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

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Abstract

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 paper 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. Land ceiling legislations resulted in an increase of 3.3 – 4.5 centimeters in height for women. Additionally, abolition of intermediate land revenue collection entities led to height gains of 1.3 – 1.8 centimeters 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. The paper concludes that land reforms constitute an effective policy option for improving long run welfare through better long term health and higher educational attainment.

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

There is however little or no evidence on the long run welfare consequences of land reforms, especially with regard to measures such as health and nutrition. This research aims to fill this void by looking at the effect of land reforms on long term health and well-being – as captured by height. Improvements in height for cohorts experiencing land reforms would suggest a positive influence of these reforms on childhood health and nutrition, which in turn are correlated with adult health and socioeconomic status (Case, Fertig and Paxson, 2005; Alderman, Hoddinott and Kinsey, 2006; Chen and Zhou, 2007). The paper also examines the effect of reforms on schooling, which could improve as a consequence of increased household income and better health brought about by land reforms. 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, increases in height or education brought about by land reforms would also suggest longer term improvements in the standard of living.

[1] 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).

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 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 a lower bound on the actual benefits from these reforms, given widespread gender discrimination in intrahousehold resource allocation in India. Also, by examining the impact of land reforms on health, 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 3.3 – 4.5 centimeters. This effect is at least as large as the negative impact of the Great Famine in China (1959–61) on the height of its survivors (Chen and Zhou, 2007). Abolition of intermediaries improved both health and education, with gains of 1.3 – 1.8 centimeters in height and an additional 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 improve health and education thereby promoting greater productivity, income, and well-being over 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 3 presents empirical evidence on the effect of land reforms on women's health. Section 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 3.2, and section 3.3 presents the results. Section 3.4 extends the empirical analysis to address problems with rural to urban migration. Section 4 examines the impact of experiencing land reforms before age 18 on women's schooling. In section 5, I examine the effects of age-specific exposure to land reforms on both height and schooling. Section 6 investigates whether land reforms had any intergenerational effects, and section 7 concludes. All tables and figures are in an appendix at the end of the paper.

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*.[2]

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).[3]

[2] Reproduced from Zaidi (1985).

[3] 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 electoral competition. In an

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 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

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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.

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 1 summarizes the main objectives behind each reform, and what these reforms eventually accomplished, based on the literature discussed above.[4]

3. Effect of land reforms on health

3.1 Conceptual issues

Did land reforms improve long run welfare 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 long term 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

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

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.[5] Hence, the redistributive aspect of land reforms, including any general equilibrium effect – on wages for instance – are likely to be more relevant in the 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 focus on women's health is largely dictated by the lack of comparable data on men. However, note that the effect of land reforms on long term health of women is likely to be smaller than that for men. This is because of the following reason. Gender

[5] 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.

discrimination in intrahousehold resource allocation, including allocations of food and medical care is well documented in the context of India (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). Hence, 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 following land reforms. Therefore, any effect of reforms on the long term health of women are likely to be small, and can probably be interpreted as the lower bound on the actual health benefit from these reforms.

3.2 Data and methods

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.[6] For each woman, I have information on her height, year of birth, age, region or state of residence, and place of residence (rural / urban).[7] 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 a state level dataset on land reform legislations in India's 16 major states.[8] Table 2 shows the years in which various land reform laws were passed by the 16 states in this analysis. 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

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

[7] 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.

[8] Data on various land reform legislations were 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).

in table 3 (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.[9]

Land being a "state subject" in India, there is considerable variation across states and birth cohorts in the implementation of various land reforms (Table 2). I utilize this variation to estimate the effect of a woman's exposure to land reforms on her long term health, 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 impact of China's 1959–61 famine on the health of its survivors.[10] Specifically, I estimate the following model –

$$H_{ics} = \tau_c + \mu_s + \sum_{j=1}^{4} \alpha^j . REF_{ics}^{j} + \pi_1 . X_{ics} + \varepsilon_{ics} \qquad \ldots\ldots \quad (1.1)$$

where *i*, *c*, and *s* are subscripts for individual, cohort, and state respectively; 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, …4, for the four types of reforms; and ε_{ics} is an idiosyncratic error term. Following the approach of Besley and Burgess (2000), land reforms are lagged by four years – to allow for sufficient time in their implementation.[11] Hence, REF^j is equal to one for woman *i* if a

[9] The mean height and education in the urban sample were 151.9 cm and 6.5 years respectively. Since exposure to reforms is zero for urban women, a separate table for the urban sample of NFHS is not presented.

[10] 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.

