Impact of an Employment Guarantee Program on Child Health and Women's Reproductive Behaviours in Rural India

by

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Abstract

In this dissertation, I examine the impact of the world's largest employment guarantee program on child health and women's reproductive behaviours in rural India. The program, popularly known as National Rural Employment Guarantee Scheme (NREGS) was introduced in India in 2005. I utilize two waves of a nationally representative datasets to perform the analyses. The phase-wise implementation of the NREGS program provides an opportunity to employ the Difference-in-Difference estimation strategy to assess the impact of the program on the chosen outcome variables.

The following is a summary of each of the essays in my dissertation.

Impact of an Employment Guarantee Program on Child Health- Evidence from India

As anti-poverty initiatives, many countries, regardless of their financial level, have used and continue to use various employment guarantee programs. It has been established that improved health is critical to overcoming poverty and achieving the larger objective of socioeconomic development. The National Rural Employment Guarantee Schemes (NREGS), which was enacted in 2005 in India, is one of the world's largest employment guarantee programs aimed at alleviating poverty.

This research examines the impact of this employment guarantee scheme on infant and child mortality in India. The program's phased implementation allows for the use of a difference-in-difference technique to determine the influence of this program on the outcomes. The study was conducted using two waves of nationally representative District Level Household and Facility Survey data.

For the districts that were subjected to NREGS, the infant mortality rate increased by 1.2 infants per 1000 live births. The poor and disadvantaged households, who were targeted by NREGS, experienced a greater detrimental impact (infant mortality increased by 1.71 and 4.12 per 1000 live births, respectively). Further analysis suggests that the indirect effect of women substituting time away from time-intensive activities and detrimental health effects are the two channels through which NREGS has led to an increase in infant mortality.

Impact of an Employment Guarantee Program on the Reproductive Behaviours of Women in Rural India

Developing countries frequently implement a variety of family planning policies aimed at reducing the overall fertility level. Researchers often raise concern that supply-side interventions to reduce fertility may not have the desired effect if demand for fertility remains high. Although the studies are primarily based on developed countries, researchers indicate that increasing female work opportunities is a critical measure that can lower the demand for fertility. This study investigates if such an effect can be observed following the implementation of the world's largest employment guarantee program, the National Rural Employment Guarantee Schemes (NREGS), which had a specific goal to increase women's employment in rural India.

Two waves of nationally representative District Level Household and Facility Survey data were utilized in the study. NREGS had a differential impact on the reproductive behaviours of women, depending on their household type. Women from marginalized caste households showed a preference for increased fertility after NREGS implementation. Further analysis suggests that women from marginalized caste households experience a strong quantity income effect of NREGS, resulting in a preference for higher fertility.

On the other hand, women from comparatively poorer households and younger women showed a preference for lower fertility; the point estimate showed 0.27 to 0.3 fewer chil-

dren being born. NREGS has a strong time substitution effect on women from poorer households. While a significant quality income effect was observed for the younger women. Both result in a decrease in fertility outcomes. This study also highlights the significance of expected future employment and the community effect as factors that influence reproductive behaviours, and thereby the fertility levels of women in rural India.

Preface

This thesis is an original work by Samprita Chakraborty. No part of this thesis has been previously published.

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1 Introduction

Sustainable development with improving social and economic conditions is one of the most sought-after issues for practically every nation in the world. As anti-poverty measures, several countries have used and continue to use various social safety net initiatives. Employment Guarantee Schemes (EGSs) are one such type of measure that is used to reduce poverty by lowering unemployment, increasing income, and improving infrastructure for the targeted groups. Women's participation is also encouraged in these initiatives, with the goal of promoting gender equality (Hagen-Zanker et al., 2011; Subbarao et al., 2012).

In 2005, India introduced an employment guarantee scheme, popularly known as National Rural Employment Guarantee Schemes (NREGS) targeted to the rural population of the country. The main objectives of NREGS were to provide employment opportunities and to create sustainable rural livelihoods through durable assets creation, for the vulnerable population of the country. NREGS provides 100 days of guaranteed employment to any member belonging to a rural household in the country, at a set minimum wage. By 2009, NREGS had provided employment to 52 million households, making it the world's largest social safety net program (Sharma, 2010).

By increasing employment opportunities, thereby increasing income; and by improving rural infrastructure, NREGS has significantly improved the quality of rural livelihoods (United Nations Development Programme, 2015). However, the sheer operating scale of NREGS has led to significant spillover effects on other socioeconomic measures. It is important to examine the significance of such spillover effects, to understand the true impact of NREGS on the livelihood of its targeted population.

In chapter 2 of this thesis titled "Impact of an Employment Guarantee Program on Child Health Outcomes-Evidence from India", I investigate the impact of NREGS on child health. Due to its nature of implementation, it is impossible to predict a priori what the impact of

NREGS would be on children's health. On the one hand, by providing employment, NREGS increases the household income. Increased income can lead to an increase in investment in health-related activities, resulting in improved health outcomes. Improved rural connectivity brought about by NREGS can improve access to healthcare facilities or services, which also favourably impacts health outcomes. On the other hand, increased employment opportunities increase the opportunity cost of time-intensive health-promoting activities. Furthermore, the physical labour and stress required by NREGS employment can be harmful to the health of a pregnant woman or a new mother. Both these factors highlight the negative effect of the NREGS that can worsen child health.

