-vis children's initial health endowments and the background risk of mortality, which is followed by an empirical analysis using nationally representative data from rural India. Chapter 4 evaluates the effect of India's extensive land reforms on human capital formation in childhood. Using across-state and across-cohort variation in the timing of reform legislations, this chapter analyzes the effect of reforms on both height and schooling of women who were likely to benefit from these reforms during their childhood and adolescence. Finally, Chapter 5 concludes by discussing the main findings and the policy implications from this research, as well as directions for

future work in this area. Tables and figures summarizing the results from the various analyses in Chapters 3 and 4 are included within the respective chapters, while additional figures are in the Appendix at the end of the dissertation.

Chapter 2

Gender Discrimination in Intrahousehold Resource Allocation in India: A Review

2.1 Introduction

There is a persistent female survival disadvantage in large parts of the developing world, especially in China and India – where the ratio of male to female population is as high as 1.07. This problem of excess female mortality – attributed both to socio-cultural factors and relatively higher economic deprivation of women – led Amartya Sen to coin the phrase "missing women" in describing the population gender imbalance (Sen, 1990; 1992). According to Sen's (1992) estimate more than 100 million women were missing in Asia and North Africa.[1] A large literature has looked at the gender gap in child mortality in India, and studied proximate determinants of this gap, such as son preference, family composition, and gender discrimination in intrahousehold allocations of food and health care ((Miller, 1981; Das Gupta, 1987; Behrman, 1988; Basu, 1989; Arnold et al., 1998; Pande, 2003; Borooah, 2004; Mishra et al., 2004; Tarozzi and Mahajan, 2007). Recently, Oster (2008) has shown that gender differences in

[1] Recently however, Oster (2005) has shown that a large number of these missing women can be accounted for by differences in sex ratios at birth caused by a high proportion of hepatitis B carriers among women – at least for China. However, as she admits, such an explanation accounts for a lower proportion of the "missing women" in India, Pakistan, and Nepal.

vaccinations explain between 20 and 30% of excess female mortality, and malnutrition explains an additional 20%, while treatment for illnesses play a relatively smaller role. A separate literature has looked at the underlying causes of son preference in India, including differences in female labor force participation rates, female education, economic development, kinship structures, and rice cultivation (Rosenzweig and Schultz, 1982; Kishor, 1993; Murthi et al., 1995).

This chapter presents a review of the existing literature on gender discrimination in intrahousehold resource allocation in India. It discusses current findings on the roles of both economic and socio-cultural factors in determining household behavior, and also presents available evidence on the consequences of gender discrimination for various outcomes. While it is by no means an exhaustive review of the vast literature that has emerged in this area, it does summarize the main findings from the literature, and also identifies certain gaps in the literature that are further related to the subsequent analyses in this dissertation. Findings from some of the most significant contributions to this literature are summarized below.

2.2 Main Findings

Miller (1981) documented the practice of female infanticide in certain areas of India – especially in the north, and more recent research shows widespread use of sex-determination techniques such as ultrasound and amniocentesis followed by sex-selective abortions (Sudha and Rajan, 1999; Arnold et al., 2002). While induced abortions have been legal in India since the passage of the Medical Termination of Pregnancy Act in 1971, there are restrictions on acceptable reasons for undergoing abortion, on the type of facility, and the type of medical practitioner who might carry out such an abortion. However, based on data from

the National Family Health Survey (1998-99) or NFHS-2, Arnold et al. (2002) show that over 100,000 sex-selective abortions were carried out in years immediately preceding the survey, following amniocentesis or ultrasound tests. Notably, the use of amniocentesis and ultrasound purely for the purpose of determining the sex of a foetus has been legally prohibited since 1996 by the Pre-natal Diagnostic Techniques (Regulation and Prevention of Misuse) Act. However, little or no enforcement combined with a high demand for prenatal sex determination have led to a large network of corrupt medical practitioners and clinics that offer these tests to couples. While amniocentesis has been available since the late 1970s, ultrasound offers a cheaper option (less than $20) and is the more popular technique, to the extent that ultrasound is considered to be a good investment by many couples in order to save far greater sums in dowry payments later on (Sudha and Rajan, 1999). Both the census of 2001, and results from NFHS-2 indicate an abnormally high sex ratio among young children and also at birth in several Indian states, most notably in Punjab, Haryana, and Delhi (116 – 120 males per 100 female children at birth).

Rosenzweig and Schultz (1982) look at sex-specific survival differentials in children in rural Indian households by examining how intrafamily resource allocations respond to economic conditions and to genetic or sex differences in children. They specifically consider whether survival differentials are related to the differences in relative returns to survival, or the expected earnings opportunities as adults. The empirical analysis uses household data from India (NCAER household survey 1971), and employs a two stage least squares or an instrumental variables approach with endogenous male and female employment rates being predicted in the first stage, and male-female survival difference being the second stage outcome. A set of variables that influence local labor demand and thus male and female employment rates, but do not directly affect child survival are used as instruments. They find that intrafamily resource allocations

do reinforce market signals, whereby an increase in adult male employment rates raises the survival difference, and an increase in female employment rate reduces the male-female survival difference among children. Also, increases in wealth increases the survival prospects of female children. The same results are found using district-level data from India (1961 Census). One important qualification to these results, as acknowledged by the authors themselves is that parity in survival rates does not necessarily reflect parity in household resource allocation, given biological differences. In other words, even though this paper finds evidence for a reinforcing pattern of parental investment in children, where children who are expected to be more economically productive *implicitly* receive a larger share of family resources, parental investment in children are imperfectly measured by child survival.

Kishor (1993) examines the roles played by several factors such as female labor force participation, kinship structures, economic development, rice cultivation, etc. in determining the gender difference in the mortality of children between ages 0 and 5 in India. Using data from 1981 on more than 350 districts in India she finds that both cultural and economic factors such as patriarchal kinship arrangements and female labor force participation are important determinants of excess female mortality. Further, the low economic and cultural worth of females can reinforce each other leading to greater gender inequality. She also finds that places with a greater percentage of cropped area under rice cultivation have greater rates of female survival. She concludes that any explanation of gender inequality in child mortality in India must consider both cultural and economic factors, and that studies that emphasize only a single factor (e.g., the economic explanation as offered by Rosenzweig and Schultz, 1982) are likely to be inadequate.

Murthi, Guio and Dreze (1995) examine child mortality, fertility, and the relative survival chances of male and female children based on a cross-section

analysis of district level data from the 1981 Census of India. They find that both greater female literacy and female labor force participation reduce the gender bias in child survival, whereas greater urbanization, better availability of medical facilities, and lower rates of poverty are associated with higher levels of female disadvantage in child survival. They claim that these results were consistent with the hypothesis that anti-female bias was particularly strong among privileged classes in India. They conclude that women's agency and empowerment are likely to play a vital role in determining how the process of economic development affects gender bias in survival among children in India. Using data from the National Family Health Survey, Arnold, Choe and Roy (1998) also examined the effect of son preference on parity progression and on child mortality. They found that son preference has a significant effect on demographic behavior in India. Specifically, existing family composition affected fertility behavior with son preference being an overwhelming consideration, and girls with older sisters were subject to the highest risk of mortality.

A number of papers have examined gender discrimination in nutrition and medical care, both of which are key determinants of childhood morbidity and mortality. Based on a study of 11 villages in Ludhiana district of Punjab, Dasgupta (1987) examines various mechanisms such as allocation of food, clothing, and medical care that bring about the gender differentials in child mortality. She finds that discrimination against girls is closely related to individual parents' family-building strategies, such that Punjabi parents restrict the number of daughters they have, and female mortality was almost twice that of males during the post-neonatal period of early childhood (1 – 59 months). She also finds that expenditure on medical care for sons was more than twice that for daughters during the first two years of life, and sons received nutritionally superior food and commanded a greater share of the expenditure on clothing. She claims that similar to India as a whole where son preference was primarily

determined by cultural considerations, gender bias in Punjab was largely determined by the structure of rights in asset ownership and decision making, and that these cultural factors were translated into economic considerations.

Using data on 240 rural households from the International Crop Research Institute for the Semi-Arid Tropics Village Level Studies (ICRISAT VLS) panel dataset, Behrman (1988) shows that parental preference parameters that govern the allocation of nutrients among children vary significantly across seasons, such that there was a pro-male bias during the lean season of around five percent. Further, this gender bias during the lean season cannot be explained by differential labor market returns for males versus females alone, and was not associated with land ownership. However, such discrimination was more likely among lower ranked castes and also when the household head was better educated. Behrman concludes that the combination of limited inequality aversion during the lean season and the preferential treatment of sons – especially among lower caste households – could endanger the survival of less endowed children in general, and female children in particular.

Behrman and Deolalikar (1990) look at nutrient intake responses to prices and income, and point out three common problems in obtaining estimates of these elasticities: first, even though intrahousehold nutrient allocations could vary by age and sex of family members, no existing studies allow for differential price and income responses of different individuals; second, failure to control for household and individual fixed effects lead to biased estimates of price and income responses of nutrient intakes; and third, assuming households protect their nutrient intakes from short-term income fluctuations, using current instead of permanent income could lead to downward biased estimates of elasticities. In their study, Behrman and Deolalikar (1990) use data on individual nutrient intakes and household income over a number of years from a panel dataset on south India (ICRISAT VLS data for the years 1976-77 and 1977-78) to address each of the

three problems mentioned above. They adopt a fixed effects strategy to difference out individual, household and community fixed effects, while controlling for time varying attributes such as prices, wages, etc.

The authors find that there were strong responses of nutrient intakes to food prices, and there was also evidence in favor of substitution among foods with changing prices. While there was no evidence of gender discrimination in nutrient intake in the form of lower average intakes of females or greater variance in female intakes, there was some evidence for discrimination in intrahousehold nutrient allocation to the extent that the nutritional burden of rising food prices during the lean season or shortages fell disproportionately on the female members of the household. Hence, in this study, the authors find some evidence of asymmetric treatment of women and girls within the household such that with rise in food prices the nutrient intakes of women and girls are adjusted downward by more than the household average.

Basu (1989) however argues that gender difference in nutrition is not among the key factors contributing to the observed female disadvantage in childhood survival. Instead, differential use of health care by the two sexes, and the socioeconomic status of women were the main determinants of the excess female mortality. Using data from a field examination or survey of poor households in two districts of Uttar Pradesh and four districts of the southern state of Tamil Nadu, she finds significant differences in the amount and quality of medical care provided during illness with girls being both less likely to be treated and less likely to receive better quality of medical care in the north Indian state of Uttar Pradesh. She also finds evidence of a narrowing of the gender gap in mortality for working mothers in Tamil Nadu, suggesting that women's employment improve their overall status within the family and reduce discrimination during childhood.

Using data from the National Family Health Survey (1992-93), Pande (2003) examines the effect of the sex composition of surviving older siblings on gender differences in childhood nutrition and immunization. She finds that severe stunting and lack of immunization were important mechanisms contributing to the gender difference in health status among children. Specifically, she finds evidence for a pattern of selective neglect such that both girls and boys with surviving siblings of only the opposite sex fare better than children with no surviving siblings, while children with two or more surviving same-sex siblings fare worse with respect to height-for-age and appropriate immunizations. Moreover, there was significant proof of strong son preference in that the harmful effect of having surviving same-sex siblings is stronger for girls, while the protective effect of having only opposite sex-siblings is weaker for girls.

Borooah (2004) also investigates gender bias in immunization and nutrition in early childhood by conducting an analysis on survey data for 4000 children between the ages of 1 and 2 years. The results suggest that the probability of girls being fully vaccinated was five percentage points lower than that for boys. For children of illiterate mothers, there was a similar female disadvantage with respect to receiving a nutritious diet, while there was no gender difference in nutrition for children of literate mothers. Mishra, Roy and Retherford (2004) use data from waves 1 and 2 of the National Family Health Survey and find that the presence and extent of gender discrimination in childhood feeding, immunizations, and nutritional status depend on the birth order of the index child and the sex composition of surviving older siblings. Specifically, discrimination against girls was more likely in families with no living sons, especially at birth order 3 and above. Using the same data, Tarozzi and Mahajan (2007) show that gender inequality in childhood nutritional status increased during the 1990s, with nutritional status improving substantially more for boys than for girls in India during this time period. They also find that such

changes in nutritional status were greater in rural areas of north and east India, where the existence of widespread son preference has been established by previous research. However, their analysis also suggests that there was unlikely to be a simple explanation for the emerging trend of increased gender difference in childhood malnutrition in India.

Access to health services or facilities can be an important determinant of child health. However, using survey data from India, Oster (2007) finds evidence for a non-monotonic relationship between access to health services and gender inequality in the utilization of such services for promoting child health. She specifically examines the effect of availability of health camps on gender differences in childhood vaccination in India, and finds the improved access initially increases gender inequality in vaccination, while further improvements in access reduce such inequality. In a related paper, Oster (2008) analyzes the proximate sources of the population gender imbalance in India, and argues that excess female mortality between the ages of 1 and 5 is large enough to explain virtually the entire imbalance in the population. She also finds that sex differences in vaccinations explain between 20 and 30% of excess female mortality, malnutrition explains an additional 20% and differences in treatment for illness play a smaller role.

2.3 Conclusion

Overall, the review of the literature on gender discrimination in intrahousehold resource allocation throws up five interesting and crucial findings. First, both economic and socio-cultural factors are important determinants of gender bias in India, and explanations based on only one of these factors are likely to be oversimplified or misleading. Second, family composition or the sex composition

of surviving older siblings and birth order of the index child were also crucial factors determining parental behavior vis-à-vis the girl child and the share of resources commanded by her. Third, gender differences in health care, especially age appropriate immunizations, and in nutrition were key contributors to excess female mortality among children in India. Fourth, women in general, and girls in poor families in particular were more vulnerable to nutritional deprivation during periods of relative food scarcity, e.g., during the lean season. Finally, women's empowerment in the form of higher female literacy and greater labor force participation can reduce gender bias in India – both independently and in conjunction with general socioeconomic development over time.

Thus, pervasive son preference and discrimination against daughters are unfortunate yet important factors that need to be taken into consideration while studying parental behavior vis-à-vis their children in the context of India. However, discrimination can take other forms as well. For instance, in order to maximize their returns from investing in child health, poor and resource constrained parents might decide to put in greater investments in the relatively well endowed child, or in the child with a greater innate ability to survive in a high-risk and disease-prone environment. Such behavior would then manifest itself in the form of a reinforcing pattern of investments in child health, whereby parents reinforce endowment differences between their children through health investments in early childhood. Additionally, this reinforcing pattern might be exacerbated in an environment where the odds of survival were highly skewed in favor of the well endowed child. The next chapter in this dissertation addresses these issues and also differentiates between parental discrimination based on initial endowment differences among their children and that based on gender differences alone.

The literature review also underscores the importance of accounting for gender discrimination in intrahousehold allocations while studying the effect of

various policies or programs on health and other human capital outcomes. In analyzing the effect of India's extensive land reforms on long term health and well-being, chapter 4 in this dissertation has to explicitly deal with this issue, since the available data permits an estimation of the program effects for women only. In this context, it is interesting to note that gender discrimination can drive the estimates of such program effects in two opposite directions. On the one hand, if girls are less likely to benefit from a particular program due to parental discrimination, the estimated program effects would be biased downward for female children. However, if girls start out with really low levels of health and nutrition investments, and there are non-linearities in the relationship between greater investments and health outcomes, then even a small increase in such investments for girls can lead to a large change in a particular outcome. In that case, the estimated program effects for girls would be larger than that for boys. This latter possibility has not been well addressed in the existing literature, and it does emerge as an important factor in interpreting the estimated effects of land reforms on women's height and schooling in chapter 4.

Chapter 3

Mortality Risks, Health Endowments, and Parental Investments in Infancy: Evidence from Rural India[2]

3.1 Introduction

Both developed and less developed countries have experienced a dramatic decline in infant mortality rates over the last few decades. World infant mortality rate is estimated to have declined from 198 in 1960 to 83 in 2001. However, infant mortality in less developed countries remains high – roughly 10 times the rate in the developed world. Reducing infant mortality in the less developed world is thus one of the most important development challenges. The millennium development goals have set a target to reduce infant mortality rates by two-thirds from 1990 to 2015.

The direct health benefits of reducing infant mortality are obvious. However, reductions in infant mortality might also have indirect effects that are less well understood. In particular, childhood mortality risks are a major source of risk in the returns to childhood investments. Thus, reductions in mortality risks could

[2] This paper was co-authored with Ashlesha Datar and Neeraj Sood.

affect parental investments in children, consequently affecting children's long term health and economic well being. For example, Dow et al. (1999) show that the incentive to invest in child health depends inversely on the level of mortality risks. They find evidence that the reduction in mortality risks due to the Expanded Programme on Immunization of the World Health Organization increased parental health investments unrelated to immunization. Similarly, Estevan and Baland (2007), argue that high mortality risks could lead to inefficient investments in human capital. They show that the level of child labor could be inefficiently high when survival is uncertain and parents expect cash transfers from their children. This is because, given the uncertain survival of their child, parents tend to favor a certain investment, such as saving, to an uncertain one, such as human capital.