[11] 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).

reform of type *j* becomes effective before her birth, or before her 18th birthday in her state of residence, and is zero otherwise. Summary statistics for these dichotomous, exposure-to-reform variables are reported in table 3 (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 1.1 therefore provide us with the effect of being exposed to a particular type of reform before age 18 on a woman's height. In other words, the α^js are estimates of the overall *treatment effect* of land reforms. Equation (1.1) 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.[12]

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. 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 1.1 in a difference-of-difference-of-difference (DoDoD) framework. This approach allows me to control for all state and cohort attributes that vary by place of residence, apart from controlling for time varying, state level factors. This is shown in equation 1.2 below –

$$H_{igcs} = \tau_c + \mu_s + G + G*\tau_c + G*\mu_s + \mu_s*\tau_c + \sum_{j=1}^{4} \delta^j . REF_{igcs}^j + \pi_2 . X_{igcs} + \phi_{igcs} \quad \text{..... (1.2)}$$

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

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

for rural residents. As mentioned above, equation 1.2 includes interactions of the state and cohort fixed effects with the place of residence ($G*\tau_c, G*\mu_s$), and also state-cohort interactions ($\mu_s*\tau_c$) that account for time varying state level attributes. 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 urban India, since they were actually not exposed to these reforms. Including urban women who were unaffected by land reforms in this estimation framework 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 in rural India. Equation 1.2 is therefore estimated on the combined rural and urban samples, and standard errors are once again clustered at the state level.[13]

Note that both the approaches described above provide us with the overall effect of a woman's exposure to land reforms. In other words, they do not distinguish between women who had only 2-3 years of exposure before age 18, versus those who derived benefits from these reforms throughout their childhood and adolescence. Hence, in a variation of the DoDoD analysis above, I estimate a dose – response type of a relationship, where the key regressors are dummies for several categories of exposure to a particular type of reform. To define such categories of exposure, I first define the actual exposure (in years) to a reform of type *j* for each woman as follows:

> Exposure = 18 years, for all reforms of type *j* that became effective before her birth;
>
> Exposure = (year she attains age 18 – year reform was effective) for all reforms of type *j* that became effective between her birth and her cutoff year, i.e., the year of her 18th birthday;

[13] 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.

Exposure = 0, for reforms of type *j* that became effective after her cutoff year, i.e., after her 18th birthday.

For each type of reform, I consider a woman's maximum exposure across various reforms of the same type to be her actual exposure to that particular type of reform before reaching age 18.[14] Summary statistics for years of exposure to specific reforms are once again shown in panel A of table 3 for the rural sample, and we find that on average a woman was exposed to tenancy reforms for 16 years, to abolition of intermediaries for 14.5 years, to land ceiling legislations for 11 years, and finally, to land consolidation reforms for about 8 years. Next, I define dummy variables corresponding to 9 different categories of exposure: 1-2 years, 3-4 years, ….., 17-18 years, versus no exposure at all – for each type of reform. A total of 36 dummy variables are therefore defined for the 4 types of reforms. These are then utilized in a DoDoD framework – similar to the one described above – to estimate the differential effect of a particular category of exposure to a specific reform on the height of a woman in rural India versus one in an urban area. This is shown in equation 2 below –

$$H_{igcs} = \tau_c + \mu_s + G + G*\tau_c + G*\mu_s + \mu_s*\tau_c + \sum_{q=1}^{9}\sum_{j=1}^{4}\eta^{qj}.E_{igcs}^{qj} + \pi_3.X_{igcs} + \theta_{igcs} \quad ..... \quad (2)$$

The estimates of η^{qj} provide us with the differential effect of the various exposure categories on the height of a woman in rural India versus one in urban India. Since women in urban India are unaffected by land reforms, E_{igcs}^{qj} = 0 for the urban sample. Hence, by including the urban sample, we are once again able to account for changes in socioeconomic circumstances that were potentially correlated with exposure to reforms and also with height. Significant and positive estimates of η^{qj} would suggest

[14] The maximum exposure to a particular type of reform is therefore 18 years.

that being exposed to land reforms for a specific number of years did lead to a significant increase in a woman's height. As before, standard errors are clustered at the state level.

3.3 Results

Table 4 presents results for the effect of being exposed to land reforms in childhood or adolescence on a woman's height. The DoD estimates of α^j from equation 1.1 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. However, we fail to detect any significant effect of tenancy reforms on women's height in rural India.[15]

Note that the estimates in column (1) 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 turn to the estimates of δ^j from equation 1.2 that should be able to account for such changes by including both the rural and urban samples in the estimation framework.[16] Column (2) of table 4 reports these DoDoD estimates from equation 1.2, 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. Specifically, we find that abolition of intermediaries, land ceiling and land consolidation reforms led to an improvement in long term health of rural women compared to their

[15] This could be due to a 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.