Therefore, I empirically examine how the NREGS have affected child health, specifically the infant and child mortality rates. I further examine the channels through which NREGS affects the child health. I utilize two waves (2002/04 and 2007/08) of nationally representative District Level Household and facility Survey (DLHS) data to perform my research. I find that NREGS has adversely affected the child health. Following NREGS implementation, the infant mortality rate had increased significantly. This adverse effect was more pronounced for poorer and marginalized caste households, who were the targeted population of NREGS. While investigating the channels through which NREGS influenced child health, I find that the opportunity of NREGS employment has prompted the women to substitute time away from types of time-intensive activities that may indirectly affect the child health. NREGS also imposes a detrimental health effect on pregnant women and new mothers, which can lower their ability to nurture their children. This also has an adverse impact on the child health.

In chapter 3 of this thesis titled "Impact of an employment guarantee program on the reproductive behaviour of women in rural India", I investigate the impact of NREGS on the reproductive behaviours of rural women who had an opportunity to opt for NREGS employment. "Reproductive behaviours" is a collective term that encompasses the fertility

outcome, intention, and preferences of these women. As before, it is also impossible to predict a priori what the impact of NREGS would be on the reproductive behaviours of these women. On the one hand, increased employment can lead to an increase in household income. Quantity/quality trade-off theory implies that the effect of higher income on reproductive behaviours is uncertain. The fertility outcome will depend on the couple's decision to invest the increased income by either having additional children (quantity) or investing in the well-being of existing children (quality). Additionally, increased employment raises the opportunity cost of having children, especially for women. This effect is likely to promote fertility-reducing reproductive behaviours. With increased employment and higher income, women are also likely to have higher intra-household bargaining power. This empowerment effect is also likely to promote fertility-reducing behaviours, as the literature suggests that women usually prefer to have fewer children than their husbands (Mason, 1997; Upadhyay and Karasek, 2012; Schaller, 2016). The influence of NREGS on the reproductive behaviours of the women will depend on the interplay between all these effects.

Therefore, for this chapter also, I empirically examine how NREGS has affected the reproductive behaviours of the women who had an opportunity of NREGS employment. Specifically, I examine the impact of NREGS on the number of children born, the probability of contraceptive use, the duration of contraceptive use, and the intention of having additional children. I further examine the channels through which NREGS affects these reproductive behaviours. For this research, I again utilize two waves (2002/04 and 2007/08) of nationally representative District Level Household and facility Survey (DLHS) data to perform the analyses. I find that the impact of NREGS on reproductive behaviours varies depending on the household composition. Following NREGS implementation, the marginalized caste households opt for fertility-promoting behaviours. For these households, a strong quantity income effect leads to fertility-promoting behaviours. However, women from low and medium income households and younger women opt for fertility-reducing behaviours. A large time substitution effect influences the responses of women in low income households, while a stronger quality

income effect influences the responses of women in middle income households.

Households belonging to the marginalized castes are also the poorer households in a community. Therefore, the contrasting results between these two types of households (fertility-promoting behaviours for marginalized castes, and fertility-reducing behaviours for low and middle income households) highlight the significance of customs and community traditions in rural India.

An indirect time substitution effect and a strong quality income effect together influence the reproductive behaviours of women aged 15 to 17 years. Additionally, there is an effect of "hope" observed for these young women. Because of an assured job opportunity in near future, these women respond by reducing their current fertility and intention for future fertility as well.

Both these essays make important contributions to the growing literature assessing the impact of NREGS on different socioeconomic outcomes. I document how the NREGS have influenced the child health and the reproductive behaviours of women. I also present the probable channels through which these effects are observed.

The results observed in this research also have policy implications. As Employment Guarantee Schemes (EGSs) are increasingly being used as social safety net programs all over the world, policymakers should also consider the negative spillover effects these programs may have. My first essay shows that NREGS adversely affects child health. Worse child health can have significant welfare costs in the future (Alderman et al., 2006; Dercon and Porter, 2014; Hoddinott et al., 2008). Therefore, while implementing EGSs policymakers should also consider implementing additional measures to mitigate the risk of adverse outcomes on child well-being. My second essay shows that the impacts of NREGS on reproductive behaviours, and thereby on fertility outcome, differ both in direction and magnitude depending on the household composition. Policymakers in the field of family planning will benefit by being aware of these opposing effects. It would help them to formulate policies that will encourage

women in poorer households to engage in EGSs or other possible work opportunities. While, they should also formulate policies targeted to marginalized caste households, which should counteract their intention for higher fertility.

The outline of this thesis is as follows: In chapter 1, I present an overview of the thesis in the introduction. In chapter 2, I investigate the impact of NREGS on child health. In chapter 3, I investigate the impact of NREGS on the reproductive behaviours of women in rural India.

2 Impact of an Employment Guarantee Program on Child Health Outcomes-Evidence from India

2.1 Introduction

Public work programs are increasingly becoming popular as social protection and safety net measures for countries all over the world. Both low and middle income countries resort to various types of public work programs to respond to economic shocks, and also to promote labour force participation. Employment Guarantee Schemes (EGSs) are one such measure that provides an opportunity to lower poverty by lowering unemployment, increasing income and improving infrastructure for the targeted groups.[1] To promote gender equality, these programs often make provisions to encourage women's participation (Hagen-Zanker et al., 2011; Subbarao et al., 2012).

Programs like EGS have the potential to significantly improve the health of the targeted population, particularly the children. On the one hand, EGS improves the employment opportunity and thereby income of the household. Increased income can lead to an increase in investment in health-related activities, which can result in better health outcomes. If a mother's income rises in a household, more money will be spent on child health and other related activities (Schultz, 2005; Bhupal and Sam, 2014).