In this paper, we add to this literature by examining how mortality risks affect intra-household childhood investments in siblings with different initial health endowments. We argue that increases in background mortality risks disproportionately affect the survival of the weaker sibling. Thus, increases in mortality risk not only increase overall risks but also increase the mortality gap between siblings with high and low initial health endowments. Since mortality risks are one of the important drivers of returns to parental investments, we argue that increases in mortality risks should also increase disparities in parental investments across high and low initial health endowment children. We empirically test this prediction using data from rural India. We use birth size as a measure of initial health endowment, immunization & breastfeeding as measures of childhood investments and infant mortality rate in the child's village as a measure of mortality risks. We find that in villages with high mortality risks, small-at-birth children in a family are less likely to be breastfed or immunized compared to their large-at-birth siblings. In contrast, we find no significant within family differences in investments in villages with low mortality risks. This finding

is robust and cannot be explained by either differences in preferences or access to health infrastructure across high- and low-infant mortality areas.

This paper also makes a direct contribution to the empirical literature on the effect of endowment differences on intra-household resource allocation (Griliches, 1979; Behrman et al., 1982; Rosenzweig and Schultz, 1982; Rosenzweig and Wolpin, 1988; Pitt et al., 1990; Behrman et al., 1994; Ayalew, 2005; Datar et al., 2006; Rosenzweig and Zhang, 2006).[3] Previous work in this area has generally treated endowments as observable to parents but unobservable to researchers. Notable exceptions are the recent studies by Datar et al. (2005), and Rosenzweig and Zhang (2006) that use birth weight as a proxy for health endowment and conduct a direct test of whether variation in birth weight across siblings generates differences in parental investments. We adopt a similar approach in this paper, but in the absence of good clinical data on birth weight, utilize birth size as reported by the mother as an indicator of children's initial endowment. Birth size is directly observable to parents, and it has also been found to be highly correlated with birth weight (Moreno and Goldman, 1990). Therefore, as in studies by Datar et al. (2006) and Rosenzweig and Zhang (2006), our measure of endowment is likely to be quite close to that used by parents in assessing the initial healthiness of a child. Additionally, we extend these earlier analyses, by explicitly modeling and testing for the effect of background mortality risks on parental investment strategies.

The rest of the paper is organized as follows. In section 2, we describe the data and variables used for this analysis, and discuss our measures for birth size, parental investments, and background mortality. In section 3, we present a model of parental investments that motivates our empirical approach. Section 4 discusses

[3] Behrman et al. (1995) and Behrman (1997) offer excellent reviews of the literature on intrahousehold resource allocation.

our empirical strategy, and section 5 presents the main results. In section 6, we discuss additional results from a number of robustness checks, and section 7 concludes.

3.2 Data and Measures

We use data from the 1992-93 National Family Health Survey (NFHS). The NFHS surveyed a nationally representative sample of households in India's 26 major states, and the primary respondents were ever-married women in the 13-49 age group. Structured interviews were conducted with the women and the household in which they resided. Detailed information on the survey is available at http://www.nfhsindia.org. We use the rural sub-sample of NFHS for our analysis, which has detailed information on 35,318 children between the ages of 0 and 47 months, born to 26,865 mothers who were sampled from the rural primary sampling units. As mentioned before, we would have liked to utilize birth weight information for children as the measure of initial health endowment. However, birth weight is available for less than 10% of the children in our sample[4], whereas information on birth size (small, average, large) is available for more than 98% of the children.[5] Therefore, for the purpose of our analysis, we first restrict our sample to mothers with at least 2 children for whom birth size information is available. Next, we only keep children for whom there is information on at least

[4] Missing data on birth weight for a large part of our rural sample is mainly due to the fact that most deliveries in rural India take place outside of health facilities and are done by traditional mid-wives who typically do not measure the newborn's weight at birth.

[5] Moreno and Goldman (1990) report that relative size at birth as reported in the Demographic and Health Surveys (DHS) was of reasonably high quality, and was well correlated with measured birth weights.

one of the parental investments examined in the paper. This reduces our sample size to 16,088 children born to 7,891 mothers. The exact sample sizes in our regressions drop further when we exclude observations with missing values for the particular parental investment being examined, and/or with missing values for any of the other variables in our analysis.[6]

We exploit 5 key features of the NFHS for the purposes of this paper. First, the NFHS collected detailed information on each child born to an interviewed woman since January 1988/1989. That is, information was collected on children even if they had died by the time of the survey. For women who had more than one live birth during this 4 year period (1988-89 to 1992-93), information was obtained on the 3 most recent live births. This allows us to examine intra-family resource allocation decisions over a relatively short time horizon, during which major changes in the socio-economic circumstances of a family are unlikely to occur. This is important because one might be concerned that between-sibling differences in birth size and health investments might simply be a consequence of changes in the family's socioeconomic circumstance at the time of birth of the various siblings.

Second, we have information on birth size for almost all surveyed children, and use this as a proxy for a child's initial endowment. In some ways, birth size may be a better measure of initial health endowment for our analysis compared to actual birth weight. Birth size is mother-reported and therefore, captures the perceived "healthiness" of the child. Ultimately, it is this perception that is likely to influence parent's decisions, regardless of what the child's actual endowment may be. In rural households, where the majority of births take place outside the

[6] In analyses not reported here, we also used the 1998-99 wave of the NFHS (NFHS-2) to estimate similar models, but our estimates from NFHS-2 lacked precision due to a significantly smaller final sample of mothers and children. Hence, we only report results from using NFHS-1 in this paper.

formal health care system, birth size may be the only indicator of the live infant's healthiness to the parent.

Third, the NFHS collected information on two key health investments that parents make in their children during infancy and early childhood – breastfeeding and immunizations. This information was collected for a maximum of 3 children in the family who were born within the last 4 years, allowing us to estimate mother fixed-effect models.

Fourth, the availability of information on maternal and child characteristics, as well as on prenatal investments at the time of each child's birth allows us to control for observable difference across siblings that may be correlated with birth outcomes as well as parental investments.

Finally, the birth history information obtained from each mother allows us to construct a village level measure of infant mortality that captures the background mortality risk for infants in each village.

The main outcomes of interest in our study are health investments that parents make in their children during infancy. In particular, we focus on immunizations and breastfeeding:

1. Whether the child received all age appropriate doses of Polio vaccination.
2. Whether the child received all age appropriate doses of non-Polio, i.e., BCG and DPT vaccinations.
3. Whether the child was breastfed for at least 6 months.

Health investments such as breastfeeding and immunizations during a child's first year are highly recommended by the World Health Organization (WHO) and are also included as objectives in the various child health programs of the Department of Family Welfare in India (Ministry of Health and Family Welfare, 2006). In order to increase immunization coverage, the Government of India

started the Universal Immunization Program (UIP) in 1985-86, which aimed to vaccinate at least 85% of all infants by 1990 against the 6 vaccine-preventable diseases or VPDs (tuberculosis, diphtheria, pertussis, tetanus, poliomyelitis, and measles). The Innocenti Declaration on the Protection, Promotion, and Support of Breastfeeding (1990), and the WHO Working Group on Infant Feeding (WHO, 1991) made several recommendations, which state that infants should be exclusively breastfed for 4 to 6 months. Also, previous research has shown that breastfeeding protects children from a number of diseases including gastrointestinal tract infections, and atopic eczema (Kramer et al., 2001). A systematic review of evidence by the WHO on the optimal duration of exclusive breastfeeding finds that exclusive breastfeeding for at least 6 months can reduce child morbidity from gastrointestinal infections (Kramer and Kakuma, 2002).

Data on immunization were collected in the NFHS through the mother questionnaire for children in the age group of 2-35 months. Mothers were asked about the immunizations received by each of her eligible children, and where possible, this information was verified by cross-checking against the child's vaccination card. Specifically, the survey asked whether the child had received BCG, DPT (all doses), Polio (all doses) and Measles vaccinations. We distinguish between 2 types of immunization coverage – Polio and non-Polio. Since both the timing as well as completeness of vaccinations are important, we follow Datar et al.'s (2006) approach and denote a child as having "full age appropriate coverage" for polio or non-polio vaccinations using Government of India's Recommended Immunization Schedule (Table 3.1). Thus, for example, a child who is 3 months old, and has BCG, DPT1 and 2, and Polio1 vaccines would be classified as having "fully age appropriate coverage" under the non-Polio vaccine category, but would be classified as not having "fully age appropriate coverage" for the Polio vaccine. This approach allows us to distinguish between children who receive age appropriate coverage and children who are immunized

at an older (or younger) age and therefore are exposed to the risk of VPDs for a longer duration of time (or are physiologically not ready for vaccination).

Table 3.1: Government of India's Recommended Immunization Schedule

Age (weeks)	Age (months)	BCG	DPT	Polio	Measles	Age Appropriate Coverage for all India
Birth	0	X		X [1]		BCG
6 weeks	1.5		X	X		BCG + DPT1 + Polio1
10 weeks	2.5		X	X		BCG + DPT1-2 + Polio1-2
14 weeks	3.5		X	X		BCG + DPT1-3 + Polio1-3
36 weeks	9				X	BCG + DPT1-3 + Polio1-3 + Measles

NOTES: [1] Polio vaccination at birth is recommended in all institutional deliveries and in all endemic areas.
Source: Universal Immunization Program Division, Department of Family Welfare, Ministry of Health & Family Welfare. http://cbhidghs.nic.in/hii2003/12.01.htm

Mothers were asked about their breastfeeding behavior for each of their 3 most recent live births in the past 4 years. The survey questions did not ask about exclusive breastfeeding, but instead focused on any breastfeeding, including when it was initiated and how for long it was done. Following the WHO guidelines, our breastfeeding measure captures whether the child was breastfed for at least 6 months. For the breastfeeding analysis, we restrict our sample to children 6 months and older.

The means and standard deviations of the parental investment variables and other explanatory variables are reported in panels A and B of Table 3.2 – for children in our analysis (those with at least one sibling), and the original sample of children respectively. These suggest that children in our analysis sample are quite similar to those in the original sample with respect to parental investments as well as other attributes. Based on the summary statistics for our analysis sample (panel A), we find that only about 35% of the children were fully immunized against polio, while only a quarter were fully immunized against non-

polio diseases. In contrast, 85% of children aged 6 months and older were breastfed for at least 6 months. This suggests that breastfeeding was fairly widespread in rural India, compared to immunization.

Birth size information for each child in the NFHS was reported by the mother retrospectively. Specifically, mothers were asked to report whether a particular child was "large", "average", or "small" when he/she was born, for each of her 3 most recent live births within the 4 years preceding the survey. The median number of months between the child's birth and the mother's report of that child's birth size, or the "recall" period in our sample is 22 months or about 2 years.[7] Nearly a quarter of all children in our sample were smaller than average size at birth (hereafter small-at-birth). Additionally, the median age of the mother at birth was 22 years, the median birth order was 3, and exactly half the children were male.

There exists a substantial amount of within-family variation in birth size and parental investments in our data. Table 3.3 reports the percentage of families with intra-family variation in birth size and health investments i.e. at least one sibling had a different birth size or investment compared to the other siblings. More than 26% of the families in this sample have across-sibling variation in birth size and in age-appropriate polio coverage, and 22% of the families have variation across siblings in age-appropriate non-polio coverage. About 41% of the families have variation across siblings in whether they were breastfed for 6 or more months.

[7] This is comparable to the median recall period for birth weight in Datar et al.'s (2006) study that used the National Longitudinal Study of Youth 1979 – Child Data. Parental recall of birth weight has been found to be fairly accurate in a number of studies (Walton et al., 2000; O'Sullivan et al., 2000). Maternal recall of whether the child was born bigger or smaller than average is likely to be more accurate relative to a numerical birth weight.

Table 3.2: Summary Statistics

Variable	Mean	Median	Std. Dev.	Min	Max	Obs
PANEL A: ANALYSIS SAMPLE						
Parental investments						
Age appropriate Polio coverage	0.35	0	0.48	0	1	16015
Age appropriate non-Polio coverage	0.25	0	0.43	0	1	15757
Breastfed for at least 6 months	0.85	1	0.36	0	1	13528
Explanatory variables						
Small-at-birth	0.23	0	0.42	0	1	16088
Sex of child (Male =1)	0.50	1	0.50	0	1	16088
Birth order	2.71	3	1.11	1	4	16088
Month of birth	6.82	7	3.39	1	12	16088
Age of Child if alive (months)	22.90	22	15.15	0	47	14348
Any small-at-birth siblings present in household	0.08	0	0.27	0	1	16088
Mother's age at birth (years)	23.37	22	5.26	12	49	16088
Given iron folic tablets during pregnancy	0.44	0	0.50	0	1	16082
Tetanus injections before birth	1.20	1	1.22	0	5	15996
First antenatal visit in 1st trimester	0.18	0	0.38	0	1	16088
First antenatal visit in 2nd trimester	0.27	0	0.44	0	1	16088
First antenatal visit in 3rd trimester	0.11	0	0.31	0	1	16088
Background variables						
High infant mortality in village	0.56	1	0.50	0	1	16088
Health infrastructure (at least PHC) in village	0.16	0	0.36	0	1	16088
PANEL B: FULL SAMPLE						
Parental investments						
Age appropriate Polio coverage	0.38	0	0.49	0	1	35174
Age appropriate non-Polio coverage	0.27	0	0.44	0	1	34590
Breastfed for at least 6 months	0.89	1	0.31	0	1	30480
Explanatory variables						
Small-at-birth	0.22	0	0.41	0	1	34760
Sex of child (Male =1)	0.51	1	0.50	0	1	35318
Birth order	2.58	3	1.20	1	4	35318
Month of birth	6.79	7	3.41	1	12	35318
Age of Child if alive (months)	22.67	22	13.93	0	47	32408
Any small-at-birth siblings present in household	0.04	0	0.19	0	1	35318
Mother's age at birth (years)	23.82	23	5.78	12	49	35318
Given iron folic tablets during pregnancy	0.45	0	0.50	0	1	35145
Tetanus injections before birth	1.26	1	1.23	0	5	34960

(continued)

First antenatal visit in 1st trimester	0.19	0	0.40	0	1	35318
First antenatal visit in 2nd trimester	0.27	0	0.44	0	1	35318
First antenatal visit in 3rd trimester	0.11	0	0.31	0	1	35318
Background variables						
High infant mortality in village	0.54	1	0.50	0	1	35318
Health infrastructure (at least PHC) in village	0.17	0	0.37	0	1	35318

NOTES: Summary statistics have been adjusted with sampling weights. Source: NFHS I (1992-93)

Table 3.3: Within-family Variation in Birth size, Parental Investments, and Other Variables

Continuous Variables	Percent of total variance explained by within-family variation
Number of Tetanus injections before birth	29.05%
Mother's age at birth (years)	9.40%
Birth order	33.14%
Month of birth	87.44%
Age of Child if alive (months)	100.00%
Dichotomous variables	Percent of families with within variation
Age appropriate Polio coverage	26.47%
Age appropriate non-Polio coverage	22.00%
Breastfed for at least 6 months	40.81%
Small-at-birth	26.49%
Any small-at-birth siblings present in household	15.52%
Given iron folic tablets during pregnancy	14.54%
First antenatal visit in 1st trimester	15.60%
First antenatal visit in 2nd trimester	24.53%
First antenatal visit in 3rd trimester	12.72%
Sex of child (Male =1)	51.32%

NOTES: Based on calculations from the National Family Health Survey, Wave I (1992-93).

Finally, we measure background mortality risk by constructing a village level infant mortality rate. Using retrospective birth history data, we aggregate the number of children born in a village within the previous 4 years across all women

who were interviewed in that village, and also the number of children who died before the age of one to construct an infant mortality rate for each village in our sample.[8] We classify a village as having high background mortality risk if the infant mortality rate for that village exceeds the median infant mortality rate in the distribution, which is 7% (same as the mean). As can be seen, more than half the children in our sample lived in villages with a high background mortality risk (Table 3.2, Panels A & B).

3.3 Theoretical Framework

In this section, we outline a simple one-period model of parental investments in children's health when child survival is uncertain. We follow the approach of consensus parental preference models (Behrman, 1997) and assume that altruistic parents maximize their consensus utility function

(1) $U[V(h_1, h_2, \ldots, h_n), Y]$

where V(.) is a parental welfare function that has as its arguments the adult health of each child (h_i), and Y is the parents' consumption.

[8] There could be concerns about the precision of the village-level infant mortality measure due to a small number of births per village (on average, there were more than 12 births per village in our sample within the previous four years of the survey). To address such concerns, we checked the correlation of our constructed infant mortality measure with the state-level infant mortality rate (IMR) independently calculated from the NFHS, and found that the two measures were highly correlated at the state level (raw correlation of 0.90). Further, we use a discrete variable reflecting low and high mortality at the village level in our analysis that is less likely to be affected by imprecise measurement, and do obtain similar results by using the actual (continuous) level of IMR calculated at the village level.