[16] 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.

urban counterparts – with their respective effects on height being 0.5, 1.4, and 1.3 centimeters.

Finally, the estimates of η^{qj} showing the effects of different degrees of exposure to land reforms are plotted in Figures 1a – 1c along with the associated 95 percent confidence intervals. These figures are for three types of reform – abolition of intermediaries, land ceiling legislations, and land consolidation reforms. The estimates for tenancy reforms are omitted due to insufficient variation in exposure to these reforms. These figures suggest that different types of reforms affected height with a somewhat different pattern in the dose – response relationship. For example, with respect to abolition of intermediaries (Figure 1a), we find that between 3-4 and 9-10 years of exposure to these reforms led to a significant increase in height of around 1.3 – 1.8 centimeters, while exposure beyond 10 years did not have any significant additional effect. Note that the DoDoD estimate of the average effect of exposure to abolition of intermediaries was much smaller at only 0.5 centimeters, as reported above.

Figure 1b suggests a very different pattern in the effects of exposure to land ceiling reforms compared to those in Figure 1a for abolition of intermediaries. First, the estimates for all the exposure categories are larger and statistically significant. Second, these estimates suggest that the effects of various degrees of exposure were more or less similar (except 1-2 years of exposure), and between 1.8 and 2.5 centimeters. Also, note that these estimates are larger than the average effect of 1.4 centimeters for exposure to land ceiling legislations that was obtained above.

The results for the effect of land consolidation reforms – as shown in Figure 1c – are somewhat mixed, with most estimates being statistically insignificant. Also, the few estimates that are marginally significant are generally smaller at around 1 centimeter, as compared to the effects of the other reforms. Overall, the results so far suggest that both land ceiling reforms and abolition of intermediaries had significant, positive effects on women's height in rural India, with land ceilings having a larger effect. The next section repeats the above analysis on restricted sub-samples of rural and urban women to address potential concerns about intersectoral migration.

3.4 Addressing rural to urban migration

The analysis above utilized the entire sample of rural and urban women, i.e., women who are currently in rural India or currently urban residents. It therefore 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 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, I now replicate the analysis above on the uncontaminated sub-samples of "always rural" and "always urban", i.e., non-migrant women.[17]

Columns (3) and (4) of table 4 report the DoD and DoDoD estimates of the overall effect of reforms on the sample of non-migrant women. The DoD estimates in column (3) for non-migrant rural women are very similar to those in column (1) for all rural women, which suggests that intersectoral migration was unlikely to be a problem in the previous analysis. However, looking at the DoDoD estimates of the effect of reforms in column (4), we find that unlike in column (2), 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. Hence, this suggests that for non-migrant rural women, land ceiling reforms led to a significant improvement in long term health, with a larger increase in height of about 3 centimeters, while land consolidation reforms had a smaller effect of about 0.6 centimeters.[18]

Finally, as before, the estimates of η^{qj} showing the effects of different degrees of exposure to land reforms are plotted in Figures 2a – 2c along with associated 95 percent confidence intervals, for women who have always been in rural India versus women always in urban areas. Once again, estimates for tenancy reform are omitted due to

[17] 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.

[18] 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.

insufficient variation in exposure to such reform. Four things stand out from these new set of figures. First, the general pattern of the coefficient estimates for the three types of reforms is very similar to that in Figures 1a to 1c. Second, the estimates for abolition of intermediaries (Figure 2a) are statistically significant for only two exposure categories – 5-6 years and 7-8 years, and these estimates of around 1.4 – 1.8 centimeters are once again similar to those shown in Figure 1a. Third, the new estimates for ceiling reforms (Figure 2b) are statistically significant for all exposure categories as before, but these are much larger at around 3.3 – 4.5 centimeters compared to the estimates of 1.8 – 2.5 centimeters obtained before (Figure 1b). Also, these are larger than the estimate of 3 centimeters obtained above in column (4) of table 4. Finally, as in Figure 1c before, most estimates for differential exposure to land consolidation reforms are statistically insignificant (Figure 2c).

These estimates from the restricted sample of non-migrant women are less likely to be biased due to contamination of either the treatment (rural) or the control (urban) group, and hence are more reliable. Overall the general pattern of these estimates is similar to that obtained before from the mixed sample of migrant and non-migrant women, with three important qualifications. First, the estimates for land ceiling reforms suggest that the effect of these reforms on women's height was much larger than what was shown by our previous estimates. Specifically, exposure to land ceiling reforms increased height by as much as 3.3 – 4.5 centimeters. In comparison, abolition of intermediaries had a limited effect in improving long term health and nutrition, with an increase in height of around 1.4 – 1.8 centimeters for at least 5 – 8 years of exposure before age 18, while land consolidation reforms did not affect women's height in a significant fashion.