Increased work, on the other hand, means that program participants, particularly mothers, have less time to devote to childcare. This may have a harmful effect on the health of the child. Multiple studies have found that as women's employment levels rise, they have less time to invest in household chores (Bianchi, 2000), which can negatively impact children's cognitive development (Bagavathinathan and Chaurey, 2020), as well as the quality of their food consumption (Crepinsek and Burstein, 2004). Furthermore, with an increase in mothers'

[1] Governments also employ unconditional cash transfers and conditional cash transfers as social safety net interventions. (Subbarao et al., 2012)

employment, a reduction in the survival rates of newborn children was also observed (Miller and Urdinola, 2010). Moreover, the stress and exertion associated with manual activities can have a detrimental effect on a mother's health or the fetal health, leading to a worse outcome for the newborn children (Rao et al., 2003; Dwarkanath et al., 2007). For the purpose of this analysis, the positive effects of an EGS will be collectively called the *positive program effect*, while the negative effects will be collectively called the *negative program effect*.

An EGS's goal of eliminating poverty can only be met if the program has a long-term impact on the targeted population's productivity and living standards. Furthermore, existing research have shown that investing in human capital development at a young age can lead to higher human capital production later in life (Alderman et al., 2006; Hoddinott et al., 2008). But as already discussed, due to the negative program effect, an EGS can also adversely affect child health. Because of the interplay between these conflicting effects, it is impossible to determine a priori what effect an EGS will have on a child's health. As a result, it is critical to examine the potential influence of an EGS on child health.

The National Rural Employment Guarantee Scheme (NREGS) is an EGS that was implemented in India in 2006.[2] NREGS was developed to minimize the rural population's reliance on agricultural wages, which were frequently subject to seasonal fluctuations and weather shocks. According to the World Bank (2013), India's agriculture sector employed 47.2 percent of the country's workforce. Agricultural work is by its very nature seasonal. As a result, there is generally a strong demand for labor during the peak season, whereas demand drops during the off-peak season. Credit markets are either non-existent or underdeveloped in many rural places. This job volatility, along with a lack of a functioning credit market, prevents rural households from smoothing out their consumption and exposes them to unfavorable economic shocks (Lal et al., 2010).

[2]The National Rural Employment Guarantee Act, which was passed in India's parliament in August 2005, provided the foundation for NREGS. In 2009, the name of the program was changed to Mahatma Gandhi National Rural Employment Guarantee Scheme.

NREGS aims to provide households in rural areas of the country with a minimum of 100 days of employment at a defined minimum wage. It also aims to develop sustainable rural livelihoods by constructing and rehabilitating long-lasting infrastructures such as roads, wells, ponds and so on. NREGS guarantees employment to any adult household applicant within 15 days of application. If a job cannot be offered, the state government is responsible for providing the applicant with unemployment benefits. To encourage female participation, NREGS stipulated that at least 33 percent of NREGS jobs be available to women, as well as equal pay for both men and women participants. According to the 2011 Census of India, the rural population comprised around 69 percent of the overall population. As a result, when NREGS was first implemented, it was the world's largest social protection program in terms of households covered (Sharma, 2010).

Over 121 million job cards were registered with NREGS in 2014.[3] This means that every rural home in India, on average, had at least one job card (although, it is unlikely practically). Over the years 2006 to 2014, women's participation in NREGS has remained consistently high, much exceeding the required 33 percent (Sukhtankar et al., 2016; Ministry of Rural Development, 2010). NREGS, like all other EGSs around the world, can directly affect the local labor market by influencing local employment and local wages (Zimmermann, 2012; Imbert and Papp, 2015; Azam, 2012).[4] However, because of its magnitude, NREGS has the potential to have major spillover effects on other areas of human development, including health, education, and nutrition.

Unsurprisingly, a large literature exists that investigates the impact of NREGS implementation on a variety of outcomes, including consumption (Bose, 2017), education (Shah and Steinberg, 2019), nutrition (Liu and Deininger, 2010), and so on. The effect of NREGS on

[3]NREGS job card is the identity document issued to an individual who registers for NREGS employment with the respective local authority (Sharma, 2010).

[4]EGS examples in various scales and with various goals can be found all over the world. EGSs in low-income countries include the Ethiopian Productive Safety Net Program (PSNP), the Rural Maintenance Program, and the Food for Assets in Bangladesh. In high-income nations, the Jefes program in Argentina and the Expanded Public Works Program (EPWP) in South Africa are some examples of EGSs (Subbarao et al., 2012).

children's health is mostly unknown. The majority of existing research looked at the impact of NREGS at a regional level, with a small subset of the population (Nair et al., 2013, 2014). (Chari et al., 2019) analyzed the influence of NREGS on newborn health at the nationwide level for the first time. To add to the growing literature examining the impact of NREGS on human development, this study investigates the impact of NREGS implementation on children's health, specifically the infant and child mortality rates.