Parents maximize their utility function subject to two constraints: the health production function for each child and the household's budget constraint. The health production function shows the adult health of child *i* and is increasing in health and educational investments that parents make in the child (x_i) and the child's endowment (e_i), but is decreasing in the background mortality risk (m) that the child faces. m refers to the underlying risk of dying due to factors exogenous to the household.

(2) $h_i = h(x_i, e_i, m) \qquad i= 1, 2,..., n$

The budget constraint requires that parental expenditures on their own consumption and investments in their children's health not exceed their total resources (M).

(3) $$\sum_{i=1}^{n} x_i v + Y = M$$

where v is the relative price of parental inputs.

First order conditions from the above model can be written as follows.

(4) $$V'_{h_i} h'_{x_i} = V'_{h_j} h'_{x_j} \quad \forall\, i \neq j$$

The above equation shows that the marginal benefit from investing in each child should be equal at the optimum. The first term on the left hand side captures the marginal utility to the parent from an increase in child *i*'s health. The second term on the left hand side captures the marginal returns in terms of health from an increase in parental inputs into child *i*.

The optimal level of parental investment in each child (x_i*) is a function of the child's endowment, background mortality risk, price of parental inputs, and income:

(5) $$x_i^* = x_i^*(e_i, m, \nu, M)$$

In this paper, we are specifically interested in two comparative statics – (a) how parental investments change as the child's endowment increases i.e. dx_i^* / de_i , and (b) how parental responsiveness to child endowment changes as background mortality risk increases i.e. $d^2 x_i^* / de_i dm$.

From the first order condition, it can be seen that x_H*- x_L*, which is the difference in parental investments between a high (H) endowment and a low (L) endowment child, depends upon two quantities – (a) the ratio of the marginal utility of health for the two children (V'_{h_L} / V'_{h_H}), and (b) the ratio of the marginal returns to parental investments for the two children (h'_{x_L} / h'_{x_H}). The first quantity depends upon the properties of the parental welfare function V(.) i.e. parental preferences for equity versus efficiency and whether parents have "equal concern" for all their children[9]. For example, all else equal, x_H*- x_L* is likely to be smaller for parents who exhibit a higher preference for equity or who have greater concern for their low endowment child. The second quantity depends upon the properties of the health production function h(.), in particular, whether the returns to parental investments are higher for the high or low endowment child. For example, x_H*- x_L* is likely to be larger if returns to parental investments increase

[9] "Equal concern" refers to whether the parental preference indifference curves are symmetric around the 45 degree line. Parental preferences for equity versus efficiency are captured by the shape of the indifference curves (e.g. L-shaped or straight lines).

with endowments. Therefore, it is a priori unclear whether x_H*- x_L* is positive, negative or zero.

The second comparative static examines how x_H*- x_L* changes as background mortality risk increases. In general, this effect would depend upon how the ratios V'_{h_L}/V'_{h_H} and h'_{x_L}/h'_{x_H} vary with background mortality risk. An increase in background mortality risk would reduce the probability of surviving to adulthood, and therefore returns to parental investments, for all children. However, the magnitude of reduction in these returns might critically depend on the endowment of the child. For example, an increase in background mortality risk might affect the survival probability of the low endowment child more than that of her high endowment sibling. This is because lower endowment children might be less resilient and more susceptible to disease. Consequently, the returns to parental investment in the low endowment child reduce more compared to the returns to investment in the high endowment sibling. This change in relative returns implies that an increase in background mortality risk will increase x_H*- x_L*. Changes in background mortality risk, however, might also be related to changes in parental preferences. For example, parents with a high preference for equity might choose to live in areas with low mortality risks. Therefore, it is a priori unclear how changes in mortality risk affect x_H*- x_L*. Ultimately, how changes in background mortality risk affect investments in children is an empirical question which we test in the subsequent sections.

3.4 Empirical Strategy

An econometric model for the demand function shown in equation (5) can be written as follows:

$$(6) \qquad I_{if} = \beta_1 small_{if} + \beta_2 small_{if} * highmortality_f + \beta_3 X_{if} + \gamma_f + \phi_i + \varepsilon_{if}$$

where "*i*" indexes child, and "*f*" indexes family. The dependent variable, *I*, is an indicator for whether a child received a specific parental investment or not. A child's own endowment is captured by the variable *small*, which is an indicator for whether the child was smaller than average birth size.[10] The variable *highmortality* is a village level indicator for whether the infant mortality rate in that village was greater than the median mortality rate (7%). The vector X_{if} includes other child- and family- specific characteristics that may influence parental investment, child survival and birth outcomes (e.g. gender, income, price of health inputs). In addition to these "observed" characteristics are a set of unobservable factors that affect parental investments – γ_f represents unobserved endowments and environmental influences (pre- and post-natal) common to all siblings in a family and ϕ_i represents unobserved child-specific factors that are correlated with parental investments and birth outcomes. Finally, ε_{if} is an idiosyncratic error term.

The key parameters of interest in equation (6) are β_1 and β_2. β_1 captures the effect of own-endowment on parental investment. β_2 captures the additional effect of own-endowment in areas where the background mortality risk is high.[11] The model that we estimate, however, is the following:

$$(7) \qquad I_{if} = \alpha_1 small_{if} + \alpha_2 small_{if} * highmortality_f + \alpha_3 X_{if} + \gamma_f + \nu_{if}$$

[10] Dow et al. (1999) also use this as their measure of low birth weight.

[11] The direct effect of *highmortality*, which does not vary across siblings within a family, cannot be estimated in this model due to the inclusion of the family fixed effect.

where, $\nu_{if} = \phi_i + \varepsilon_{if}$. While the mother fixed-effect γ_f controls for the influence of all unobserved family specific factors correlated with parental investment and birth outcomes, one might be concerned that the error term may still include sibling-specific factors that are correlated with parental investment and birth outcomes. Below, we discuss 3 reasons why such concerns are minimized. First, we include a number of sibling-specific controls in X_{if} such as gender, birth month, birth order, mother's age at birth, and a host of prenatal investments in child *i* such as whether the mother received iron folic tablets during pregnancy, whether she was given tetanus injections before birth, and the trimester of her first antenatal visit. Inclusion of these covariates will absorb a lot of the important sibling-specific heterogeneity contained in the error term. Second, the siblings within a family are all born within a relatively short time period. This significantly reduces the likelihood that aspects of family circumstance, not already captured by our covariates, changed enough between the birth of the 2 siblings to affect their birth size and parental investments. Third, if the bias from sibling-specific heterogeneity remains the same across high- and low-infant mortality villages, then the estimated α_2 will be unbiased, because α_2 captures the differential effect of being small in high mortality areas.[12] In section 6, we test whether the bias from sibling-specific heterogeneity is the same across high and low mortality villages.

We estimate equation (7) using linear probability models and adjust the standard errors for clustering at the family level (Bertrand et al 2004).

[12] To see this, let δ_1 and δ_2 be the estimated coefficients on *small* from 2 separate regressions that estimate equation (3) using the low mortality and high mortality subsamples, respectively. The difference δ_2 - δ_1 is equal to the estimate α_2 from equation (3). If $\delta_1 = \beta_1$+bias and $\delta_2 = \beta_1 + \beta_2$+bias then δ_2 - $\delta_1 = \beta_2$.

3.5 Results

We begin by reporting estimates from a special case of the model in equation (7) that assumes there are no differences in parental response to birth size across high- and low-infant mortality areas i.e. $\alpha_2 = 0$. Panel A in Table 3.4 reports the estimated effects of being smaller-than-average birth size on the likelihood of receiving age-appropriate polio and non-polio immunizations and breastfeeding for at least 6 months. We find that children with smaller birth size are significantly less likely to be immunized against both polio and non-polio diseases relative to their larger birth size siblings; smaller birth size siblings have a 4 and 3 percentage point lower likelihood of being immunized against polio and non-polio diseases, respectively, and both these effects are significant at the 1% level. However, a child's relative birth size does not significantly affect her chances of being breastfed for at least 6 months. Among other covariates in the model, gender, maternal age and prenatal investments are associated with immunizations, but not with breastfeeding. Boys[13] and siblings born when the mother is younger and when she took tetanus injections and iron folic tablets during pregnancy have a significantly greater likelihood of receiving polio and non-polio immunizations. For breastfeeding, first borns are less likely to be breastfed for 6 months and younger mothers are less likely to breastfeed for 6 months or more.

Panel B in Table 3.4 reports estimates from the model in equation (7). The interaction term tests whether parents residing in villages with a high infant mortality rate are more likely to adopt a reinforcing strategy compared to parents

[13] To examine the hypothesis that parental response to birth size differences between their children might depend upon whether the small birth size child is a boy or girl, we tested for the interaction between birth size and gender in an alternate specification (results available from the authors upon request). The interaction effect was not statistically significant, and all other estimated parameters were same as before.

Table 3.4: Effect of Birth Size and Background Mortality on Parental Investments

	Age appropriate polio coverage	Age appropriate non-polio coverage	Breastfed for 6 months
	(1)	(2)	(3)
PANEL A			
Small-at-birth	-0.038***	-0.032***	-0.01
	(0.01)	(0.01)	(0.01)
Observations	15679	15269	8571
Number of mothers	7,616	7,418	4,240
PANEL B			
Small-at-birth	-0.006	-0.009	0.009
	(0.02)	(0.02)	(0.01)
Small-at-birth * High IMR in village	-0.057***	-0.042**	-0.041**
	(0.02)	(0.02)	(0.02)
Observations	15,679	15,269	8,571
Number of mothers	7,616	7,418	4,240

NOTES: Estimates are from mother fixed-effects models that include the following covariates: mother's age at birth, whether the mother received iron folic tablets during pregnancy, number of tetanus injections received by the mother during pregnancy, dummies for the trimester of first antenatal care visit, and dummies for birth order and birth month. Figures in parentheses are standard errors. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

in villages with lower background mortality. Our results confirm this hypothesis. In high infant mortality villages, a small birth size child is about 6 and 4 percentage points less likely to be immunized for polio and non-polio vaccines, respectively, compared to her better endowed siblings. However, there is no significant effect of a child's birth size on immunizations in low infant mortality villages. Further, the same reinforcing pattern in parental investments is now observed for breastfeeding as well. In high mortality villages, a small birth size child is about 4 percentage points less likely to be breastfed for at least 6 months

compared to her larger birth size siblings. As in the case of immunizations, there is no significant effect of birth size on breastfeeding in low mortality villages.[14]

3.6 Robustness Checks

There is some concern that infant mortality rate is not an exogenous measure of background mortality risks. Thus, it is possible that our results might be driven by observed or unobserved differences across high- and low-mortality villages that are correlated with investments in children. To address this issue we test the robustness of our results for two important sources of heterogeneity across high- and low-infant mortality villages. The first analysis examines whether our results are driven by differential preferences for discrimination across high- and low-infant mortality villages. Our second analysis tests whether our results are explained by differences in health infrastructure availability across high- and low-infant mortality villages.[15]

In the last two subsections we report results from 2 additional robustness checks. The first analysis tests the sensitivity of our main results to presence of

[14] We also estimated equation (3) with a continuous measure of infant mortality at the village level instead of the indicator for high mortality. The results were similar to those reported above. Additionally, we compared villages above the 75th percentile in the distribution of the infant mortality rate with those below the 25th percentile, instead of looking at villages above and below the median. Once again, results were similar suggesting a stronger reinforcing pattern in villages with high background mortality risk.

[15] Use of natural disaster or epidemics as instruments for background mortality is problematic for several reasons. First, such disasters and epidemics not only affect infant mortality but also affect adult mortality, access to health infrastructure and local economies. Second, disasters and epidemics typically engender an endogenous policy response in terms of increased aid in cash or in kind to these affected areas. These changes might have a direct effect on childhood investments independent of the changes in mortality risks.

other small-at-birth siblings in the household. Finally, our last set of tests examines whether our results can be explained by unobserved sibling level economic shocks that affect both child endowments and post natal investments.

3.6.1 Do Preferences for Discrimination Explain the Stronger Reinforcing Effects in High Mortality Villages?

As discussed in section 3, it may be possible that villages that have a high background mortality risk are also those that have generally higher parental preferences for discrimination. If this were true, the evidence of stronger reinforcing effects in high mortality villages might be the result of such parental preferences rather than the result of background mortality *per se*. To test this alternate explanation, we examine intra-household gender differences in parental investments across high- and low- infant mortality villages. If the stronger reinforcing effects in high mortality villages are driven purely by parental preferences for discrimination then we should find that parents in high mortality villages are more likely to discriminate between their sons and daughters.

Table 3.5 reports estimates from models that include an additional interaction term for male child and high background mortality. There are 3 notable results from this analysis. First, our main finding that parents in high mortality villages are more likely to reinforce birth size differences remains unchanged. Second, consistent with the prior literature, we also find that parents are significantly more likely to immunize their sons compared to daughters.[16] And finally, the insignificant coefficient on the male-high mortality interaction suggests that

[16] For instance, see Oster (2006), and also the literature review in Chapter 2.

parents in high mortality villages do not have any different preferences for gender discrimination compared to parents in low mortality villages.

Table 3.5: Effect of Background Mortality Risk on Gender Differences in Parental Investments

	Age appropriate polio coverage	Age appropriate non-polio coverage	Breastfed for 6 months
	(1)	(2)	(3)
Small-at-birth	-0.006	-0.009	0.009
	(0.02)	(0.02)	(0.01)
Small-at-birth * High IMR in village	-0.060**	-0.038	-0.042**
	(0.03)	(0.02)	(0.02)
Male child	0.046***	0.036***	0.009
	(0.01)	(0.01)	(0.01)
Male * High IMR in village	-0.012	-0.02	0.00
	(0.02)	(0.02)	(0.01)
Observations	15,679	15,269	8,571
Number of mothers	7,616	7,418	4,240

NOTES: Estimates are from mother fixed-effects models that include the following covariates: mother's age at birth, whether the mother received iron folic tablets during pregnancy, number of tetanus injections received by the mother during pregnancy, dummies for the trimester of first antenatal care visit, and dummies for birth order and birth month. Figures in parentheses are standard errors. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

3.6.2 Does Differential Availability of Health Infrastructure Explain the Stronger Reinforcing Effects in High Mortality Villages?

One might be concerned that villages with high infant mortality also have inadequate health infrastructure. If this were true, the evidence of stronger reinforcing effects in high mortality villages might be the result of differential health infrastructure availability rather than the effect of background mortality *per se* (Oster, 2006). To address this concern, we examine whether the interaction

between *small* and *highmortality* is significantly different in villages that have at least a Primary Health Center (PHC) compared to villages that do not have a PHC. [17]

Table 3.6: Effect of Health Infrastructure Availability on Parental Investments

	Age appropriate polio coverage	Age appropriate non-polio coverage	Breastfed for 6 months
	(1)	(2)	(3)
Small-at-birth	-0.003	-0.007	0.013
	(0.018)	(0.017)	(0.014)
Small-at-birth * High IMR in village	-0.056**	-0.037*	-0.037*
	(0.024)	(0.022)	(0.020)
Small-at-birth * at least PHC in village	-0.017	-0.007	-0.014
	(0.038)	(0.039)	(0.032)
Small-at-birth * at least PHC * High IMR	-0.012	-0.03	-0.021
	(0.055)	(0.057)	(0.048)
Observations	15,679	15,269	8,571
Number of mothers	7,616	7,418	4,240

NOTES: Estimates are from mother fixed-effects models that include the following covariates: mother's age at birth, whether the mother received iron folic tablets during pregnancy, number of tetanus injections received by the mother during pregnancy, dummies for the trimester of first antenatal care visit, and dummies for birth order and birth month. Figures in parentheses are standard errors. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

Table 3.6 reports estimates from models that include a triple interaction term for *small*, *highmortality*, and an indicator for whether there is a PHC or bigger health facility in the village. Two main results stand out from this analysis. First, parents' response to differences in their children's birth size is not influenced by whether there is a PHC present in the village. And second, the triple interaction

[17] Using NFHS data, Datar et al (2007) found that presence of a PHC or bigger health facility in the village had a significant impact on immunizations, but smaller sizes facilities had no effect.

term is statistically insignificant for all investments suggesting that the stronger reinforcing effect found in high mortality villages is not explained by differences in health infrastructure availability.[18]

3.6.3 Controlling for the Presence of Other Small-at-Birth Siblings in the Household

As pointed out in Datar et al. (2006), other siblings' endowments could also impact the amount of investment parents make in child *i*. Presence of other less-endowed siblings in the household might increase or decrease the level of parental investment in a child because, first, the realization of a low endowment child might raise parental concern for all children and therefore increase the levels of all subsequent investments, and second, parents' *ability* to either reinforce or compensate for endowment differences would depend upon the endowments of other children in the household who compete for the same limited family resources. Since a child's endowment is likely to be correlated with that of his or her siblings, failure to control for siblings' endowment may lead to biased estimates of the effect of birth size on parental investments. In addition, it is likely that presence of other small-at-birth siblings is correlated with background mortality.