4. Land reforms and schooling

Did land reforms also improve schooling in rural India? As mentioned before, the increase in income brought about by land reforms could increase households' demand for

health and other human capital investments. 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.[19] 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. Note however that as for height, the effect of reforms on women's education are likely to be smaller than for men, given the existence of gender disparities in schooling outcomes in rural India (Deolalikar, 2005).

The econometric framework for identifying the effect of land reforms on women's schooling is same as the one used for height (see section 3.2). It involves estimation of equations 1.1 and 1.2, as well as equation 2, with the outcome now being reported years of schooling instead of height. As shown in Table 3 (summary statistics), rural women in NFHS-2 had less than 3 years of schooling on average. Table 5 presents results for the effect of being exposed to land reforms in childhood or adolescence on schooling. The DoD estimates in column (1) for rural women suggest that exposure to abolition of intermediaries and land ceiling reforms increased schooling by about 0.5 years and 1 year respectively. However, as reported in column (2), the DoDoD estimates for rural women vis-à-vis their urban counterparts show that only abolition of intermediaries had a statistically significant impact on women's education, increasing schooling by one full year. In columns (3) and (4), the estimation sample is restricted to

[19] 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).

non-migrant women, and the reported estimates are similar to those obtained from the unrestricted sample in columns (1) and (2).

Finally, the DoDoD estimates showing the effects of different degrees of exposure to land reforms are plotted in Figures 3a – 3c along with the associated 95 percent confidence intervals. As before, these figures are for three types of reform – abolition of intermediaries, land ceiling legislations, and land consolidation reforms, with the estimates for tenancy reforms being omitted due to insufficient variation in exposure. Figure 3a shows that at least 5-6 years of exposure to abolition of intermediaries increased women's schooling by more than 1 year, with exposure beyond 6 years having no significant additional effect. Further, in line with the DoDoD estimates reported above for land ceiling and land consolidation reforms, none of the estimates in Figures 3b and 3c for the effects of different levels of exposure to these reforms on women's schooling are statistically significant at conventional levels. The effects of differential exposure to the various reforms were also separately estimated for the sample of non-migrant women, and the results were similar. Hence, those estimates are not reported in the interest of brevity, but are available upon request. Overall, the results suggest that abolition of intermediaries did lead to a significant increase in women's schooling in rural India, with exposure to such reforms before age 18 resulting in an additional year of schooling.

5. 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 during the fist 6 years of life could possibly lead to larger gains in height compared to exposure 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.

In an extension of the DoDoD estimation framework in equation 1.2, I estimate the effect of experiencing land reforms on height for 3 different 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. As before, this equation is separately estimated for the sample of all rural and urban women for whom information on height is available, and a sub-sample of non-migrant rural and urban women to address concerns about intersectoral migration. I also examine whether the effect of land reforms on schooling differ by age of exposure using the same estimation framework.[20]

The results are presented in Table 6, with the results for height reported in columns (1) and (2), and those for schooling in columns (3) and (4). The preferred estimates for height from the sub-sample of non-migrant women (column (2)) 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,

[20] Note that the analysis on the effects of age-specific exposure to land reforms is related to the earlier analysis on the effects of differential categories of exposure to land reforms 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 benefited from that reform during the first 6 years of life and beyond. However, while the earlier analysis focused on deriving the effects of differential duration of exposure to reforms, the analysis in this section explicitly focuses on the window of exposure, i.e., the specific age range during which such exposure occurred.

column (4)), and also suggest that the effect of land ceiling reforms on height did not significantly vary by age of exposure.

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 (4) of Table 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 were no significant gains in schooling from experiencing abolition of intermediaries during 0 – 6 years of age, even though previous estimates suggest that land reforms did lead to a significant improvement in pre-school nutrition and health. These results are consistent with the earlier estimates for the overall effect of exposure to land reforms before age 18 on schooling (Table 5, column (4)), with none of the estimates for the effects of other reforms being statistically significant.[21]

These findings 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.

6. 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

[21] The only exception is the estimate for the effect of experiencing tenancy reforms between 7 and 12 years of age that suggests a significant gain of an additional year in schooling, but only at the 10 percent level.

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.[22]

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

[22] 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.

height, the final sample for estimating any intergenerational effects has only 18,000 mothers and less than 20,000 children. 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 1.1 and 1.2.[23]

Table 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.[24] 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 3.