This study exploits spatial and temporal variation in the implementation of the NREGS and employs a difference-in-difference (DID) method to perform the analysis. Two waves of nationally representative, District Level Household and facility Survey (DLHS) data were utilized to perform the analysis. An earlier wave of the DLHS data was also utilized to perform a pre-trend analysis. The results show that there was no pre-trend which increases the confidence in the DID method's ability to assess the impact of NREGS on the health outcomes. It can be seen that following the NREGS implementation, the infant mortality rate (IMR) increased significantly by 1.2 more infant deaths per 1000 live births (average IMR = 5.8 per 1000 live births). This negative effect of NREGS was more intense for poor households (1.71 more infant deaths per 1000 live births) and the scheduled caste households (4.12 more infant deaths per 1000 live births), who were the target groups of NREGS.[5]

To investigate the channels through which NREGS could affect the infant health, additional analyses were done on exclusive breastfeeding duration, number of antenatal care visits, probability of different facilities deliveries and probability of home delivery, maternal death, and the stillbirth rates. The results suggest that NREGS may affect infant health negatively due to two strong effects. First, due to an increase in employment following NREGS, women are substituting time away from types of time-intensive activities that can have an indirect negative impact on infant health. Second, results for maternal death and stillbirth rates show that NREGS imposes a detrimental health effect on pregnant women and new mothers, which decreases their ability to properly nurture their infants. This effect is threatening for the

[5]Average IMR for both the poor households and scheduled caste households was 6.8 per 1000 live births.

infants, who are at the most vulnerable age of their life.

From the literature assessing the impact of NREGS, it is evident that NREGS have a substantial positive effect in improving the livelihood of the rural population of India. But, as this study shows, NREGS can have negative spillover effects as well, especially on children's well-being. This is an important concern that should be considered by the Government of India, or any government for that matter, who are considering implementing an EGS. Worse child well-being can have significant welfare costs in the future (Alderman et al., 2006; Dercon and Porter, 2014; Hoddinott et al., 2008). Therefore, consideration should be given to additional measures whilst implementing EGS to mitigate the risk of adverse outcomes on child well-being, by providing better support to women with younger children who participate in NREGS. These measures may include better implementation of the childcare services provided on-site of employment. It may also include the organization of awareness programs that emphasize the importance of activities like drinking clean water and practicing good feeding habits, among others. Pregnant women and new mothers might also be allocated to tasks requiring less manual labour, which would counteract the detrimental health effect of the program.

The remainder of this chapter is structured as follows. The background for this study is presented in section 2.2. It includes a review of relevant literature for this study, a brief introduction to NREGS program, and a summary of the National Rural Health Mission (NRHM), a health program that is extremely relevant to this study. The conceptual framework for the analyzed model is presented in section 2.3. Section 2.4 presents the information on the data, providing a description of the survey, a discussion of the sample, and a discussion of the variables considered in the analysis. Section 2.5 describes the estimation procedure with a discussion on the identification strategy, the level of estimation, and the utilized model. The results of the analysis are presented in section 2.6. Section 2.7 discusses the results, while section 2.8 concludes.

2.2 Background

2.2.1 Literature Review

Impact of other EGSs on child health: EGSs, as previously stated, are a type of social protection program commonly employed by low and middle-income nations to provide a road to poverty reduction. However, as Hagen-Zanker et al. (2011) and Subbarao et al. (2012) emphasize, these programs differ greatly in their design, implementation, context, and target population. It is unsurprising that the impact of the different EGSs on poverty and other development indices vary greatly. Hagen-Zanker et al. (2011) emphasized that the heterogeneity in multiple aspects of EGSs across countries makes a general comparison of these programs meaningless and hence misleading. Nonetheless, reviewing the papers studying the impact of EGSs on health, especially that of children, is informative.

Along with the NREGS, the Public Safety Net Program (PSNP), which began in Ethiopia in 2005, is likely the most researched EGS. However, studies on the impact of PSNP on children's health are still limited. According to Porter and Goyal (2016), both the short-term nutritional benefit (measured in terms of weight-for-height) and the long-term nutritional benefit (measured in terms of height-for-age) of children in participating households improved after the PSNP was implemented. Better food security and a reduction in child labor are the key reasons for these increases in nutritional benefits.

On the other hand, Berhane et al. (2017) and Belete (2021) show that PSNP did not result in any reduction in stunting or wasting among children in participating households. The authors show that children under the age of seven in PSNP-participating households are more stunted than their non-participating counterparts. The authors attribute this failure to children's poor diet quality and mothers' lack of awareness about proper feeding techniques. They further show that the inability to improve child outcomes is due to the presence of inequity in intra-household resource allocation, parental labor demands, and insufficient

PSNP income. Due to these conflicting results between Porter and Goyal (2016), Berhane et al. (2017) and Belete (2021), the impact of PSNP on child nutrition outcomes is therefore inconclusive.

The impact of PSNP on child cognitive abilities was investigated by Favara et al. (2019). They provide suggestive evidence that PSNP may help children improve their cognitive ability. When comparing children from houses that had graduated (participated but left) from the program to children from households that were still participating in the program, the effect is more pronounced. The time effect is highlighted by the authors, implying that households that have completed the program have more time to invest in childcare.

PSNP's impact on household dietary diversity (HDD) and women's BMI was investigated by Irenso and Atomsa (2018). Despite the study's modest sample size (1258 women in Ethiopia's Kombolcha area), the authors identified some fascinating and concerning characteristics. PSNP had a stronger effect on enhancing HDD but had no influence on women's BMI, according to the findings. This means that while households may have profited from the PSNP, the advantage may not have been passed on to all members of the household. According to the authors, this could be due to time, money, and other factors that could alter the women's nutritional state.