To check the robustness of our results, we re-estimate equation (7) with the inclusion of another dummy variable that captures whether the child has any siblings who were also small-at-birth and are currently alive (results reported in Table 3.7). This variable is measured during the first year of child *i*'s life, when majority of the immunization and breastfeeding investments are made. The value

[18] We obtained similar results by reestimating the regressions reported in tables 6 and 7 with a continuous measure of infant mortality at the village level (instead of the indicator for high mortality).

of this variable varies across siblings. We find that the presence of other small-at-birth siblings does not have any significant effect on parental investments in a child – as shown by the estimated coefficients on "any small-at-birth siblings present". Moreover, the effect of birth size on immunizations remains virtually unchanged – both in terms of magnitude and the direction of effects.

Table 3.7: Sensitivity of Birth Size Effects to Presence of Other Small-at-Birth Siblings in the Household

	Age appropriate polio coverage	Age appropriate non-polio coverage	Breastfed for 6 months
	(1)	(2)	(3)
Small-at-birth	-0.045***	-0.036***	-0.007
	(0.012)	(0.011)	(0.011)
Any small-at-birth siblings present	-0.024	-0.013	0.006
	(0.017)	(0.017)	(0.014)
Observations	15,679	15,269	8,571
Number of mothers	7,616	7,418	4,240

NOTES: Estimates are from mother fixed-effects models that include the following covariates: mother's age at birth, whether the mother received iron folic tablets during pregnancy, number of tetanus injections received by the mother during pregnancy, dummies for the trimester of first antenatal care visit, and dummies for birth order and birth month. Figures in parentheses are standard errors. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

3.6.4 Do Unobserved Economic Shocks Explain the Stronger Reinforcing Effects in High Mortality Villages?

Finally, as discussed in section 5, there may be concern that our results are partly driven by unobserved sibling level economic shocks correlated with birth size and parental investments that vary across high- and low-mortality villages. In other

words, the bias from sibling-specific heterogeneity may differ across high- and low-infant mortality villages. To address this concern, we performed 2 tests. First, we estimated models without child level covariates. The results from this test are reported in Table 3.8, and show that the estimates are similar to the estimates in Panel B of Table 3.4. Thus, we find that our results are virtually unchanged when we add child level covariates, including prenatal investments.

Table 3.8: Effect of Birth Size and Background Mortality on Parental Investments: Estimates from Models without Additional Covariates

	Age appropriate polio coverage	Age appropriate non-polio coverage	Breastfed for 6 months
	(1)	(3)	(5)
Small-at-birth	-0.022	-0.019	0.011
	[0.017]	[0.016]	[0.013]
Small-at-birth * High IMR in village	-0.061***	-0.045**	-0.039**
	[0.022]	[0.021]	[0.019]
Observations	15,679	15,269	8,571
Number of mothers	7,616	7,418	4,240

NOTES: Estimates are from mother fixed-effects models without additional control variables. * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

Second, we reestimated our models with births spaced within 2 years of each other. The assumption here is that family circumstances are likely to change slowly over time and therefore sibling-specific heterogeneity is likely to be minimal. The point estimates from this test are also similar to those from the full sample, although the standard errors are larger as we drop more than 75% of the observations due to the restriction of closer spaced births. Both these tests suggest that it is unlikely that our results are driven by unobserved economic shocks.

3.7 Conclusion

In this paper, we examined the relationship between a child's initial health endowment, measured by birth size, and parental investments that promote child health, when infants' survival is uncertain. Using data from rural Indian households, we estimated mother fixed-effects models to examine whether there were any systematic differences in health investments such as immunizations and breastfeeding across children who were relatively larger-at-birth compared to their small-at-birth siblings. We found that parents in villages with a high infant mortality rate adopted a reinforcing strategy of investments in child health whereby larger-at-birth children were significantly more likely to be immunized and breastfed compared to their small-at-birth siblings. For example, in villages with high infant mortality, small-at-birth children in a family were 4-6 percentage points less likely to receive these health investments compared to their large-at-birth siblings. In percentage terms, these amount to a 17 percent, 16 percent, and 6 percent reduction in the probabilities of polio vaccination, non-polio vaccination, and breastfeeding respectively. In contrast, we found no significant differences in breastfeeding and immunization rates between small at birth and large at birth siblings in low infant mortality villages.

These results show that children's endowment differences as well as background mortality risk can have sizeable impacts on intra-household resource allocations in a developing country. They also show that reductions in mortality can not only improve overall population health but also reduce health disparities. Reductions in mortality affect less endowed and weaker children more than healthy children. Thus, they create unique incentives for parents to invest in weaker children, consequently reducing health disparities.

The results also highlight that public health investments do not crowd out private investments in child health. In fact, they are complements. For example,

public health interventions that improve birth weight are likely to encourage parental investments such as immunizations and breast feeding. Dow et al. (1999) make a similar argument in their study that showed that women were more likely to increase inputs into birth weight when the United Nation's Expanded Programme of Immunization (EPI) was implemented. By decreasing the probability of child mortality from any of the 6 vaccine preventable diseases, the EPI increased mothers' incentives for improving birth outcomes.

Chapter 4

The Effect of Land Reforms on Long Term Health and Well-being in India

4.1 Introduction

Many agrarian economies are simultaneously characterized by an unequal distribution of land and a high level of destitution. Indeed, access to land can be a crucial determinant of poverty in such economies. Hence, redistributive policies in several countries have taken the form of land reforms to ensure a more equitable distribution of landholdings across rural households.[19] Over the past three decades, World Bank policies on rural land issues have also emphasized the role of land reforms to achieve a more egalitarian distribution of assets and ensure the survival of owner operated family farms that have been found to be more efficient and productive (Deininger and Binswanger, 1999; Mearns, 1999). Prior research suggests that land reforms can reduce poverty, raise agricultural productivity, and promote economic growth (Dorner and Thiesenhusen, 1990;

[19] For instance, the fast growing East Asian economies of China, Taiwan, Japan and Korea implemented successful land reforms after World War II; the Landless Workers' Movement (MST) has led a vibrant land reforms movement in Brazil since the 1980s, while reforms in other Latin American countries such as Mexico and Peru have had somewhat limited success (Moene, 1992; Boyce, Rosset, and Stanton, 2005).

Moene, 1992; Besley and Burgess, 2000; Banerjee, Gertler and Ghatak, 2002; Boyce, Rosset, and Stanton, 2005).

There is however no evidence on the effect of land reforms on long term measures of well-being such as health and nutrition. This research aims to fill this void by looking at the effect of land reforms on human capital formation in childhood and adolescence, as captured by height and schooling. Land reforms can lead to greater human capital investments in childhood by ensuring a more egalitarian distribution of rural assets, a stable source of income from land, as well as greater food security and improved future prospects for rural households. Childhood health and nutritional status are important determinants of adult health and socioeconomic outcomes (Case, Fertig and Paxson, 2005; Alderman, Hoddinott and Kinsey, 2006; Chen and Zhou, 2007). Also, both height and schooling are correlated with earnings in adulthood (Fogel, 1992 & 1994; Ashenfelter and Krueger, 1994; Steckel, 1995; Strauss and Thomas, 1995 & 1998; Card, 1999; Duflo 2001). Hence, greater human capital accumulation brought about by land reforms can be a potential mechanism for breaking the chain of intergenerational transmission of poverty and ensuring upward socio-economic mobility across generations. Moreover, from a purely human development perspective, health and education are crucial endowments that determine both the capabilities of an individual as well as her quality of life.

This paper focuses on land reforms implemented in the Indian states. From the 1950s onwards, India pursued one of the largest programs of land reforms ever implemented in any country (Thorner, 1976). However, most of these reforms suffered due to flawed design and political failure in implementation, and the evidence on their effectiveness is mixed. (e.g., see Thorner, 1962 and 1976; Appu, 1996; Behuria, 1997; Mearns, 1999). While an empirical evaluation of land reforms using panel data on the Indian states finds these reforms to have reduced poverty (Besley and Burgess, 2000), a review of longitudinal village level studies

suggests that these reforms had a mixed impact on poverty and inequality with the effects varying across different areas (Jayaraman and Lanjouw, 1999).

Also, there is scant evidence on the effect of these reforms on long term well-being. Using across-state and across-cohort variation in the timing of land reforms, I therefore estimate the effect of these reforms on the height and schooling of women who were likely to benefit from their households' improved access to land during childhood and adolescence. While the lack of comparable data prevents an estimation of these effects for men, identifying the causal impact of reforms on women does provide estimates of long run benefits for a particularly vulnerable group, given widespread gender discrimination in intrahousehold resource allocation in India. Also, by examining the impact of land reforms on health and well-being, this research directly contributes to the literature on interlinkages between health, nutrition, and economic development (see Behrman and Deolalikar, 1988; Strauss and Thomas, 1995 & 1998 for extensive reviews).

The findings in this paper suggest that land reforms led to important improvements in health and education for cohorts experiencing such reforms before age 18. Land ceiling legislations increased the height of women by 3 centimeters. This effect is similar to the negative impact of the Great Famine in China (1959–61) on the height of its survivors (Chen and Zhou, 2007). Abolition of intermediaries led to a gain of nearly one full year in schooling. I also find some evidence for intergenerational health benefits from land reforms. Specifically, abolition of intermediaries improved the height-for-age performance of children whose mothers benefited from such reforms. Overall, the results suggest that land reforms can not only reduce poverty in the short run, but also promote greater human capital formation thereby improving health, education, and general well-being in the long run.

The following section provides a brief background on land reforms implemented in India since her independence in 1947. Specific reform measures are discussed along with the major shortcomings in their design and implementation. Section 4.3 presents empirical evidence on the effect of land reforms on women's health & schooling. Section 4.3.1 is devoted to a discussion of conceptual issues, especially on determinants of height and the challenges involved in identifying the impact of reforms on long term health. The data and methods are described in section 4.3.2, and section 4.3.3 presents the results. Section 4.4 examines the effect of age-specific exposure to land reforms on both height and schooling. Section 4.5 investigates whether land reforms had any intergenerational effects, and section 4.6 concludes.

4.2 Land reforms in India

With the bulk of India's population dependent on agriculture for their livelihoods, land reforms were accorded high priority under the system of planned development adopted in independent India. Even before independence, and as early as in 1936, the Indian National Congress – the political party leading India's freedom movement – adopted the following resolution acknowledging the plight of the farmers and endorsing the need for State action to lift them out of poverty:

> "This Congress is of opinion that the most important and urgent problem of the country is the appalling poverty, and unemployment and indebtedness of the peasantry fundamentally due to antiquated and repressive land tenure and revenue systems and intensified in recent years by the great slump in the prices of agricultural produce. The final solution of this problem inevitably involves the removal of British imperialistic exploitation, a thorough change of the land

tenure and revenue systems and a recognition by the state of its duty to provide work for the rural unemployed masses."

INC Resolution, Lucknow, 1936.[20]

It is instructive to note that in spite of recognizing the hardships of the exploited peasantry, and the importance of changing production relations in agriculture, land reforms did constitute some kind of a political dilemma for the ruling elite. This was due to the following reasons. First, the Indian National Congress, which led the freedom struggle, and was in power both at the center and states after independence, was politically dependent on a solid rural base of medium and small land owners who were opposed to land reforms. Second, barring the top leadership of the Congress, most of the leaders owned land that they did not cultivate themselves. Therefore, the political reliance of the Congress on the upper layers of the agrarian society was too high for the party to pursue land reforms in an active and efficient fashion (Appu, 1996; Mearns, 1999). Kohli (1987) sums it up thus: "…The Congress party penetrated the Indian countryside, but not without being captured by the rural elite. … Therefore, irrespective of the numerous legislations and policy statements, the landed classes were able to manipulate the workings of political power to their own advantage, making a sham of the Indian land reforms." Notably, the relatively successful land reforms in the states of Kerala and West Bengal were initiated by Left Front governments and involved both political mobilization in the countryside and a firm commitment to reforms (e.g., see Bandyopadhyay, 2003; Krishnaji, 2007).[21]

[20] Reproduced from Zaidi (1985).

[21] However, implementation of reforms at the local level might be more influenced by local factors, rather than political ideology alone. For instance, Bardhan and Mookherjee (2005) found that land reform implementation at the village level in West Bengal cannot be explained by differences in political ideologies between the Congress and the Left parties alone, and that reform efforts of local governments increased with an increase in

Nevertheless, starting from the early 1950s, a considerable number of land reform legislations were enacted by most Indian states under the leadership of the Congress party. These reforms can be grouped into the following four categories – tenancy reforms, which aimed to regulate tenancy contracts and/or transfer ownership to tenants; abolition of intermediaries that sought to abolish the hierarchy of proprietary interests that existed between the State and the actual cultivator; ceilings on landholdings that allowed for surplus land to be redistributed to landless households; and land consolidation reforms that sought to consolidate disparate or fragmented land holdings. However, this large volume of reforms suffered from significant loopholes in design and also political failure in their implementation, which led to limited success in terms of achieving their stated goals (Thorner, 1962 and 1976; Bandyopadhyay, 1986; Radhakrishnan, 1990; Chattopadhyay, 1994; Appu, 1996; Behuria, 1997; Mearns, 1999). Also, as mentioned before, there is mixed evidence on the effectiveness of reforms in reducing poverty (Jayaraman and Lanjouw, 1999; Besley and Burgess, 2000).

Among specific drawbacks or failures of these reforms, the following deserve special mention. While most states enacted a number of tenancy reforms, these achieved limited success, except in states such as Kerala and West Bengal. This was mainly due to mass eviction of tenants on the eve of legislations, concealed tenancy, and rotation of tenants among landlords' plots to prevent them from acquiring occupancy rights (Appu, 1996; Mearns, 1999). On the other hand, abolition of intermediaries was the first land reform measure implemented after independence, and it enjoyed greater political support than most other reforms since the intermediaries (especially, the *zamindars*) were seen as a parasitic group

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electoral competition. In an earlier paper, Bardhan and Mookherjee (2004) report that land reforms and other anti-poverty programs were more likely to be undertaken at the village level when land was distributed more equally, the poor were literate, and local elections were more contested. According to the authors, this suggested that political accountability to the poor declined when the poor became more vulnerable.

that exploited the peasantry and had enjoyed the patronage of their former colonial masters (Appu, 1996; Mearns, 1999). However, the law usually allowed the intermediaries to retain or resume land that was under "personal cultivation". This provision, combined with the absence of reliable land records and the nexus between intermediaries and village level record keepers (*patwaris*) allowed the ex-proprietors to retain possession of considerable amounts of land and also led to large scale evacuation of former tenants from such land – both through legal and illegal means (Appu, 1996; Behuria, 1997, Mearns, 1999). For instance, Thorner and Thorner (1962) report that in 1955, five years after the implementation of the Zamindari Abolition Act in Uttar Pradesh, 10 percent of the families still owned 50 percent of the land.

Land ceiling legislations involving actual redistribution of ceiling-surplus land suffered from a number of flaws including high levels of ceiling, granting of several exemptions, and inefficient implementation. Further, the loopholes in these laws and the delays in their implementation allowed landowners to resort to widespread fictitious transfers and partitions of land among family members and friends that effectively reduced their reported landholdings below the set ceiling (Chattopadhyay, 1994; Appu, 1996; Behuria, 1997; Mearns, 1999). Also the implementation of both tenancy and land ceiling reforms lagged behind plan targets as set down in the various 5 Year Plans of the central government (Bandyopadhyay, 1986; Radhakrishnan, 1990). Finally, land consolidation measures were enacted in only a few states, and had limited success due to the non-availability of proper land records (Radhakrishnan, 1990; Appu, 1996; Behuria, 1997). Also, these reforms were not meant to affect the actual distribution of land, but promote consolidation of fragmented holdings, and as such were more beneficial for richer farmers with larger holdings (Mearns, 1999; Dreze, Lanjouw and Sharma, 1998).

In spite of their widespread failures, some of these reforms did provide a certain degree of relief and security of livelihood to the poor and the landless in rural India. For example, as a direct consequence of the abolition of intermediaries, around 25 million tenants were brought into direct relationship with the State, and the same reforms also provided relief from the illegal exactions, forced labor, and other forms of oppression widely practiced by the Zamindars in British India (Appu, 1996). Also, in spite of their many limitations, the threat of ceilings did prevent further expansion of large landholdings, and also brought some relief to the poor through the redistribution of small plots of homestead land (Mearns, 1999).