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 controls in these regressions that include the child's age, sex and birth order, father's education,

[23] 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.

[24] 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.

household access to piped water, toilet, and electricity, and as before, dummies for caste and religion.[25] 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 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 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. 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.

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

7. 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.[26]

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 long term health and well-being 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. The findings indicate that in spite of several limitations, land reforms did foster better long term health among rural women.

[26] 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.

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 3.3 – 4.5 centimeters for cohorts experiencing such reforms before age 18. Abolition of intermediaries also had a positive but smaller impact of about 1.3 – 1.8 centimeters on height. I also find that abolition of intermediaries had a significant and positive impact on schooling with exposure to such reforms before age 18 resulting in 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 health and 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.

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.[27] 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 4 centimeters in height due to land ceiling reforms, i.e., an increase of 2.6 percent over the average height of women in the NFHS (151.5 centimeters), I calculate the income elasticity of height to be 0.26. This is very similar to the earlier, independent estimate obtained by Steckel (1995).

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 estimates for the effect of land ceiling reforms obtained in this paper are larger at 3.3 – 4.5 centimeters, in terms of height increases. The estimated 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 improving health and schooling, and therefore, general well-being in the long run. There is also some evidence that improvements in health brought about through

[27] 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).

land reforms are likely to persist across generations. Also, as discussed before, the estimated effects of land reforms on women's health and education are likely to be lower bounds for the actual effect of these reforms. Therefore, the true effects of land reforms on height and schooling are possibly larger than the estimates obtained in this paper. Hence, it can reasonably be concluded that 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.

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Appendix

Table 1: 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 smaller cultivators in some states

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

Table 2: Land reforms in India's 16 major states: the years of specific reforms

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).

Table 3: 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
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

Note: 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.

Table 4: Effect of experiencing land reforms before age 18 on women's height

	Current rural	Current rural versus current urban	Always rural	Always rural versus always urban
	(1)	(2)	(3)	(4)
Any tenancy reform before age 18	-0.16	0.083	-0.116	0.131
	[0.231]	[0.211]	[0.226]	[0.179]
Any abolition of intermediaries reform before age 18	0.640***	0.462***	0.648***	0.04
	[0.125]	[0.126]	[0.129]	[0.158]
Any land ceiling reform before age 18	2.103***	1.398***	2.102***	3.017***
	[0.129]	[0.124]	[0.134]	[0.168]
Any land consolidation reform before age 18	0.692***	1.298***	0.679***	0.632**
	[0.102]	[0.189]	[0.106]	[0.231]
Constant	149.276***	151.611***	149.316***	151.461***
	[0.376]	[0.252]	[0.396]	[0.457]
Observations	47009	67631	43724	55291
Number of states	16	16	16	16
State fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
State - group (rural) interactions	No	Yes	No	Yes
Cohort - group (rural) interactions	No	Yes	No	Yes
State - Cohort interactions	No	Yes	No	Yes

Note: The dependent variable is height in centimeters. Columns (1) and (3) report estimates of α^j from equation 1.1, and columns (2) and (4) report estimates of δ^j from equation 1.2. All regressions include controls for caste (dummies for Scheduled Caste, Scheduled Tribe, Other Backward Caste), and religion (dummies for Muslim, Christian, Sikh).

Figure 1: DoDoD estimates of the effects of differential exposure on height along with 95% confidence intervals for all rural women