Cho and Ruthbah (2018) investigated the influence of Bangladesh's Employment Generation Program for the Poorest (EGPP) on a number of poverty indicators, including household nutrition and overall healthcare spending. The authors discovered that rather than the quantity of food consumed, the quality of food consumed had improved among participating households. They also notice a significant (approximately 35 percent) increase in healthcare spending among the participants. Both male and female members of the households experienced an increase in healthcare spending.

The inconclusive results for the effect of PSNP on child health as well as the diverse consequences of different EGSs on women's healthcare, further support the conclusion made

by Hagen-Zanker et al. (2011), that the impact of EGSs must be analyzed individually and carefully due to the variety in numerous elements of the implementation of the EGSs both within a country and across the world.

Impact of NREGS on other outcomes: The impact of NREGS on various outcomes has been extensively studied in the literature. The influence of NREGS on the labor market was studied by (Zimmermann, 2012; Imbert and Papp, 2015; van den Berg et al., 2010; Azam, 2012). Both Azam (2012) and Imbert and Papp (2015) analyzed data from two rounds of National Sample Survey (NSS) (one from 2004-05 and the other from 2007-08). They used a difference-in-difference technique. According to the studies, once the NREGS was implemented, there was an overall drop in private-sector jobs, which included self-employment and domestic work. Women's participation in the labor force had grown. According to Azam (2012), both men's and women's actual wages grew as a result of NREGS, but the percentage rise was bigger for women than for men (8 percent vs 3.8 percent). While van den Berg et al. (2010) discovered an increase in the general wage rate, the effect was gender-neutral and particularly for unskilled workers.

Zimmermann (2012), however, showed no influence on male wage rates and a significant increase in female wage rates using the same NSS data but a different empirical approach (Regression discontinuity design). The disparity in the findings of these studies can be attributed to the authors' focus on different comparison groups. In conclusion, it appears that the real wage rate increased after NREGS implementation, particularly for women. Women's participation in the labor force has also risen.

The impact of NREGS on consumption and nutrition has been researched by (Ravi and Engler, 2015; Liu and Deininger, 2010; Bagavathinathan and Chaurey, 2020; Klonner and Oldiges, 2012; Bose, 2017). Both Ravi and Engler (2015) and Liu and Deininger (2010) looked at data from Andhra Pradesh, India. Following the establishment of the NREGS, both

studies indicated that per capita expenditure at the household level increased. The quality of the food consumed improved, and the likelihood of savings and wealth accumulation increased (Ravi and Engler, 2015; Liu and Deininger, 2010). Klonner and Oldiges (2012) and Bose (2017), using data from the National Sample Survey (NSS), found comparable results on consumption as the previous two research. They both found that for households with access to NREGS, household per capita expenditure grew. Both analyses suggest that the impact is greater for households from underprivileged castes who were given priority for NREGS jobs. Klonner and Oldiges (2012) also discovered that marginalized caste households experienced a reduction in poverty, as measured by various poverty indices.

On the other hand, using national-level data, Bagavathinathan and Chaurey (2020) studied the impact of NREGS on children's meal intake. This study is different from others, because of the outcome variable considered. Children's meal intake at home requires a time commitment from the women of the households. The authors find that the number of meals consumed at home, by preschool and school-going children, was reduced following NREGS implementation. The number of meals were lower for small landholders or marginalized caste households, which were likely to take up NREGS employment. It was also lower during the lean agricultural seasons when households were likely to take up NREGS employment. Additionally, the quality of the meal did not improve either. In summary, these studies capture the positive income effect of the NREGS program on consumption and expenditure. However, for components that require time commitment from the women, the negative time effect is observed.

(Afridi et al., 2016; Shah and Steinberg, 2019; Li and Sekhri, 2013) analyzed the impact of NREGS on child education and child labor. Afridi et al. (2016) used the Young lives survey data from Andhra Pradesh state of India. The authors find that following mother's labor force participation the children's, especially girls' time spent in school had improved, along with their grade progression. The author attributes this finding to the improvement

in female bargaining power. However, these results were not reflected at the national level. Using different data sets, Li and Sekhri (2013) and Shah and Steinberg (2019) have found that in general school enrollment and school performance has suffered following NREGS implementation. They also find that the child labor has increased. It is more likely that the adolescent boys were taking up other wage employments, while adolescent girls were substituting into unpaid domestic works. Although, Shah and Steinberg (2019) showed that younger children benefited from the program with better scores and higher enrollment at an earlier age.

In summary, these papers highlight the negative time effect of NREGS. They show that the educational development became worse for older children following NREGS implementation, while the younger children may have benefited.

Impact of NREGS on health outcomes: Literature on the impacts of NREGS on different health-related outcomes is not as abundant as it is on the other outcomes. Earlier studies had focused on smaller sub-sample and anecdotal evidence. More recently, several studies have been published that looked at the impact of the NREGS on different health outcomes at the national level. Nair et al. (2013) looked at the effect of NREGS employment on the malnutrition of infants, based on the prevalence of underweight, wasting and stunting in children under 5 years of age.[6] This study used data from 528 households with 1056 participants. Nair et al. (2014) assessed the effect of women's employment on infant feeding and care. The study recruited 62 mothers, divided into 10 focus discussion groups. Both studies were conducted in Dungarpur district of Rajasthan and both had small datasets. The authors found that NREGS participant households were less likely to have wasted and underweight infants compared to non-participant households. The authors claimed that the reduction in infant malnutrition among participating households was mainly because of

[6]Underweight is an indicator of child health. It implies low weight for age for a child. Wasting or thinness is an indicator of the current nutritional status of a child. It implies low weight for height for a child. Stunting is a measure of long term growth for a child. It implies low height for age for a child.

improvement in birth-weight rather than improved infant feeding.