Both Kerala and West Bengal achieved far greater success with tenancy reforms than any other state – mainly due to political mobilization on a massive scale, and the commitment of the respective state governments (under Left Font rule) to land reforms. For example, in Kerala, nearly 300,000 tenants were granted ownership rights since the beginning of the land reforms process in the 1960s. In the case of West Bengal, successful tenancy reforms were implemented from 1977 onwards in the form of "Operation Barga" that led to formal registration of tenants and the recognition of their legal entitlement to higher crop shares (Appu, 1996). Further, the success of tenancy reforms in West Bengal led to a rapid growth in agricultural productivity since the early 1980s (Banerjee, Gertler and Ghatak, 2002; Bandyopadhyay, 2003). Finally, even with respect to land consolidation reforms, Oldenburg (1990) finds that land consolidation programs in the state of Uttar Pradesh reduced the economic dependency and exploitation of small and marginal farmers, and also enhanced their economic viability. Table

4.1a summarizes the main objectives behind each reform, and what these reforms eventually accomplished, based on the literature discussed above.[22]

Table 4.1a: Specific reform measures: objectives and achievements

Reform measure	Objectives	Achievements
Tenancy reform	Regulate and stipulate tenancy contracts Transfer ownership to tenants	Recognition of legal entitlements of tenants and formal registration in some areas Limited success in granting ownership rights to tenants in some states
Abolition of intermediaries	Abolish proprietary interests (*Zamindars, Jagirdars, etc*) between the State and actual cultivators	Millions of tenants brought into direct relationship with the State Relief from illegal exactions, forced labor, and other forms of oppression
Land ceiling	Stipulation of maximum household landholding Redistribution of ceiling-surplus land to landless and smaller cultivators	Limited redistribution of surplus land, and relief to the poor through redistribution of small plots of homestead land Prevented further expansion of large landholdings and land concentration
Land consolidation	Consolidation of disparate and fragmented landholdings	Reduced economic dependency and exploitation of smallholders in some states

Source: Thorner, 1962 and 1976; Bandyopadhyay, 1986; Radhakrishnan, 1990; Chattopadhyay, 1994; Appu, 1996; Behuria, 1997; Mearns, 1999.

[22] A summary table of reform measures enacted by the major Indian states is provided in Besley and Burgess (2000).

4.3 Effect of land reforms on health & schooling

4.3.1 Conceptual issues

Did land reforms improve long term well-being in spite of all the limitations discussed above? It is useful to note at this juncture that there are several plausible mechanisms through which land reforms can improve health and nutrition. First, by providing land ownership or better shares in agricultural produce these reforms can ensure both higher incomes and greater food security for rural households. Second, redistribution of land and changes in production relations – such as greater tenurial security and freedom from oppression – can lead to an upward pressure on agricultural wages that enables landless agricultural households to avoid chronic poverty. Besley and Burgess (2000) do find that land reforms resulted in an increase in agricultural wages.

Third, an increase in income brought about by land reforms could increase households' demand for health and other human capital investments. Finally, land reforms can improve long term food security through an increase in agricultural productivity that leads to greater per capita food availability. However, an increase in food availability will not automatically lead to improved nutrition in a typical rural household, unless the household has the means to acquire food.[23] Hence, the redistributive aspect of land reforms, including any general equilibrium effect – on wages for instance – are likely to be more relevant in the

[23] A separate literature on farm size and productivity shows that small farms are more productive than large farms (e.g., see Bardhan, 1973; Binswanger, Deininger and Feder, 1995). However, the evidence on the effect of land reforms on productivity is mixed. Besley and Burgess (2000) find a negative effect of tenancy reforms on agricultural output, while as reported above, Banerjee, Gertler, and Ghatak (2002) find that successful tenancy reforms in West Bengal were followed by an increase in agricultural productivity.

context of overcoming hunger and malnutrition, and achieving better long-term health.

As mentioned before, the measure of long term health and well-being used in this paper is height. Adult height is a useful indicator of the standard of living, since it is correlated with education and earnings (Fogel, 1992 & 1994; Steckel, 1995; Strauss and Thomas, 1995 & 1998). Further, height is determined by adulthood, partially through genetic influence but also by nutrition and health investments earlier in life; and growth deficits in childhood are largely responsible for short stature in adulthood (Martorell and Habicht, 1986). Hence, if land reforms allowed rural households to undertake greater nutrition and health investments in their children, one can expect to see a positive effect of reforms on long term health and nutrition. Such a hypothesis is also supported by recent findings on the long term effects of childhood health and economic circumstances on adult health and socioeconomic status (Case, Fertig and Paxson, 2005; Alderman, Hoddinott and Kinsey, 2006; Chen and Zhou, 2007). Therefore, assuming that adult height is fully determined by age 18, I estimate the effect of being exposed to land reforms at any time during the first 18 years of life on a woman's height.

The increase in income brought about by land reforms could increase households' demand for other human capital investments, such as schooling. Similarly, greater security of livelihood and freedom from oppression can improve future prospects and thus make it more worthwhile to invest in children's education. Further, the abolition of *Zamindari* and the end of associated exploitative practices including forced labor could make it easier for households to send their children to school. Finally, given the robust association between improved health and better schooling outcomes, land reforms could indirectly raise school attendance and performance by improving children's health and

nutritional status.[24] On the other hand, increased land-ownership that creates greater needs for family labor could negatively affect children's schooling. It is therefore interesting to investigate whether land reforms actually led to increased schooling for cohorts exposed to these reforms in their childhood and adolescence.

The focus on women's human capital formation is largely dictated by the lack of comparable data on men. Given that gender discrimination in intrahousehold resource allocation – including allocations of food and medical care – is well documented in the context of India, this does allow for an estimation of the effect of land reforms for a more vulnerable group (Miller, 1981; Rosenzweig and Schultz, 1982; Das Gupta, 1987; Basu, 1989; Behrman, 1988; Behrman and Deolalikar, 1990; Pande, 2003; Borooah, 2004; Oster, 2006; Tarozzi and Mahajan, 2007). Note that the effect of land reforms on women's health and nutrition could either be smaller or larger than that for men, depending on which of the following two mechanisms dominate. On the one hand, it is reasonable to expect that sons rather than daughters were more likely to benefit from a family's greater command over food and other resources. Therefore, any effect of reforms on the long term health of women is likely to be a lower bound on the actual health benefit from these reforms. On the other hand, if girls suffered from really low levels of nutrition prior to land reforms, even a small increase in food intake and medical care could lead to large gains in health, given possible non-linearities in the relationship between food and medical care on the one hand and health and nutrition on the other.

[24] On better health and nutrition leading to improved schooling outcomes, see Miguel and Kremer (2004), Walker et al. (2005), Bobonis, Miguel and Puri-Sharma (2006), Alderman, Hoddinott and Kinsey (2006).

4.3.2 Data and methods

Information on land reform legislations in India's 16 major states was obtained from the detailed list provided by Besley and Burgess (2000), and cross-validated with respect to other sources such as Appu (1996), Behuria (1997), and Mearns (1999). Table 4.1b shows the years in which various reform laws were passed by

Table 4.1b: The Years of Specific Land reforms in India's 16 major states

State	Tenancy reform	Abolition of intermediaries	Land ceiling legislation	Land consolidation reform
Andhra Pradesh	1950, 54, 56, 74	1952, 54, 56, 57		
Assam	1971	1951, 54	1956, 76	1960
Bihar	1957, 61, 73, 86	1950	1961, 73, 76, 82	
Gujarat	1948, 55, 60, 73	1969	1960	
Haryana	1953, 55			
Jammu & Kashmir	1976			1962
Karnataka	1961, 74	1954, 55	1961, 74	
Kerala	1963, 69, 74, 79	1960, 69, 79	1969, 79	
Madhya Pradesh	1959	1950, 51, 52	1960	1959
Maharashtra	1950, 58		1961	
Orissa	1960, 73, 76	1951, 72	1960, 73, 76	1972
Punjab	1953, 55, 72			
Rajasthan	1955	1952, 53, 55, 59		1954
Tamil Nadu	1952, 55, 56, 61 65, 69, 71, 76	1948	1961	
Uttar Pradesh	1950, 52, 54, 56, 58, 77	1950, 52, 54, 56, 58, 77`	1960	1953
West Bengal	1950, 53, 55,70, 71, 72, 75, 77	1953	1953, 81, 86, 90	1955, 70, 71, 77

Source: Besley and Burgess (2000); also, Behuria (1997) and Mearns (1999).

the 16 states in this analysis. For health and schooling, I use data from wave 2 of the National Family Health Survey (NFHS-2) implemented during 1998-99 in India. NFHS-2 surveyed a nationally representative sample of more than 90,000 women between the ages of 15 and 49.[25] For each woman, I have information on her height, year of birth, age, region or state of residence, and place of residence (rural / urban).[26] I restrict the data to birth cohorts up to 1980 to ensure all women in the final sample are at least 18 years old. The individual level data was merged with the state level dataset on land reforms.

The final dataset used in this analysis has information on about 73,000 women – of whom nearly 51,000 are in rural India – across 16 states and 32 birth cohorts (1949 to 1980). However, the size of the estimation sample falls to 67,600 women (47,000 for the rural sample) due to missing information on height for more than 5000 women. As shown in table 4.2 (Panel A), on average women in the rural sample of NFHS were about 151.5 centimeters tall, and had less than 3 years of schooling.[27]

4.3.2.1 Basic econometric strategy: DoD estimation

Land being a "state subject" in India, there is considerable variation across states and birth cohorts in the implementation of various land reforms (Table 4.2). I utilize this variation to estimate the effect of a woman's exposure to land reforms

[25] Detailed information on the NFHS is available at: http://www.nfhsindia.org/

[26] Data on women's height was not collected in NFHS-1 (1992-93). Also, NFHS did not collect data on men's anthropometric measures in either wave 1 or wave 2.

[27] The mean height and education in the urban sample were 151.9 cm and 6.5 years respectively.

Table 4.2: Women's height and exposure to land reforms: summary statistics

Panel A: All rural women					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Height (in cm)	47009	151.51	5.87	82	199.8
Years of schooling	50898	2.41	3.76	0	22
Any tenancy reform before age 18	50914	0.98	0.14	0	1
Any abolition of intermediaries reform before age 18	50914	0.84	0.36	0	1
Any land ceiling reform before age 18	50914	0.73	0.45	0	1
Any land consolidation reform before age 18	50914	0.52	0.50	0	1
Years of exposure to tenancy reform before age 18	50914	16.07	4.20	0	18
Years of exposure to abolition of intermediaries reform before age 18	50914	14.55	6.65	0	18
Years of exposure to land ceiling reform before age 18	50914	11.25	7.80	0	18
Years of exposure to land consolidation reform before age 18	50914	8.32	8.50	0	18
Panel B: Non-migrant rural women					
Height (in cm)	43724	151.52	5.87	82	199.8
Years of schooling	47360	2.20	3.58	0	22
Any tenancy reform before age 18	47375	0.98	0.14	0	1
Any abolition of intermediaries reform before age 18	47375	0.84	0.36	0	1
Any land ceiling reform before age 18	47375	0.73	0.45	0	1
Any land consolidation reform before age 18	47375	0.52	0.50	0	1

(continued)

Years of exposure to tenancy reform before age 18	47375	16.04	4.22	0	18
Years of exposure to abolition of intermediaries reform before age 18	47375	14.57	6.63	0	18
Years of exposure to land ceiling reform before age 18	47375	11.21	7.81	0	18
Years of exposure to land consolidation reform before age 18	47375	8.39	8.50	0	18

NOTES: Data on the timing of land reforms in each state was merged with individual level data from NFHS-2 to define exposure to specific reforms. Information on height is from the NFHS.

on her height as well as schooling, in a difference-of-difference (DoD) framework. The methodological approach is similar to that of Chen and Zhou (2007) who exploit variation in famine mortality across regions and birth cohorts to estimate the the impact of China's 1959–61 famine on the health of its survivors.[28] Specifically, I estimate the following model –

$$H_{ics} = \tau_c + \mu_s + \sum_{j=1}^{4} \alpha^j . REF_{ics}^j + \pi_1 . X_{ics} + \varepsilon_{ics} \qquad \ldots\ldots \quad (4.1)$$

where *i*, *c*, and *s* are subscripts for individual, cohort, and state respectively; *H* is a specific human capital outcome (height or schooling), τ_c and μ_s denote cohort and state fixed effects; *X* is a vector of individual level controls that include dummies for caste and religion; REF^j is a dummy variable that is equal to one if woman *i* of birth cohort *c*, in state *s* was exposed to reform *j* before age 18, where $j = 1, \ldots 4$, for the four types of reforms; and ε_{ics} is an idiosyncratic error term.

[28] A similar strategy has also been used to evaluate the impact of public programs. For instance, Duflo (2001) utilizes variation across regions and cohorts to estimate the effect of Indonesia's school construction program on education.

Following the approach of Besley and Burgess (2000), land reforms are lagged by four years – to allow for sufficient time in their implementation.[29] Hence, REF^j is equal to one for woman *i* if a reform of type *j* becomes effective before her birth, or before her 18th birthday in her state of residence, and is zero otherwise.[30] Summary statistics for these dichotomous, exposure-to-reform variables are reported in Table 4.2 (Panel A) for the rural sample in NFHS, and we find that almost all women (98 percent) experienced tenancy reform by age 18. The percentages of women with exposure to the other types of reforms are between 50 and 84 percent.

The estimates of α^j in Equation 4.1 therefore provide us with the effect of being exposed to a particular type of reform before age 18 on a woman's height (or schooling). In other words, the α^js are estimates of the overall *treatment effect* of land reforms. Equation 4.1 is estimated on the rural sample, since women in rural areas were actually exposed to these reforms, and standard errors are clustered at the state level.[31]

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[29] I also tried lags of 2 and 3 years that gave similar results. Given the inherent bureaucratic and other delays involved in implementing new laws in India, a lag of four years seems reasonable – especially for land reforms that mostly went against the interests of the ruling classes, and therefore, were likely to face a greater lack of political will in their implementation. This is indeed corroborated by past research as discussed above (e.g., see Thorner, 1976).

[30] Given that multiple reforms of type *j* were often enacted in some states, effectively, it is the date of the first reform of type *j* enacted in a particular state along with a woman's year of birth that determine whether a woman experiences a reform of that type or not. This seems to be a reasonable formulation since once a particular type of reform is implemented, it stays in place, and additional reforms of the same type usually involved adjustments in the original provisions to maintain the effectiveness of a particular type of reform.

[31] There could be concerns about a small number of clusters (16 states) with relatively large group sizes, e.g., see Wooldridge (2006). Hence, I re-estimated all regressions with standard errors clustered at the state-cohort level, which resulted in a larger number of groups or clusters (16 x 32 = 512) with relatively small group sizes for all regressions.

4.3.2.2 DoDoD estimation

While the DoD analysis described above accounts for state and cohort level heterogeneity, it does not account for state level attributes that vary across cohorts, and are correlated with land reforms as well as nutritional status. For example, there could be concerns that apart from land reforms, states also implemented other policies, such as improving public health facilities or building more schools in rural areas that were correlated with land reform implementation and also affected health and schooling. To eliminate any bias arising from the omission of such variables, I extend the DoD analysis to include the urban sample – not likely to be affected by land reforms – and re-estimate equation 4.1 in a difference-of-difference-of-difference (DoDoD) framework. This approach allows me to control for all time varying, state level factors that could be correlated with both land reforms and height. This is shown in Equation 4.2 below –

$$H_{igcs} = \tau_c + \mu_s + G + G*\tau_c + G*\mu_s + \mu_s*\tau_c + \sum_{j=1}^{4} \delta^j . REF^j_{igcs} + \pi_2 . X_{igcs} + \phi_{igcs} \quad \text{..... (4.2)}$$

where *i*, *c*, and *s* are subscripts for individual, cohort, and state respectively, as before, and *g* is a subscript for group (rural or urban); *G* is a group dummy that is equal to one for rural residents and it controls for any fixed rural – urban difference in height.

Note that Equation 4.2 also includes interactions of the state and cohort fixed effects with rural versus urban place of residence ($G*\tau_c, G*\mu_s$), apart from the state-cohort interactions ($\mu_s*\tau_c$) that account for time varying, state level attributes. These additional interactions fully control for any differences between

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The results, however, were very similar to those reported in the paper. Hence, these results are not separately reported, but are available on request.

rural and urban women – that either vary across birth cohorts or across states. The coefficients of interest are the δ^j s that provide us with the differential effect of exposure to particular reforms on the height of a woman in rural India versus one in urban India. Note that $REF^j_{igcs} = 0$ for all women in the urban sample of NFHS, since only rural women benefited from these reforms. The inclusion of this additional group of women in our estimation framework who are currently in urban areas and were unlikely to be affected by land reforms allows us to control for changes in socioeconomic conditions that were correlated with land reforms, and could also have been correlated with changes in height. Hence, this approach allows for a cleaner identification of the effects of reforms on women's health and schooling in rural India. Equation 4.2 can therefore be estimated on the joint rural and urban samples, with standard errors once again clustered at the state level.[32]

One concern with the above approach is with regard to the validity of the urban sample as a control group. Note that the group or rural/urban dummy (G) controls for any fixed difference in height between rural and urban women; also, the additional interaction terms included in Equation 4.2 ($G*\tau_c, G*\mu_s$) allow this rural – urban difference to vary across states and birth cohorts. Additionally, it would be interesting to check whether pre-reform trends in height were similar across the rural and urban samples. However, most Indian states started implementing land reforms from the early 1950s onwards, and the oldest cohort in NFHS was born in 1949, making such a comparison almost impossible. However, two states in this analysis – Jammu & Kashmir and Kerala started implementing land reforms only from the early 1960s. Hence, I am able to compare pre-reform

[32] I also examined whether the effects of land reforms varied by caste membership by including interactions between the reform dummies and caste dummies in specification 1.2 discussed above. I did not find any evidence for significant differences in the effects of reforms by caste.

trends in height (also schooling) across rural and urban women for these two states.