Figure 1a: Effect of abolition of intermediaries

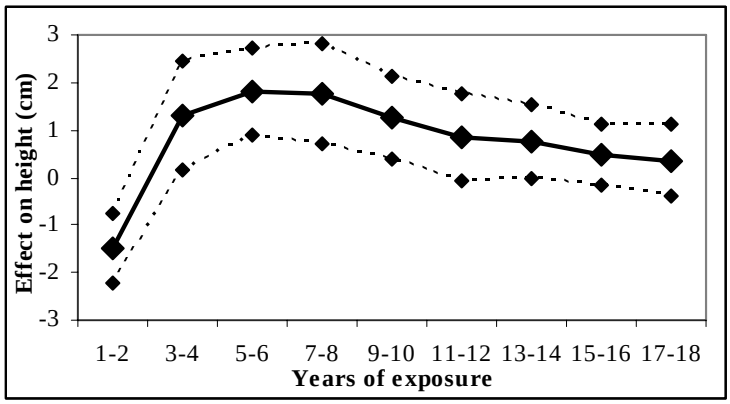


Figure 1b: Effect of land ceiling legislations

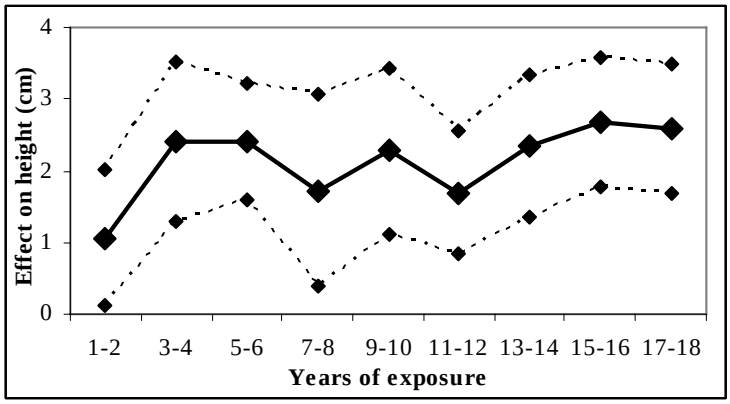
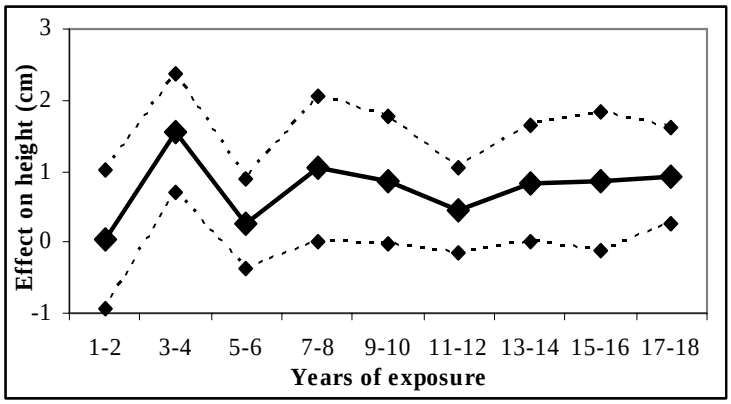


Figure 1c: Effect of land consolidation reforms



Note: Plotted estimates and confidence intervals are for women's height and were obtained from the DoDoD estimates of η^{qj} from estimating equation 2 on the current rural versus current urban sub-samples. The omitted category is no exposure or zero years of exposure to particular reforms. The estimates for tenancy reforms are omitted due to lack of sufficient variation in exposure to tenancy reforms.

Figure 2: DoDoD estimates of the effects of differential exposure on height along with 95% confidence intervals for non-migrant rural women