Due to the small sample sizes, these studies can not be generalized for the country. However, the findings are in line with the general observation that was made in the previous section. Following NREGS employment, a positive income effect was observed in different outcomes, unless the outcomes considered require a time commitment from the women (or mothers). In which case, a negative time effect is observed.

(Tsaneva and Balakrishnan, 2019; Parmar and Banerjee, 2019; Chari et al., 2019) looked at the impact of NREGS employment on mental health, maternal health care utilization, and neonatal mortality respectively. Tsaneva and Balakrishnan (2019) utilized the nationally representative SAGE (Study on global AGEing and adult health) data and found that women who had the opportunity to participate in NREGS were less likely to experience depression symptoms. They attributed this effect to the increase in economic security and independence that came with employment and earnings through NREGS.

To investigate the influence of NREGS on maternal health care utilization, Parmar and Banerjee (2019) employed data from the nationally representative DLHS (District Level Household and Facility survey) using a difference-in-difference (DID) model. The authors discovered that once NREGS was implemented, there was no change in percentage of overall facility based delivery. However, the percentage of public-sector based delivery grew, while that of private-sector based delivery fell. The authors also discovered that the percentage of home based delivery rose for poorer households (who are more likely to use NREGS). Furthermore, the authors discover no change in the marginalized caste households' health-seeking behavior. The authors speculate that these impacts are due to an increase in women's time opportunity costs as a result of NREGS implementation. This study again emphasizes the negative temporal effect of the NREGS on such outcome that requires time commitment from the women. However, the results may be biased as the authors control for wealth status which is likely to suffer from endogeneity.

Contemporary and closely related to this study is Chari et al. (2019). It is the first study to extensively examine the impact of NREGS implementation on neonatal mortality.[7] The authors also use DLHS data and three different methodologies to investigate the program's intent-to-treat effect. The strategies are: a) DID with parallel trend assumption, b) Triple DID with this assumption relaxed, and c) a triple DID design using a parametric regression discontinuity approach. They conclude that the program has a considerable impact on neonatal mortality among women who have worked for NREGS. The authors attribute these unfavorable consequences on neonatal mortality to a "crowd-out" hypothesis. According to this hypothesis, increased maternal employment displaces time-consuming health-related activities. The authors also imply that work-related stress and effort may have a detrimental impact on neonatal mortality.

However, Parmar and Banerjee (2019) and Chari et al. (2019) did not account for the health policy that was implemented concurrently with NREGS across the country.[8] Because this policy could have a major impact on the outcomes used in these two investigations, accounting for them could have enhanced the confidence in the results.

These papers, like those in the previous section, show that the NREGS has both an income and a temporal effect on many outcomes. Following the introduction of NREGS, positive program effects are usually observed. But, for outcomes that are sensitive to time input, especially from women, the reduced time available for in-home labour resulting from NREGS employment produces a net negative impact.

Impact of other economic shocks on health outcomes in developing countries: The presence of a strong time effect of NREGS observed in the studies reviewed above is not surprising for developing countries. Various studies show that when women opt for

[7] Neonatal mortality is defined as a child's death within one month of delivery.

[8] The policy is known as National Rural Health Mission (NRHM). A brief discussion on this policy is provided in section 2.2.3.

employment as a response to an economic shift, it tends to have an adverse effect on their children's health. For example, Miller and Urdinola (2010) looked at the effect of coffee price shocks on child survival in Colombia's coffee producing areas, and Bhalotra (2010) assessed the impact of aggregate income shocks on Infant Mortality Rate (IMR) in India. In both cases (positive shock for Miller and Urdinola (2010) and negative shock for Bhalotra (2010)), the authors found that the women had responded to such shocks by participating in the labour market, resulting in an increase in the infant mortality rate. Both the studies concluded that, when the women increase their labor supply in the market, they invariably have less time to invest in other time-intensive health-related activities, childcare being one of them. This adversely affects the children's health, as evident in rising infant mortality rate in both the studies.

2.2.2 NREGS overview

Before NREGS, India had implemented several employment guarantee schemes at different points of time. Employment Guarantee Scheme of Maharashtra was introduced in the state of Maharashtra in 1972/73 following a severe drought. Jawahar Rojgar Yojana (JNY) was introduced in 1989. The focus of this program was to provide manual employment to people living below the poverty line. In 1999, JNY ceased to be an employment generation program and was converted into a rural infrastructure development program. Employment Assurance Scheme (EAS) was introduced in India in 1993. It was launched in specific blocks in the country identified as drought-prone, tribal, hilly and desert areas. EAS was restructured later and ceased to be demand-driven (Devereux and Solomon, 2006).

Most recently, the National Rural Employment Guarantee Act, later known as Mahatma Gandhi National Rural Employment Guarantee Act, was introduced in India in September 2005. Based on this act, the states of the country had introduced public employment schemes, which were collectively called National Rural Employment Guarantee Schemes (NREGS).

The target population are the households living in the rural areas of the country. The scheme provides 100 days of guaranteed wage employment per fiscal year to at least one adult member of every household who applies for the job. The program is set to provide the applicant with unskilled manual work at a set minimum wage comparable to ongoing market wage rate, determined by the state government. Upon applying, the applicant has to be provided with a job within 15 days and the location must be within a five kilometer radius of the applicant's village, failing which it is the duty of the state government to provide the applicant with the unemployment allowance.[9] NREGS promotes job equality for women by mandating a 33 percent women participation in each fiscal year and providing the female participants with equal wage as their male counterpart (Sharma, 2010).