I use the following methodology for this comparison. I regress height (also schooling) on birth year and an interaction between the rural dummy (*G*) and birth year, controlling for caste, religion, and state fixed effects – for women born between 1949 and 1962 for the two states of Kerala and Jammu & Kashmir. The results as reported in Table 4.3 clearly show that birth year has a positive and significant effect on both outcomes, i.e., both height and schooling increase across successive birth cohorts. However, this trend in height or schooling does not significantly vary across rural and urban women in these two states.

Table 4.3: Pre-reform trends in height and schooling for rural versus urban women in states starting land reforms later in the 1960s

	Height	Schooling
	(1)	(2)
Year of birth	0.158***	0.135***
	[0.059]	[0.045]
Rural	-0.039	2.343
	[4.038]	[2.858]
Rural * Year of birth	-0.002	-0.083
	[0.072]	[0.051]
Constant	144.368***	-1.345
	[3.302]	[2.566]
Observations	2038	2124
Number of states	2	2

NOTES: Both regressions were estimated on the combined rural and urban samples for two states that started land reforms later (early 1960s) – Jammu & Kashmir and Kerala. Regressions include controls for caste (dummies for Scheduled Caste, Scheduled Tribe, Other Backward Caste), religion (dummies for Muslim, Christian, Sikh), and a state dummy for Kerala. Robust standard errors in brackets. * Significant at 10%; ** significant at 5%; *** significant at 1%.

While this comparison could be carried out for only two states in the sample, these states are not only widely separated in terms of geographical location, but are also quite different in their broad socio-economic and cultural attributes. Hence, these results suggest that there was unlikely to be any significant difference in pre-reform trends for either height or schooling between rural and urban women in any of the other states.

4.3.2.3 Addressing rural to urban migration

So far, we did not address the problem of migration across sectors that can contaminate the *treatment* (rural) and *control* (urban) sub-samples. The NFHS provides information on each woman's childhood place of residence, which together with information on their current residence can be used to distinguish migrants from non-migrants. Among the 73,000 women in our sample, 51,000 are currently in rural India, while the remaining 22,000 are in urban areas. Among current rural residents, more than 93% also spent their childhood in a rural area, which suggests that urban to rural migration is unlikely to be a problem in this analysis. However, among current urban residents, around 56% spent their childhood in urban areas, while the remaining 44% were previously in a rural area. Hence, the urban sample that served as our control group in the analysis above is likely to be contaminated by women who experienced some land reforms during their childhood.

Note that the bias due to any contamination of the rural or urban sample might not be a serious problem depending on the exposure to reforms of the migrants. For example, if women who migrated from rural to urban areas did not experience a particular type of reform, then there is unlikely to be any bias in the estimated effect of that reform. On the other hand, if the same group of migrants were

exposed to a particular reform for a considerable period in their childhood, then that would lead to an underestimation of the effect of that reform on women's height in rural India. Unfortunately, the exact age at which these women migrated from rural to urban areas is not known, and hence that information cannot be used to refine the treatment and control groups.

However, the analysis above can be repeated on uncontaminated sub-samples of rural and urban women, by focusing only on women whose current residence is same as their childhood place of residence, i.e., women who have always been rural residents and women who have always been urban residents. While this reduces the sample size to less than 60,000 non-migrant women (around 47,000 in rural areas), it allows us to draw clearer conclusions about the effect of land reforms on women's nutritional status. Panel B of Table 4.3 reports the summary statistics for the restricted rural sample of non-migrant women, and as can be seen, the distributions of height, education, and exposure to land reforms before age 18 in this smaller sample are very similar to that in the full sample (panel A). Hence, the DoD analysis described above is replicated on an uncontaminated sub-sample of non-migrant rural women, while the DoDoD analysis is restricted to an uncontaminated sample of non-migrant rural and urban women.[33]

4.3.3 Results

Table 4.4 presents the DoD results for the effect of being exposed to land reforms in childhood or adolescence on a woman's height as well as on schooling. The

[33] There could also be concerns about across state migration. I am unable to account for such migration in this analysis, but it is reasonable to assume that across state migration is likely to be less of a problem compared to migration across sectors within the same state. Further, across state migration – to the extent it occurs – for the control group of urban women does not directly affect this analysis, since urban women in all states are assumed to have had zero exposure to these reforms in their childhood or adolescence.

DoD estimates of α^j for height are in column (1), and these suggest that exposure to land reforms before age 18 did lead to a significant increase in adult height for women in rural India. Specifically, we find that land ceiling legislations had the largest effect – increasing height by as much as 2 centimeters, while abolition of intermediaries and land consolidation reforms also led to significant but smaller increases in height of about 0.6 – 0.7 centimeters.[34] Column (2) of Table 4.4 reports the DoD estimates of the overall effect of reforms on height for the sample of non-migrant rural women. As can be seen, the estimates in column (2) for non-migrant rural women are very similar to those in column (1) for all rural women, suggesting that intersectoral migration did not pose a significant problem for an analysis involving rural residents alone.

Columns (3) and (4) of Table 4.4 present the results for the effect of being exposed to land reforms in childhood or adolescence on schooling for the sub-samples of all rural women and non-migrant rural women respectively. The estimates in column (3) for all rural women suggest that exposure to abolition of intermediaries and land ceiling reforms increased schooling by about 0.5 years and 1 year respectively. In column (4), the estimation sample is restricted to non-migrant women, and as for height, these estimates are once again similar to those obtained from the unrestricted sample in column (3). Overall, the results so far suggest that both land ceiling reforms and abolition of intermediaries had significant, positive effects on women's height and schooling in rural India.

Note that the estimates in Table 4.4 do not account for changes in socioeconomic conditions within a state over time, and also other time varying, state-level attributes that could affect height or nutritional status. Hence, we now

[34] None of the coefficients for tenancy reforms were significant, and hence, those are not reported. Note that this is most likely due to the lack of sufficient variation in exposure to tenancy reforms, with around 98% of the rural women being exposed to these reforms. Hence, the evidence on tenancy reforms cannot be taken as being conclusive in this regard.

Table 4.4: DoD estimates of the effect of land reforms on women's height and schooling

	Height		Education	
	All rural women	Non-migrant rural women	All rural women	Non-migrant rural women
	(1)	(2)	(3)	(4)
Any abolition of intermediaries reform before age 18	0.640***	0.648***	0.496***	0.523***
	[0.125]	[0.129]	[0.138]	[0.139]
Any land ceiling reform before age 18	2.103***	2.102***	1.135***	1.246***
	[0.129]	[0.134]	[0.124]	[0.125]
Any land consolidation reform before age 18	0.692***	0.679***	-0.141	-0.176
	[0.102]	[0.106]	[0.121]	[0.122]
Constant	149.276***	149.316***	1.450***	1.074***
	[0.376]	[0.396]	[0.242]	[0.216]
Observations	47009	43724	50898	47360
Number of states	16	16	16	16
State fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes

NOTES: The dependent variables are height in centimeters and years of schooling. All regressions additionally control for caste (dummies for Scheduled Caste, Scheduled Tribe, and Other Backward Caste), and religion (dummies for Muslim, Christian, and Sikh, versus Hindu). Estimates for tenancy reforms are omitted due to the lack of variation in exposure to tenancy reforms. Robust standard errors in brackets.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

turn to the estimates of δ^j from Equation 4.2 that should be able to account for such changes by including both the rural and urban samples in the estimation framework.[35] As mentioned before, we restrict the DoDoD analysis to non-

[35] I also obtained separate DoD estimates for the effect of land reforms on urban women by re-estimating equation 1.1 on the urban sub-sample only. None of the coefficients on the reform dummies were statistically significant, confirming that land reforms did not affect women's height in the urban sector.

migrant rural and urban women, since the sample of all urban women is likely to be significantly contaminated due to rural-urban migration.

Column (1) of Table 4.5 reports the DoDoD estimates from Equation 4.2 for height, and we find that even after accounting for factors other than land reforms, exposure to these reforms did lead to a significant increase in height for rural women as compared to their urban counterparts. However, unlike in the case of the earlier DoD estimates, only the effects of land ceiling and land consolidation reforms are statistically significant. Further, the effect of land ceilings is larger in magnitude at 3 centimeters, while land consolidation reforms seem to have had a smaller effect of only about 0.6 centimeters.[36] Column (2) of Table 4.5 reports the DoDoD estimates from Equation 4.2 for schooling, and we find that only abolition of intermediaries seem to have significantly improved women's education in rural India, increasing schooling by nearly one full year.

The DoDoD estimates from the restricted sample of non-migrant women are unlikely to be biased from the presence of omitted variables or contamination induced by migration. Hence, these estimates are more reliable. Overall, the results suggest that land ceiling reforms had the greatest impact on health and nutrition, increasing height by as much as 3 centimeters, while abolition of intermediaries led to a significant increase of about a year in women's schooling in rural India. These results in turn suggest plausible mechanisms through which land reforms improved health and schooling. By ensuring access to at least small pieces of homestead land, land ceiling reforms are likely to have ensured a source

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[36] As before, I obtained separate DoD estimates for the effect of land reforms on non-migrant urban women by re-estimating equation 1.1 on the non-migrant urban sub-sample only. Once again, none of the coefficients on the reform dummies were statistically significant, confirming that land reforms did not affect women's height in the urban sector.

Table 4.5: DoDoD estimates of the effect of land reforms on women's height and schooling

	Height	Education
	(1)	(2)
Any abolition of intermediaries reform before age 18	0.04	0.848**
	[0.158]	[0.311]
Any land ceiling reform before age 18	3.017***	0.2
	[0.168]	[0.305]
Any land consolidation reform before age 18	0.632**	-0.13
	[0.231]	[0.264]
Constant	151.461***	7.325***
	[0.457]	[0.313]
Observations	55291	59855
Number of states	16	16
State fixed effects	Yes	Yes
Cohort fixed effects	Yes	Yes
State - group (rural) interactions	Yes	Yes
Cohort - group (rural) interactions	Yes	Yes
State - Cohort interactions	Yes	Yes

NOTES: DoDoD estimates obtained by combining the non-migrant rural and urban samples. The dependent variables are height in centimeters and years of schooling. All regressions additionally control for caste (dummies for Scheduled Caste, Scheduled Tribe, and Other Backward Caste), and religion (dummies for Muslim, Christian, and Sikh, versus Hindu). Estimates for tenancy reforms are omitted due to the lack of variation in exposure to tenancy reforms. Robust standard errors in brackets.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

of basic sustenance for many households, and thus improved health and nutrition. On the other hand, the removal of intermediaries brought an end to various exploitative practices including extraction of forced labor from poor peasants and their household members, and therefore would have provided households the

opportunity to send their children to school, and also ensured greater freedom and more secure rights to land.

4.4 Effects of age-specific exposure to land reforms

In this section, I examine whether the effects of land reforms differ by age at which a woman experienced these reforms. Prior research on children's nutritional status suggests that early childhood is the most critical period for growth, and that growth deficits during the first 6 years of life are unlikely to be regained in late childhood or adolescence (e.g., see Martorell and Habicht, 1986). Therefore, exposure to reforms starting during the fist 6 years of life could possibly lead to larger gains in height compared to exposure starting at later ages. Note however that there could be catch-up growth among children as they move into their preadolescent and adolescent years (e.g., see Adair, 1999; Coly et al., 2006). Also, undernutrition in early childhood does not rule out height gains in adolescence. In other words, while childhood height deficits might be carried into adult height, there need not be any *additional* growth deficit during puberty (Satyanarayana et al., 1989). Hence, experiencing land reforms as an older child or adolescent could also lead to a significant increase in adult height.

4.4.1 An extension of the DoDoD estimation framework

In an extension of the DoDoD estimation framework in Equation 4.2, I estimate the effect of experiencing land reforms on height for 3 different starting age of exposure categories: 0 – 6 years, 7 – 12 years, and 13 – 18 years. Hence, for each type of land reform, I now include 3 dummy variables – one for each of the 3 age

of exposure categories, thereby estimating a total of 12 reform dummies for the 4 types of land reforms (E_{igcs}^{qj} in Equation 4.3 below). As before, this equation is estimated on the sample of non-migrant rural and urban women. I also examine whether the effect of land reforms on schooling differ by age of exposure using the same estimation framework.

$$H_{igcs} = \tau_c + \mu_s + G + G*\tau_c + G*\mu_s + \mu_s*\tau_c + \sum_{q=1}^{3}\sum_{j=1}^{4}\eta^{qj}.E_{igcs}^{qj} + \pi_3.X_{igcs} + \theta_{igcs} \quad ..... \quad (4.3)$$

The results are presented in Table 4.6, with the results for height reported in column (1), and those for schooling in column (2). The estimates for height from the sub-sample of non-migrant women suggest that exposure to land ceiling reforms before age 6 led to a higher height increase of 3.6 centimeters compared to exposure during 7 – 12 years (3.1 cms) or during 13 – 18 years of age (3.2 cms). However, these differences are not statistically significant. Also, none of the other estimates for the effects of age specific exposure to the 3 other types of land reforms are significant. Overall, these results are consistent with the earlier estimates for the overall effect of exposure to land reforms before age 18 on women's height (Table 4.5, column (1)), and also suggest that the effect of land ceiling reforms on height did not significantly vary by age of exposure.[37] In other words, land reforms improved nutritional status regardless of the age at which such exposure occurred, and not only for exposure that occurred during a critical

[37] Note that the effect of age-specific exposure to land reforms is related to the effect of differential categories of exposure on women's height and schooling. For instance, all those who were exposed to a particular reform for at least 12 years before reaching age 18 are also those who started benefiting from that reform during the first 6 years of life, or those who were exposed to a reform only after age 12, benefited from that reform for only 6 years before reaching age 18.

Table 4.6: DoDoD estimates of the effect of age-specific exposure to land reforms

	Height	Education
	(1)	(2)
Any abolition of intermediaries reform before age 6	-0.121	0.685
	[0.345]	[0.447]
Any abolition of intermediaries reform between ages 7 & 12	0.435	1.015**
	[0.267]	[0.464]
Any abolition of intermediaries reform between ages 13 & 18	-0.572	0.604*
	[0.467]	[0.311]
Any land ceiling reform before age 6	3.640***	-0.073
	[0.610]	[0.870]
Any land ceiling reform between ages 7 & 12	3.111***	-0.072
	[0.703]	[0.688]
Any land ceiling reform between ages 13 & 18	3.161***	0.045
	[0.533]	[0.548]
Any land consolidation reform before age 6	0.302	-0.312
	[0.400]	[0.442]
Any land consolidation reform between ages 7 & 12	0.425	0.012
	[0.253]	[0.320]
Any land consolidation reform between ages 13 & 18	0.566	-0.065
	[0.353]	[0.353]
Constant	151.626***	7.342***
	[0.370]	[0.306]
Observations	55291	59855
Number of states	16	16

NOTES: All estimates are DoDoD estimates from an extension of equation 4.2, obtained from combining the non-migrant rural and urban samples. All regressions include state and year fixed effects, as well as state-rural, cohort-rural & state-cohort interactions. The regressions also control for caste (dummies for Scheduled Caste, Scheduled Tribe, Other Backward Caste), and religion (dummies for Muslim, Christian, Sikh). Robust standard errors in brackets.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

growth period of 0 – 6 years. This is consistent with findings in the previous literature, as discussed above.

The corresponding estimates for the effect of age specific exposure to land reforms on schooling for the sub-sample of non-migrant women are presented in column (2) of Table 4.6. We find that experiencing abolition of intermediaries between 7 and 12 years of age significantly increased schooling by an additional year, and experiencing these reforms between 13 and 18 years of age led to schooling gains of 0.6 years. However, there are no significant gains in schooling from experiencing abolition of intermediaries during 0 – 6 years of age. These results also tend to support the hypothesis that abolition of intermediaries improved schooling through the removal of the exploitative practices of the former landlords, since the effects of abolition of intermediaries on schooling are most pronounced for exposure during the pre-adolescent and adolescent years – ages during which girls were most likely to have been victims of forced labor.[38]

These findings therefore indicate that improvements in health and family circumstances brought about by land reforms during late childhood and adolescence contributed to increased schooling. Previous research on schooling trends in India suggest that both school enrollment and participation peak during 6 – 11 years of age, i.e., the age when children are in primary school, or grades 1 – 5, and decline thereafter (Deolalikar, 2005). Similarly, I find that experiencing land reforms during 7 – 12 years of age – when the probability of school attendance is the highest – led to a larger gain in schooling. Further, exposure to reforms during 13 – 18 years of age, when children are most likely to drop out of school, significantly increased schooling, though by a smaller amount of 0.6 years.

[38] Once again, estimates for tenancy reforms were not significant, and these estimates are not reported due to the lack of sufficient variation in exposure to tenancy reforms.