Figure 2a: Effect of abolition of intermediaries

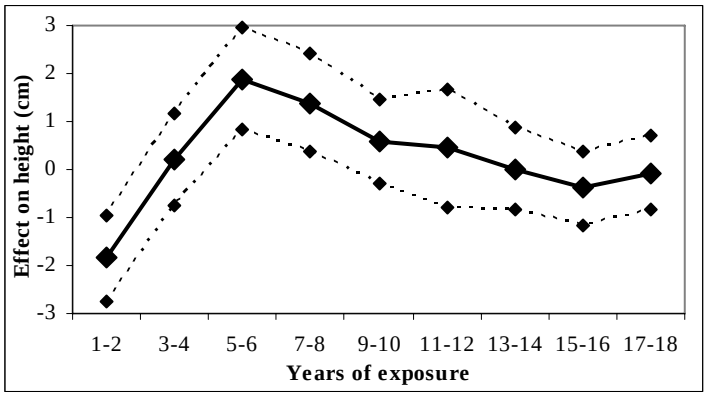


Figure 2b: Effect of land ceiling legislations

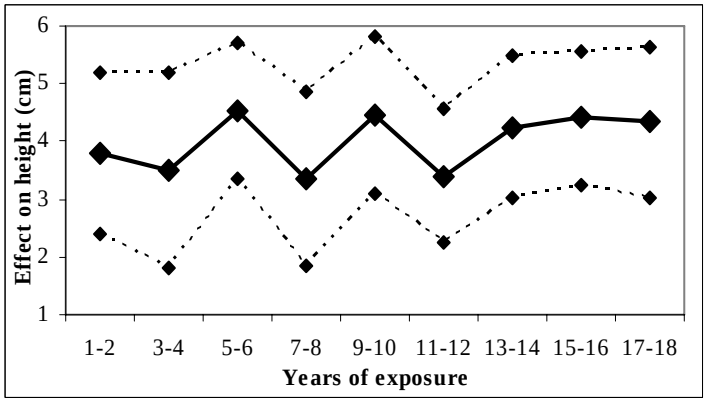
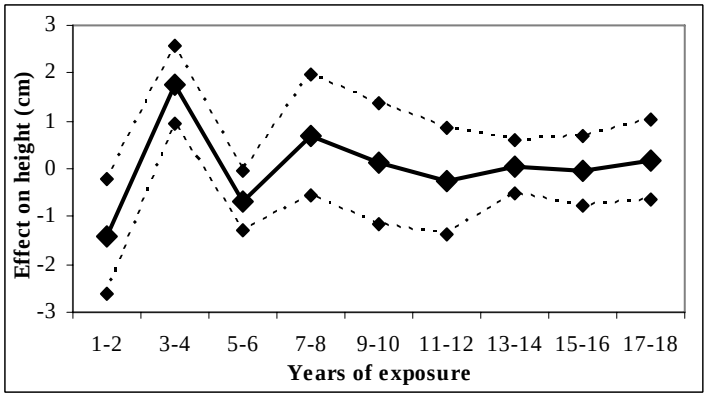


Figure 2c: Effect of land consolidation reforms



Note: Plotted estimates and confidence intervals are for women's height and were obtained from the DoDoD estimates of η^{qj} from estimating equation 2 on the always rural versus always urban sub-samples. The omitted category is no exposure or zero years of exposure to particular reforms. The estimates for tenancy reforms are omitted due to lack of sufficient variation in exposure to tenancy reforms.

Table 5: Effect of experiencing land reforms before age 18 on women's schooling

	Current rural	Current rural versus current urban	Always rural	Always rural versus always urban
	(1)	(2)	(3)	(4)
Any tenancy reform before age 18	0.009	0.082	0.03	0.7
	[0.130]	[0.235]	[0.133]	[0.406]
Any abolition of intermediaries reform before age 18	0.496***	1.070***	0.523***	0.848**
	[0.138]	[0.283]	[0.139]	[0.311]
Any land ceiling reform before age 18	1.135***	0.161	1.246***	0.2
	[0.124]	[0.275]	[0.125]	[0.305]
Any land consolidation reform before age 18	-0.141	0.237	-0.176	-0.13
	[0.121]	[0.232]	[0.122]	[0.264]
Constant	1.450***	5.882***	1.074***	7.325***
	[0.242]	[0.222]	[0.216]	[0.313]
Observations	50898	73025	47360	59855
Number of states	16	16	16	16
State fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
State - group (rural) interactions	No	Yes	No	Yes
Cohort - group (rural) interactions	No	Yes	No	Yes
State - Cohort interactions	No	Yes	No	Yes

Note: The dependent variable is years of schooling. Columns (1) and (3) report estimates of α^j from equation 1.1, and columns (2) and (4) report estimates of δ^j from equation 1.2. All regressions include controls for caste (dummies for Scheduled Caste, Scheduled Tribe, Other Backward Caste), and religion (dummies for Muslim, Christian, Sikh).

Figure 3: DoDoD estimates of the effects of differential exposure on schooling along with 95% confidence intervals for all rural women