NREGS was introduced throughout the country in three distinct phases. In phase 1, the program was introduced in 200 districts in February 2006. In phase 2, the program was extended to 130 more districts by April 2007. In April 2008, phase 3 was implemented and the remaining 285 districts were brought under the program. Presently the program covers the whole country except for the districts that comprise only urban population. NREGS was supposed to be implemented according to their status of backwardness. Although it is not explicitly stated, it is believed that the measure of backwardness was based on the official ranking of the districts calculated by Planning Commission of India, 2003. The Planning Commission report (2003) was specifically written to identify the backward districts in the country. Also, this measure was reported closest to the time when NREGS was implemented. The calculation was based on the Scheduled Caste and Scheduled Tribe population in a district in 1991, the output per agricultural worker in 1990-93 for each district and the agricultural wages in each district in the year 1996-97 (Planning Commission, 2003).

Along with the target of providing guaranteed employment through NREGS to poorest districts, another target that was explicitly mentioned was to implement NREGS to at least

[9]In fiscal year 2006/07, on average over 98% of the jobs demanded at NREGS was met. So, the incidence of providing unemployment allowance is quite low. The NREGS data does not further identify who received unemployment allowance and who received the job (Ministry of Rural Development, 2007).

one district of each state in the country. The implementation of NREGS however cannot be fully accounted for by the above two criteria. Some of the districts that received NREGS in phase 1 ranked significantly higher than some other districts in phase 3. Observationally similar districts were assigned to different phases of implementation (Bose, 2017).

Since the inception of NREGS, based on its target group, this program has ensured social protection to the most vulnerable and marginalized communities of rural India by providing an unprecedented amount of employment opportunities. Different provisions, like easy access to work, equal wage rate, decent working conditions and representation in decision making bodies, were undertaken to ensure women participation in NREGS. Women participation rate has been quite high ranging from 40-48 percent well over the mandated requirement of 33 percent. NREGS also has played a vital role in natural resource regeneration and sustainable development. The focus on eco-restoration and sustainable livelihoods helped the workers to make successful transition from wage employment to sustainable employment. Additionally, NREGS approved works also have a vital impact on the agricultural sector of India. By increasing land productivity and improving irrigation channels, higher agricultural productivity was realized, which thereby reinforced the food and water security of rural India (Ministry of Rural Development, 2010, 2015).

It is apparent that NREGS can have a substantial impact on the overall livelihood of the rural population of India. It has the potential to alleviate poverty and help the rural population to have a continuous and sustainable basic standard of living. The positive impacts of NREGS on rural livelihood, however, may not be sustained over time if they are not translated into improved health outcomes of the population. To have a sustainable standard of living, positive health outcomes must be evident, not only among the workers, but also among the other members of the household, especially children.

2.2.3 Health policy: National Rural Health Mission (NRHM)

India had simultaneously invested in improving the health care sector throughout the country, to improve human potential along with economic development. In 2005, the National Rural Health Mission (NRHM) was launched. Ministry of Health and Family Welfare (2005) claims that the rural health sector in India was highly neglected, and it would need a longer time (more than 4 years when the report was written), to see any substantial impact. But it does have the potential to improve health responses in the long run. The main power to implement NRHM was given to the state governments in the country. States were asked to prioritize their needs to improve the healthcare quality and accessibility.

Although different states took different approaches, some common objectives of those approaches were to – *1)* Decentralize the health care service, by involving local government bodies and NGOs in provision of health care, *2)* Provide flexible funding at each level of health care centres, to be used as necessary to improve the health care infrastructure and services provided by these institutions. Also, provide separate funding named *Janani Suraksha Yojana* (JSY), which is a safe motherhood intervention to promote institutional delivery. *3)* Improving the management and services by increasing the number of health care workers. Also, establishing Patient Welfare Committees (aka, *Rogi Kalyan Samiti*, in short RKS) for community management of the public hospitals. *4)* Provide skill-based training to new and existing healthcare workers (Ministry of Health and Family Welfare, 2005).

Both NREGS and NRHM policies were introduced in India in 2005. However, the basic health care provision in rural India was so inadequate and neglected, that it is too ambitious to expect any substantial impact of NRHM on health outcomes in just 3 years after its implementation (Ministry of Health and Family Welfare, 2005). However, NREGS has a greater potential for a short-term impact, as it directly affects household income and other time-consuming activities. Another distinction between NRHM and NREGS is that, NRHM was implemented all over the country rather than in phases. The states were given the

authority to implement NRHM as suited by them. Given that this policy could significantly impact the outcome variables chosen in this study, several variables were introduced as controls for the NRHM policy. These variables will be discussed in section 2.4.3.

2.3 Conceptual Framework

NREGS can potentially increase income for the households by— a) increasing the household employment and b) increasing the real wage rate. As evident from the literature review, the effect of employment generation on health is uncertain.

On the one hand, there is an income effect. With additional money, households can invest in health-improving goods and services including nutritious foods, medicines, and hygiene products, among other things. Research has shown that women's wage rates in the local labour market have grown as a result of NREGS (Imbert and Papp, 2015; Azam, 2012). NREGS also provided additional guaranteed employment. Literature about NREGS impact on different outcomes also highlights the evidence of an income effect.[10] Rural infrastructure, including rural connection, has also been improved through NREGS. This can improve access to healthcare facilities or services, which can have a favourable impact on health outcomes once again. This is the infrastructure effect of NREGS. These beneficial effects of the NREGS are collectively called the *positive program effect*.