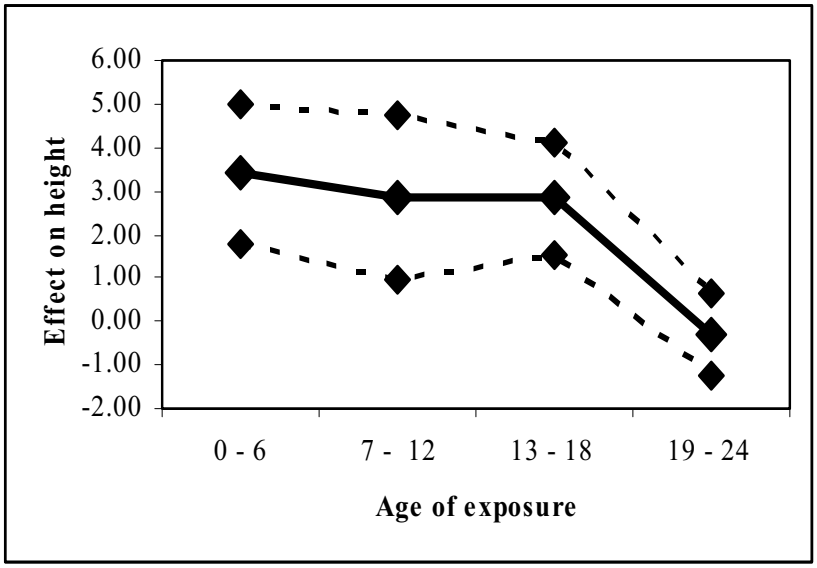
4.4.2 A falsification test

The analysis on the effect of age-specific exposure to land reforms on height also points to a falsification test that can be carried out to check whether these effects can truly be attributed to improved health and nutrition brought about by land reforms or not. If land reforms affected adult height for only those who experienced reforms prior to reaching age 18, then we should not expect to find any significant effect of reforms on the adult height of women who experienced these reforms only after age 18. On the other hand, if we find that experiencing land reforms beyond age 18 was also associated with a significant increase in height, then that would suggest a spurious correlation between land reforms and height, with unobservable factors leading to such a positive correlation. I implement this test by including an additional age-of-exposure category – exposure to reforms between 19 and 24 years of age – and estimate the same DoDoD model. If the earlier estimates of height increase were truly brought about by exposure to land reforms alone, then the coefficient on this fourth exposure category should be statistically insignificant, since it is physiologically extremely unlikely for women to grow taller beyond age 18 due to exposure to any reform.

The DoDoD estimates from this test for the effects of age-specific-exposure to land ceiling reforms are plotted in Figure 4.1 along with 95% confidence intervals. The estimates for the first three age-of-exposure categories are quite similar to the previous estimates in Table 4.6, and clearly show that exposure to land ceiling reforms starting before age 6 led to a higher height increase of 3.4 centimeters compared to exposure starting during 7 – 12 years (2.8 cms) or during 13 – 18 years of age (2.8 cms). However, the effect of starting to experience land ceiling reforms between 19 and 24 years of age on height is statistically indistinguishable from zero, and therefore suggests that the estimated effects of

land reforms on health and well-being are unlikely to be a result of unobserved factors and can truly be attributed to these reforms.

Figure 4.1: Effects of age-specific exposure to land ceiling reforms on height for non-migrant rural women



4.5 Intergenerational effects of land reforms

Finally, in this section I investigate whether land reforms had any intergenerational effect. Specifically, I examine whether mother's exposure to land reforms affect the long run nutritional status of children in the 0 – 3 year age group, as captured by children's linear growth or the height-for-age Z-score. The literature on children's nutritional status shows a strong and positive correlation between parental height and parental education on the one hand and nutritional status in early childhood on the other (e.g., see Strauss, 1990; Thomas, Strauss

and Henriques, 1990; Sahn and Stifel, 2002; Ghuman et al., 2005). Such a correlation arises due to genetic predisposition, background factors such as socioeconomic status, and better health knowledge and child care practices associated with improved maternal education. Therefore, a mother's exposure to land reforms could affect the child's nutritional status through an improvement in the long term health, education, and overall socioeconomic circumstances of the mother. More generally, if land reforms led to an improvement in land ownership and also in health, nutrition and education among the poor and the landless, then the beneficial effects of these reforms could spill over to successive generations.

Note however that such an intergenerational effect can be quite small for the following reasons. First, with divisions in a family's landholding across successive generations, the initial spurt in a household's consumption due to land reforms is likely to be eroded over time. Second, the benefits from land reforms could be short lived if poor peasants are forced to forego their rights on land – either due to economic hardships or due to social pressure, for instance, from the previous owners of such land. Finally, since women leave their parental homes after marriage, their children could be born in an environment with little or no exposure to reforms.[39]

Apart from these theoretical issues, identifying such an intergenerational impact is empirically challenging given the restrictions imposed by the data. The NFHS collected detailed health and anthropometric information for children born in the last three years, and only around 23,000 women among the 73,000 in our original sample report having had at least one child in that time period. Further, with missing information on children's height, the final sample for estimating any intergenerational effects has only 18,000 mothers and less than 20,000 children.

[39] Theoretically at least, the effect could also go the other way, if for instance, a woman with limited exposure to reforms moves to a household after her marriage that benefited from these reforms, and hence, her child also derives the benefit of such exposure.

This drastic reduction in sample size also means considerably less variation across birth cohorts (of women) in their exposure to reforms. This problem is further compounded by the fact that in this final sample of 18,000 women, we have very few women from the earliest birth cohorts – especially, cohorts born in the 1950s – since most of these women are older and were less likely to have a child within the previous three years of the survey.

Given these limitations, the results for the intergenerational effects of land reforms have to be interpreted with caution. I test for the existence of any such intergenerational effects by using the same strategy as in the previous sections, with the observations now at the level of the child. Specifically, I derive DoD and DoDoD estimates of the overall effect of mother's exposure to land reforms on a child's height-for-age z-score (HAZ) using extensions of Equations 4.1 and 4.2.[40]

Table 4.7 reports summary statistics for children's HAZ and mothers' overall exposure to various reforms for children in rural India. The average HAZ in the sample is –1.93 showing a generally low level of nutritional status for 0 – 3 year old children in rural India.[41] The mothers of nearly all the children experienced some tenancy reform, while the mothers of 50 – 80% of the children had some exposure to the other types of reform. Also, these overall exposures, on average, are similar to those reported before in Table 4.2.

Since observations are at the level of the child, and a child's HAZ is likely to be affected by the household environment and resources, I include a richer set of

[40] I do not include state-cohort interactions, and group-cohort or group-state interactions in the DoDoD regressions for children's HAZ. I adopt this limited approach for the DoDoD analysis on account of the reduced sample size, and also due to the fact that for quite a few states there were no women (or mothers) in some of the birth cohorts in this reduced sample.

[41] In comparison, the average HAZ for children in urban India was -1.46. A child is defined as being stunted if her HAZ is less than or equal to -2, and as severely stunted for a HAZ of -3 or below.

controls in these regressions that include the child's age, sex and birth order, father's education, household access to piped water, toilet, and electricity, and as before, dummies for caste and religion.[42] However, unlike the previous analyses for women's height and schooling, I do not separately estimate the effect of mother's exposure for children of non-migrant women, i.e., those who did not migrate across sectors, since that would impose further restrictions on the severely reduced sample size for this child-level analysis.

Table 4.7: Children's HAZ and mother's exposure to land reforms in rural India: summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Child's height-for-age z-score (HAZ)	14554	-1.93	1.70	-5.99	5.97
Mother experienced any tenancy reform before age 18	14554	0.998	0.04	0	1
Mother experienced any abolition of intermediaries reform before age 18	14554	0.83	0.37	0	1
Mother experienced any land ceiling reform before age 18	14554	0.71	0.45	0	1
Mother experienced any land consolidation reform before age 18	14554	0.55	0.50	0	1

NOTES: Data on the timing of land reforms in each state was merged with individual level data from NFHS-2 to define mother's exposure to specific reforms. Information on children's HAZ is from the NFHS, and only includes children born within the last 3 years of the survey.

Table 4.8 reports the estimates of the effect of mother's exposure to various reforms on the child's nutritional status. The DoD estimates in column (1) – for the currently rural sample – suggest that a mother's exposure to both abolition of intermediaries and land consolidation reforms significantly improved the height-for-age z-score of her children by 1 to 1.2 standard deviations. Surprisingly, the

[42] For a discussion on the proximate determinants of children's HAZ in India, see Borooah (2005) and also, Tarozzi and Mahajan (2007).

effect of land ceiling legislation is not statistically significant, even though it was found to have a large and positive effect on women's nutritional status. However, moving on to the DoDoD estimates in column (2), we find that the only significant effect of mother's exposure to reforms on children's nutritional status comes from a mother having experienced any abolition of intermediaries reform before age 18. Further, the estimated overall effect of exposure to abolition of intermediaries is quite small at around 0.19 standard deviations, though highly significant. Once again, we fail to detect any significant effect of a mother's exposure to land ceiling legislation on her children's nutritional status.

Overall, the results for intergenerational effects suggest that on average the health benefits of land reforms for successive generations were somewhat small, and only abolition of intermediaries had some impact on nutritional status across generations. This however does suggest a plausible mechanism through which land reforms can have an intergenerational impact. Since land ceiling legislations significantly increased women's height, and abolition of intermediaries significantly improved women's schooling (as per the main results reported earlier), the results for intergenerational effects do suggest that by improving maternal education and therefore her knowledge and health practices, abolition of intermediaries ensured better health for the next generation of children. As mentioned before, current evidence on the effect of mother's schooling on children's nutritional status also lends support to such a mechanism.

As mentioned before, these results need to be interpreted with caution, given the limitations in the data. Also, it would have been interesting to look at educational outcomes for children whose mothers benefited from land reforms. However, as mentioned before, the NFHS (wave 2) collected detailed information on only those children who were less than 3 years old at the time of the survey, i.e., on children of pre-school age only, and therefore, no information on schooling is available for these children.

Table 4.8: Effect of mother's exposure to land reforms on children's HAZ

	Current rural	Current rural versus current urban
	(1)	(2)
Mother experienced abolition of intermediaries reform before age 18	1.081***	0.188***
	[0.244]	[0.037]
Mother experienced land ceiling reform before age 18	0.536	0.001
	[0.395]	[0.040]
Mother experienced land consolidation reform before age 18	1.235***	-0.075
	[0.128]	[0.046]
Constant	-2.763***	-1.532**
	[0.759]	[0.688]
Observations	14514	19755
Number of states	16	16
State fixed effects	Yes	Yes
Cohort fixed effects	Yes	Yes

NOTES: The dependent variable is children's height-for-age Z-score. All regressions include controls for the child's age, sex, birth order, paternal education, household's caste and religion, and access to electricity, piped water and toilet. Robust standard errors in brackets. * Significant at 10%; ** significant at 5%; *** significant at 1%.

4.6 Conclusion

India experienced rapid economic growth over the last decade and a half – brought about mainly through policies of economic liberalization adopted since the early 1990s. Also, as per official estimates, the rate of rural poverty declined from around 37 percent to less than 30 percent during the 1990s. However, direct poverty estimation – with the calculation of the percentage of people unable to meet the nutrition norm in calories – shows that there was little or no decline in nutrition poverty during this period, with three quarters of the rural population

unable to meet the recommended daily allowance of 2400 calories throughout the 1990s (Patnaik, 2007). This highlights the fact that people in the poorest sections of society were not able to overcome hunger and malnutrition during a period of rapid economic growth and a general rise in prosperity.[43]

There are several plausible reasons behind such a phenomenon. While it is primarily due to the unequal sharing of the fruits of rapid growth, it also confirms the fact that increased income translates into improved nutrition at a much slower rate (Alderman, 2005). Moreover, an improvement in the real incomes of the poor are often accompanied by an increasing concern for food variety that leads to a low income elasticity of calorie intake (e.g., see Behrman and Deolalikar, 1987 and 1989). Therefore, a rise in per capita income may not bring about an improvement in developing country nutrition. Hence, redistributive policies continue to be of relevance for most countries where a significant fraction of the population lives in hunger and poverty.

This paper examined the impact of an important redistributive policy on human capital formation in rural India. Specifically, using across state and across cohort variation in the implementation of various land reform laws, I examined the impact of these reforms on women's height and schooling. The findings indicate that in spite of several limitations, land reforms did foster better long term health and well-being among rural women. Specifically, land ceiling legislations, which resulted in actual land redistribution in favor of poor and landless households led to a significant improvement in height of around 3 centimeters for cohorts experiencing such reforms before age 18. I also find that abolition of intermediaries had a significant and positive impact on schooling with

[43] There is also some evidence for an increase in gender inequality in child nutrition during the 1990s – with nutritional improvements for girls lagging behind that for boys (Tarrozi and Mahajan, 2007). Further, recent findings from the third wave of the National Family Health Survey suggest that there has been little or no reduction in child malnutrition rate (weight-for-age) between 1998-99 and 2005-06.

exposure to such reforms before age 18 resulting in nearly an additional year in school. Finally, I investigated into the intergenerational effects of land reforms by looking at the height-for-age performance of children whose mothers benefited from these reforms. Once again, I found that abolition of intermediaries had a positive impact on health across generations. However, this effect was small, and this result needs to be interpreted with caution due to limitations in the data.

In their state-level analysis of India's land reforms, Besley and Burgess (2000) found tenancy reforms and abolition of intermediaries – especially the latter – to have reduced poverty in rural areas. In comparison, I find that land ceiling legislations had the largest impact on women's health, while abolition of intermediaries had a significant effect on both health and schooling, and also a lasting yet small effect on health across generations. Given that most states enacted a considerable number of tenancy reforms, there was limited across cohort variation in exposure to these reforms. Hence, the effect of tenancy laws could not be properly evaluated.

While the significant effects of abolition of intermediaries on education are in line with previous findings on poverty reduction, the larger effect of land ceiling reforms on women's height merits additional discussion. As mentioned before, legislative delays and other lacunae in these measures did allow large landowners to considerably blunt the provisions of ceiling reforms. However, these laws achieved limited success in the following ways – first, land ceilings did lead to the redistribution of a small percentage of agricultural land; second, the threat of ceilings prevented large landowners from further expanding their landholdings and therefore prevented further concentration of land; and finally, the redistribution of at least smaller pieces of homestead land brought relief to the poor (Appu, 1996; Mearns, 1999). These facts combined with the results in this paper suggest that land ceiling reforms did contribute to health and well being in rural India in the long run.

These results in turn suggest plausible mechanisms through which land reforms improved health and schooling. By ensuring access to at least small pieces of homestead land, land ceiling reforms are likely to have ensured a source of basic sustenance for many households, and thus improved health and nutrition. On the other hand, the removal of intermediaries brought an end to various exploitative practices including extraction of forced labor from poor peasants and their household members, and therefore would have provided households the opportunity to send their children to school, and also ensured greater freedom and more secure rights to land.

Are the estimated effects of land reforms on women's height consistent with previous findings on height increases brought about by improvements in earnings or living standards? Using data on several countries, Steckel (1995) estimates the income elasticity of height to be around 0.2 – 0.3.[44] According to Besley and Burgess (2000), the effect of land reforms on poverty was similar to the effect of a 10 percent increase in per capita income. Combining this with the estimated increase of around 3 centimeters in height due to land ceiling reforms, i.e., an increase of about 2 percent over the average height of women in the NFHS (151.5 centimeters), I calculate the income elasticity of height to be around 0.2 - very similar to Steckel's (1995) earlier, independent estimate.

How big are the effects of land reforms on women's health? To put the findings from this analysis in perspective, I compare these effects with Chen and Zhou's (2007) findings on the effect of the Chinese famine during 1959–61. They found that the Great Famine in China reduced the height of its survivors by 3.03 centimeters on average. The estimated effect of land ceiling reforms obtained in this paper is similar at 3 centimeters, in terms of height increase. The estimated

[44] Estimates of the income elasticity of child malnutrition – as obtained from both household level and cross-country data – are somewhat higher at around -0.5 (Haddad et al., 2003).

effects of land reforms on both height and schooling are also consistent with previous estimates of the effect of improved pre-school nutrition on subsequent human capital formation. For example, Alderman, Hoddinott and Kinsey (2006) found that improving the pre-school nutritional status of the median child in rural Zimbabwe to the level of the median child in a developed country would lead to gains of 3.4 centimeters in height and 0.85 grades in schooling.

Prior research shows land reform to be an important policy option against poverty in agrarian economies. This paper has demonstrated that land reforms can also be a viable policy option for promoting greater human capital accumulation in childhood and adolescence, and therefore, improving general well-being in the long run. Land reforms can therefore be an effective vehicle for preventing the intergenerational transmission of poverty. Further, given the causal relationship between health and education on the one hand and labor productivity and income on the other, significant long term improvements in health and education brought about by land reforms can also lead to faster economic growth. There is also some evidence that improvements in health brought about through land reforms are likely to persist across generations. Based on findings from the analysis in this paper, exploring the intergenerational effects of land reforms in greater detail should be a fruitful avenue for future research.