Figure 3a: Effect of abolition of intermediaries

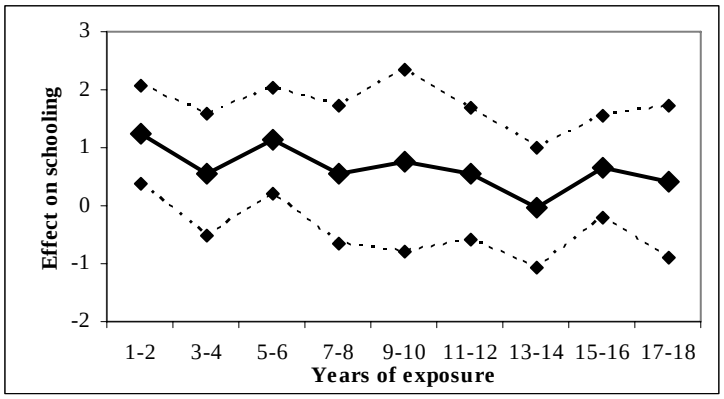


Figure 3b: Effect of land ceiling reforms

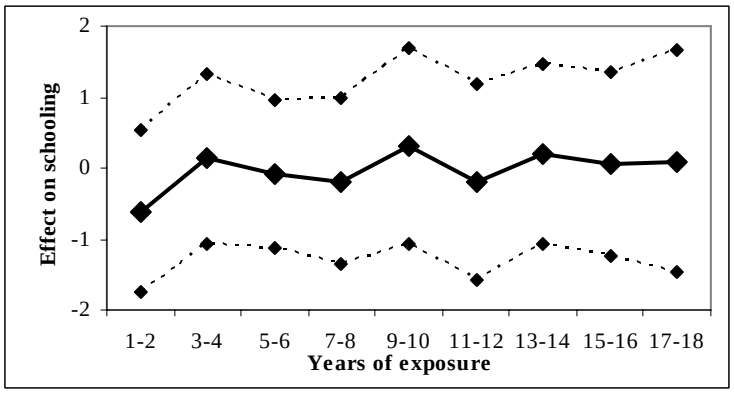
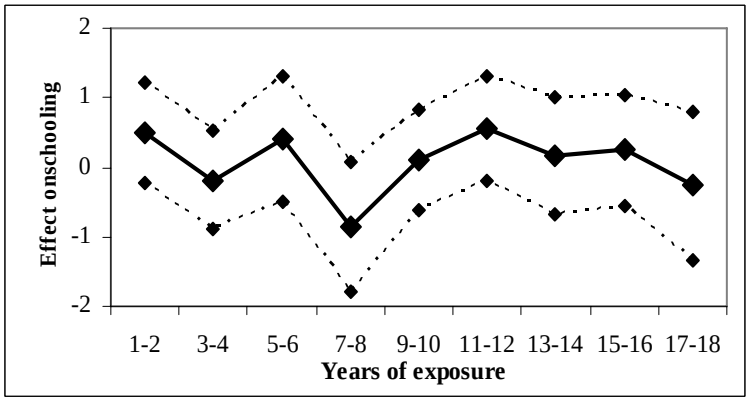


Figure 3c: Effect of land consolidation reforms



Note: Plotted estimates and confidence intervals are for women's years of schooling and were obtained from the DoDoD estimates of η^{qj} from estimating equation 2 on the current rural versus current urban sub-samples. The omitted category is no exposure or zero years of exposure to particular reforms. The estimates for tenancy reforms are omitted due to lack of sufficient variation in exposure to tenancy reforms.

Table 6: Effects of age-specific exposure to land reforms

	Effects on height		Effects on schooling	
	Current rural versus current urban	Always rural versus always urban	Current rural versus current urban	Always rural versus always urban
	(1)	(2)	(3)	(4)
Any tenancy reform before age 6	0.233	0.464	0.268	0.879
	[0.300]	[0.465]	[0.423]	[0.752]
Any tenancy reform between ages 7 & 12	0.054	0.408	0.254	1.015*
	[0.215]	[0.362]	[0.288]	[0.517]
Any tenancy reform between ages 13 & 18	-0.088	0.601	-0.004	0.729
	[0.451]	[0.380]	[0.289]	[0.714]
Any abolition of intermediaries reform before age 6	0.38	-0.121	1.007**	0.685
	[0.231]	[0.345]	[0.425]	[0.447]
Any abolition of intermediaries reform between ages 7 & 12	0.576	0.435	1.051***	1.015**
	[0.372]	[0.267]	[0.351]	[0.464]
Any abolition of intermediaries reform between ages 13 & 18	-0.351	-0.572	1.132***	0.604*
	[0.352]	[0.467]	[0.306]	[0.311]
Any land ceiling reform before age 6	1.444**	3.640***	0.077	-0.073
	[0.529]	[0.610]	[0.612]	[0.870]
Any land ceiling reform between ages 7 & 12	0.884	3.111***	0.016	-0.072
	[0.617]	[0.703]	[0.397]	[0.688]
Any land ceiling reform between ages 13 & 18	1.050**	3.161***	-0.053	0.045
	[0.379]	[0.533]	[0.281]	[0.548]
Any land consolidation reform before age 6	1.086**	0.302	0.093	-0.312
	[0.369]	[0.400]	[0.422]	[0.442]
Any land consolidation reform between ages 7 & 12	0.878***	0.425	0.212	0.012
	[0.245]	[0.253]	[0.264]	[0.320]
Any land consolidation reform between ages 13 & 18	0.901*	0.566	0.096	-0.065
	[0.496]	[0.353]	[0.244]	[0.353]
Constant	151.604***	151.626***	5.901***	7.342***
	[0.263]	[0.370]	[0.217]	[0.306]
Observations	67631	55291	73025	59855
Number of states	16	16	16	16

Note: All estimates are DoDoD estimates from an extension of equation 1.2. 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).

Table 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

Note: 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 8: Effect of mother's exposure to land reforms on children's HAZ

	Current rural	Current rural versus current urban
	(1)	(2)
Mother experienced tenancy reform before age 18	0.435	0.387
	[0.365]	[0.390]
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

Note: 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.