Chapter 5

Discussion and Policy Implications

This dissertation focused on human capital investments in childhood in the context of rural India, and studied three crucial factors that determine such investments. First, it looked at gender discrimination in intrahousehold resource allocation through a detailed review of the existing literature and summarized important findings from this literature. Second, it studied the role of mortality risks and initial health endowments in determining parental strategies for health investments in infancy and early childhood. Finally, it analyzed the effect of an important redistributive policy – land reforms – on human capita formation in childhood and adolescence. In this chapter, the main findings from this research are presented along with certain policy implications arising from the different analyses.

5.1 Main findings

The literature review in Chapter 2 confirmed that son preference and discrimination against daughters are unfortunate yet important factors that need to be accounted for while studying parental behavior vis-à-vis their children in the context of India. Specifically, the review of the literature in this area led to five interesting and crucial findings. First, both economic and socio-cultural factors

are important determinants of gender bias in India, and explanations based on only one of these factors are likely to be oversimplified or misleading. Second, family composition or the sex composition of surviving older siblings and birth order of the index child were also crucial factors determining parental behavior vis-à-vis the girl child and the share of resources commanded by her. Third, gender differences in health care, especially age appropriate immunizations, and in nutrition were key contributors to excess female mortality among children in India. Fourth, women in general, and girls in poor families in particular were more vulnerable to nutritional deprivation during periods of relative food scarcity, e.g., during the lean season. Finally, women's empowerment in the form of higher female literacy and greater labor force participation can reduce gender bias in India – both independently and in conjunction with general socioeconomic development over time.

However, it is important to remember that discrimination can take other forms as well. For instance, in order to maximize their returns from investing in child health, poor and resource constrained parents might decide to put in greater investments in the relatively well endowed child, or in the child with a greater innate ability to survive in a high-risk and disease-prone environment. Such behavior would then manifest itself in the form of a reinforcing pattern of investments in child health, whereby parents reinforce endowment differences between their children through health investments in early childhood. Additionally, this reinforcing pattern might be exacerbated in an environment where the odds of survival were highly skewed in favor of the well endowed child.

Hence, Chapter 3 in this dissertation examined how mortality risks affect intra-household childhood investments in siblings with different initial health endowments in the context of rural India. Using birth size as a measure of initial health endowment, immunization & breastfeeding as measures of childhood

investments, and infant mortality rate in the child's village as a measure of mortality risks, we found that that parents in villages with a high infant mortality rate adopted a reinforcing strategy of investments in child health whereby larger-at-birth children were significantly more likely to be immunized and breastfed compared to their small-at-birth siblings. For example, in villages with high infant mortality, small-at-birth children in a family were 4-6 percentage points less likely to receive these health investments compared to their large-at-birth siblings. In percentage terms, these amount to a 17 percent, 16 percent, and 6 percent reduction in the probabilities of polio vaccination, non-polio vaccination, and breastfeeding respectively. In contrast, we found no significant differences in breastfeeding and immunization rates between small at birth and large at birth siblings in low infant mortality villages. This finding was robust and could not be explained by either differences in preferences or access to health infrastructure across high- and low-infant mortality areas.

Finally, Chapter 4 evaluated the effect of India's extensive land reforms on long term health and well being as determined by human capital formation in childhood. While India pursued one of the largest programs of land reforms on record since the 1950s, there is mixed evidence on the effect of these reforms on poverty, and the long run welfare consequences of these reforms have not been evaluated. Using across-state and across-cohort variation in the timing of reform legislations, I examined the impact of India's extensive land reforms on height, a long term measure of health. The results suggest that land reforms led to significant improvements in health and well-being for cohorts experiencing such reforms before age 18. Land ceiling legislations resulted in an increase of 3 centimeters in height for women. Additionally, abolition of intermediate land revenue collection entities led to a gain of nearly a full year in schooling for cohorts exposed to these reforms. There was also some evidence for

intergenerational health benefits from land reforms with improved height-for-age performance of children whose mothers benefited from such reforms.

5.2 Policy implications

The policy implications from this dissertation need to be viewed in the light of the recent trends in health and other human capital outcomes in India, as well as in the trends in poverty and food security. Findings from the three waves of the National Family Health Survey (1992-93, 1998-99, and 2005-06) suggest that the goal of universal immunization coverage for children continues to be unfulfilled in India. This is particularly true for rural India, where less than 40% of children between the ages of 12 and 23 months were fully immunized in 2005-06, up from 31% in 1992-93. Even for India as a whole, the picture is quite dismal, with the data showing that only 44% of children between the ages of 12 and 23 months had received all recommended vaccines, while for urban India the proportion of children fully vaccinated has actually declined from 61% to 58% between 1998-99 and 2005-06 (Figure A.1 in the Appendix). While the reduction in infant mortality from 79 per 1000 live births to 57 between 1992-93 and 2005-06 is a significant achievement for India as a whole, it still continues to be quite high at 62 per 1000 live births in rural India versus 42 in urban India in 2005-06 (Figure A.2 in the Appendix). Moreover, infant mortality rate is projected to be 45 per 1000 live births in 2015 for India as a whole – much above the Millenium Development Goal of 27 (Deolalikar, 2005).

Against this backdrop of the recent trends in infant mortality and immunization coverage, the findings in Chapter 3 suggest that children's endowment differences as well as background mortality risk can have sizeable

impacts on intra-household resource allocations in a developing country. They also show that reductions in mortality can not only improve overall population health but also reduce health disparities. Reductions in mortality affect less endowed and weaker children more than healthy children. Thus, they create unique incentives for parents to invest in weaker children, consequently reducing health disparities. The results also highlight that public health investments do not crowd out private investments in child health. In fact, they are complements. For example, public health interventions that improve birth weight are likely to encourage parental investments such as immunizations and breast feeding. Dow et al. (1999) make a similar argument in their study that showed that women were more likely to increase inputs into birth weight when the United Nation's Expanded Programme of Immunization (EPI) was implemented. By decreasing the probability of child mortality from any of the 6 vaccine preventable diseases, the EPI increased mothers' incentives for improving birth outcomes. Similarly for India, public health investments that seek to reduce infant mortality and improve birth outcomes can go a long way towards improving immunization coverage and promoting better long run health, as well as ensuring reduced disparities in population health outcomes.

While India experienced rapid economic growth over the last decade and a half – brought about mainly through policies of economic liberalization adopted since the early 1990s, people in the poorest sections of society were not able to overcome hunger and malnutrition during this period. As per official estimates, the rate of rural poverty declined from around 37 percent to less than 30 percent during the 1990s. But direct poverty estimation – with the calculation of the percentage of people unable to meet the nutrition norm in calories – shows that there was little or no decline in nutrition poverty during this period, with three quarters of the rural population unable to meet the recommended daily allowance of 2400 calories throughout the 1990s (Patnaik, 2007). Moreover, findings from

the most recent wave of the National Family Health Survey (NFHS-3) indicate that there has been little or no decline in child malnutrition rates as captured by weight-for-age between 1998-99 (47%) and 2005-06 (46%) for children under age 3 in India. The situation is particularly dire in rural India where nearly half the children in this age group continue to be malnourished (Figure A.3 in the appendix). As pointed out by Deolalikar (2005), at this current rate of decline in child malnutrition, the Millenium Development Goal of an underweight rate of 27.4% among children was unlikely to be achieved by India. This does highlight the fact that economic growth alone was not enough to eradicate hunger and malnutrition, and redistributive policies continue to be of relevance for most countries including India where a significant fraction of the population lives in hunger and poverty.

While previous findings suggest that redistributive policies such as land reforms can emerge as successful social protection mechanisms, the results in Chapter 4 demonstrate that land reforms can also be a viable policy option for promoting greater human capital accumulation in childhood and adolescence, and therefore, improving general well-being in the long run. Land reforms can therefore be an effective vehicle for preventing the intergenerational transmission of poverty. Further, given the causal relationship between health and education on the one hand and labor productivity and income on the other, significant long term improvements in health and education brought about by land reforms can also lead to faster economic growth. While past experience suggests that there are likely to be significant political and administrative hurdles in implementing successful land reforms in India, a strong political will combined with successful mobilization at the local level could overcome most of these difficulties – as the examples of Kerala and West Bengal show. Hence, carefully designed and well implemented land redistribution policies can ensure current food and economic security, greater human capital investments, and consequently future prosperity

and well-being for the large number of rural households living below subsistence levels in India.

Appendix

Figure A.1: Percentage of children 12-23 months old who are fully immunized in India

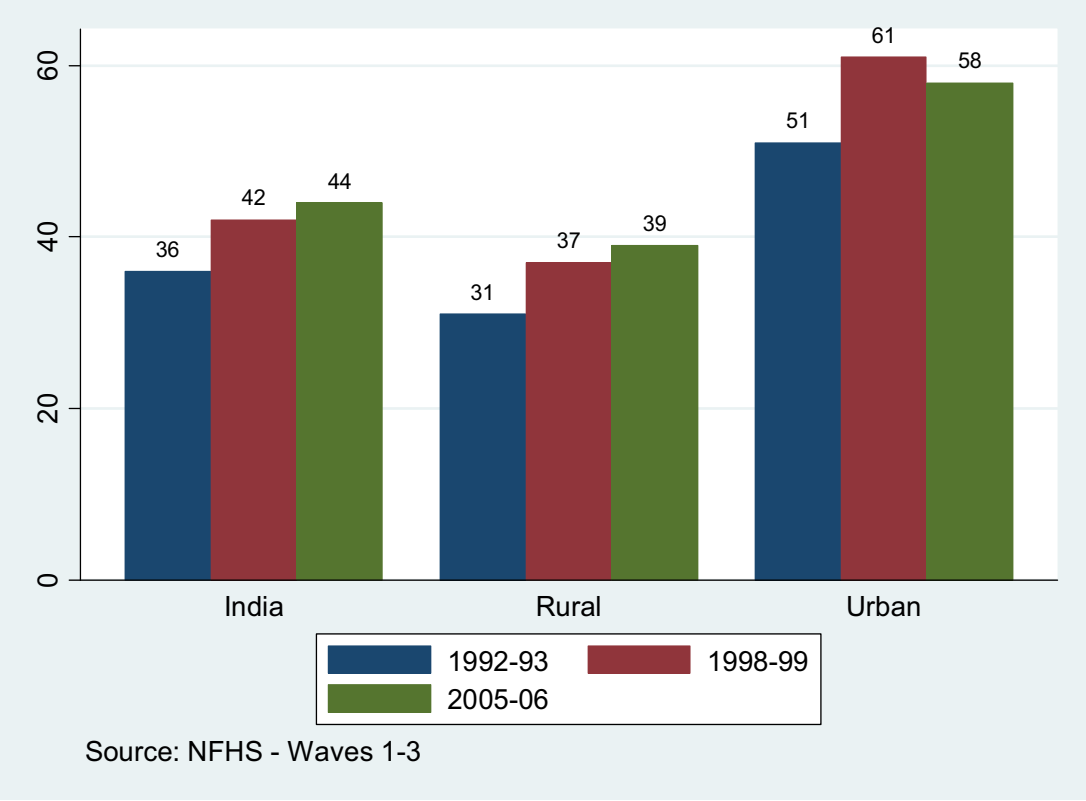


Figure A.2: Infant mortality rate per 1000 live births in India

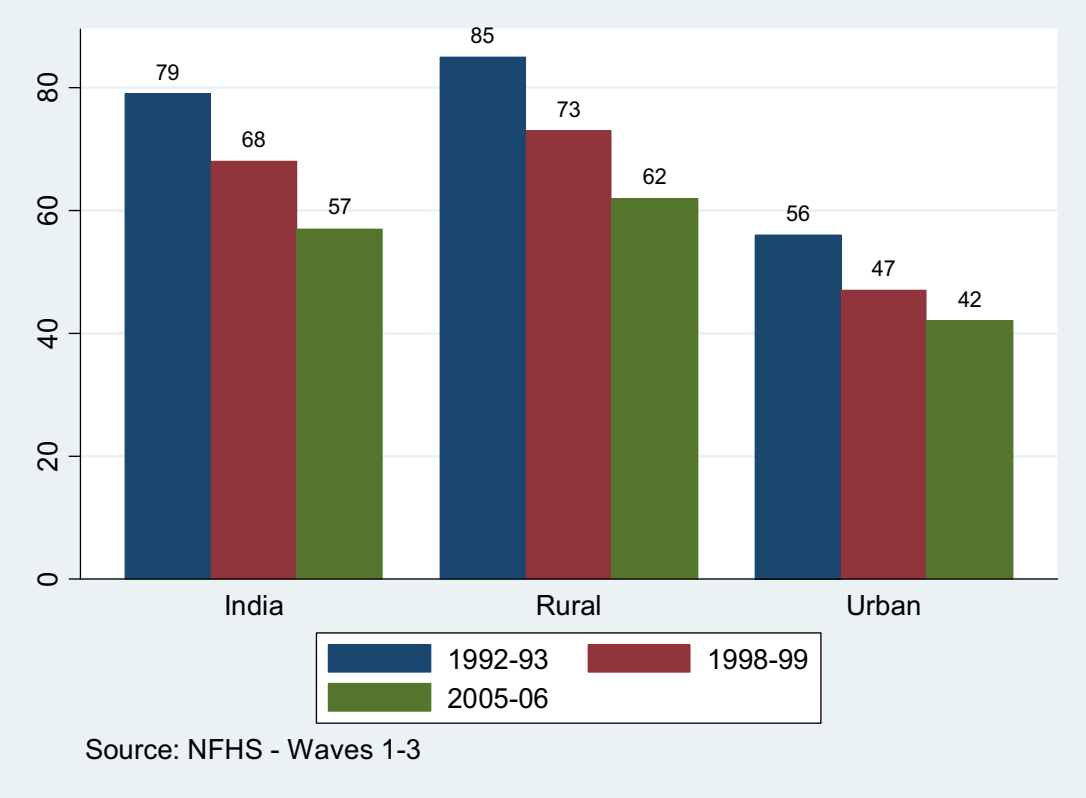
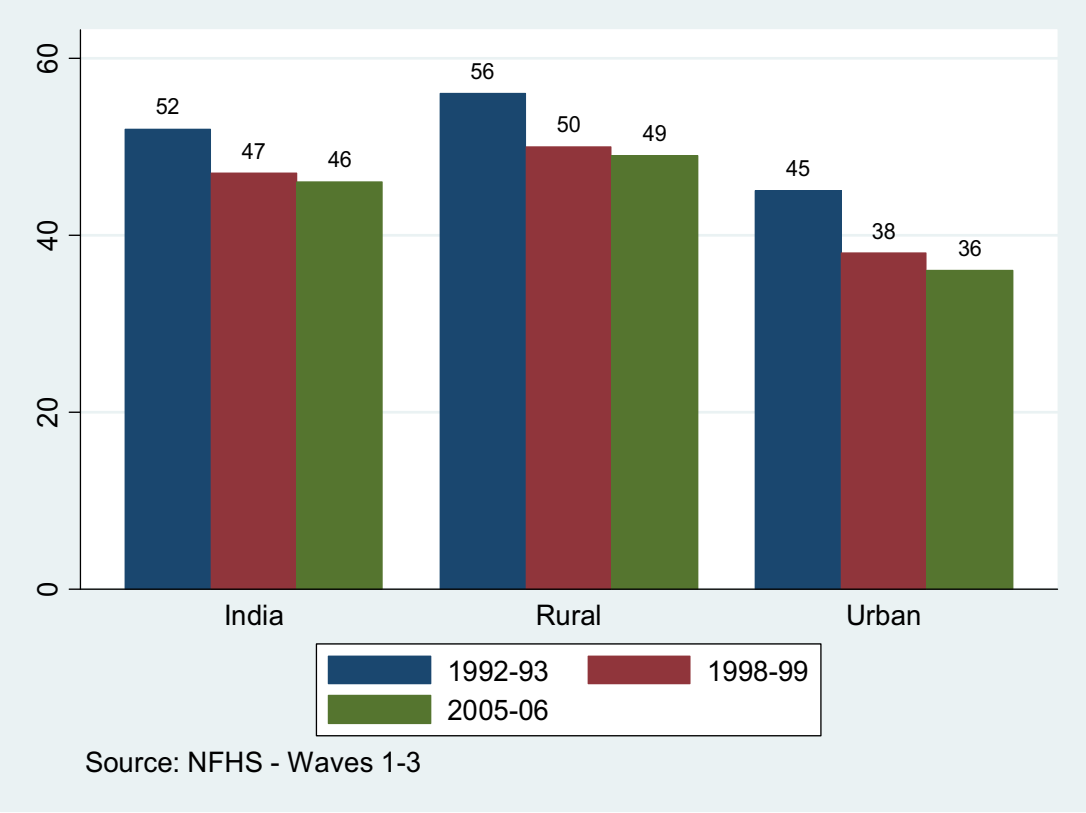


Figure A.3: Percentage of children under age 3 who are underweight in India



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