Increased employment opportunities, on the other hand, increases the opportunity cost of

[10]It can be argued that the income effect of NREGS may have a negative impact on children's health. NREGS offers temporary job opportunities for a minimum of 100 days per fiscal year. Opting for NREGS may lower the chance of acquiring a permanent job that can provide income for the whole year. However, one of the major reasons for implementing NREGS was to lower the rural population's reliance on agricultural employment, which by its very nature is seasonal. Employment fluctuation is a common occurrence in the agricultural sector. Therefore, NREGS employment is likely to provide an additional employment opportunity. Multiple studies have shown that NREGS has provided the first employment opportunity for a significant number of women (De Mattos and Dasgupta, 2017), and it also has increased the local wage rate for women (Azam, 2012; Imbert and Papp, 2015). These are likely to have positive income effect on children's health. Therefore, it is reasonable to assume that the negative income effect of NREGS, if exists, is likely to be negligible, at least in the first 3 years that is considered in this study. This effect may become more prominent in the longer run, when the employers may adjust to the changes in the labour market.

time-intensive health-improving activities. NREGS reported a high level of female engagement, well exceeding the required 33 percent (De Mattos and Dasgupta, 2017; Khera and Nayak, 2009). NREGS was the first paid job opportunity for a significant portion of these women. Increased labour force participation, particularly among women, can substitute time away from activities, such as making healthy meals, collecting clean drinking water, and preventative health care visits, among others. This could have a negative impact on health outcomes. This is the program's time substitution effect.

Furthermore, the jobs offered by NREGS, such as land development and rural connectivity, require manual labour. This was one of the ways in which NREGS was aimed at the country's poor rural population. Physical labour and stress associated with such employment can be harmful to the health of a pregnant woman or a new mother. This, in turn, can have a negative impact on the health of infants. This is the detrimental health effect of NREGS. The time substitution effect and the detrimental health effect are collectively called the *negative program effect*.

The relative magnitude of the positive and negative program effect of an EGS varies across the nature of countries and the target population; the type of economic shock or policy changes, and the type of outcomes that are considered (Ferreira and Schady, 2009). Since the net effect of NREGS on health outcomes is a priori uncertain, it must be evaluated empirically. Unfortunately, the data used here does not allow for a clear distinction between all of these effects. This is a caveat for this study. Nevertheless, attempts have been made to identify different channels through which the NREGS may affect the analyzed health outcomes.

2.4 Data

2.4.1 Survey Description

This study utilizes data from two waves of India's District Level Household and Facility Survey (DLHS). The DLHS is a nationally representative, cross-sectional survey that is conducted on a regular basis. The primary goal of DLHS is to collect information on mother and child healthcare service utilization and quality perceptions.

The survey was undertaken by a total of 12 research organizations, with the International Institute of Population Science (IIPS) serving as the nodal agency. All the districts of the country were surveyed. A systematic, multi-stage stratified sampling approach was used to choose 40 Primary Sampling Units (PSUs) within each district. A Circular Systematic Random Sampling (CSRS) approach was used to select 28 residential families within each PSU. The sample was inflated by 10 percent to account for the non-response concerns. DLHS 2 was conducted in 593 districts between 2002 and 2004 (prior to NREGS implementation). A total of 620,107 households were interviewed. Approximately 67 percent of the households surveyed were from rural areas of the country. 507,622 currently married women (aged 15-44 years) were interviewed from these households.

The sample design for DLHS 3 was similar to that of DLHS 2. 50 PSUs were chosen from each district. 22 to 33 households were questioned inside each PSU. The number of households surveyed in each district ranged from 1000 to 1500. From December 2007 to December 2008, fieldwork was conducted in 601 districts across the country. Nagaland was not included in the DLHS 3 survey. According to the 2011 census, Nagaland accounted for 0.16 percent of India's total population. A total of 720,320 households were surveyed in this round. Around 77 percent of the households interviewed were from the country's rural areas. A total of 643,944 ever married women aged 15-49 years and 166,260 unmarried women aged 15-24 years were interviewed from these households.

Table 2.1: Districts in phases of implementation and districts on which data is available, by phases

	NREGS implementation	Data available on districts
Phase 1 (by 2006)	200	175
Phase 2 (by 2007)	130	100
Phase 3 (by 2008)	289	167
Total	619	442

The married women respondents were interviewed on their use and perceptions of the quality of maternity and child healthcare services in both rounds. Additionally, information about their children was gathered, including their date of birth, gender, and death age (if applicable). DLHS 3 collected birth records of married women since January 1, 2004. A limited amount of socioeconomic data for these women and their households was also obtained in both rounds.[11]

2.4.2 Sample

A closer examination of the districts in the two rounds of the DLHS revealed a difference in the number of districts interviewed in each state.[12] Following a thorough examination, it was discovered that both the DLHS 2 and DLHS 3 surveys were carried out in 585 districts. In most of these districts, NREGS was implemented in three stages.

Out of these 585 districts, 194 districts (33 percent) belonged to phase 1, 121 districts (21 percent) belonged to phase 2 and 254 districts (43 percent) belonged to phase 3. NREGS was not implemented in 16 of these 585 districts, which are entirely urban. As a result, observations from these 16 districts were also left out of the study.

[11]DLHS interviews were conducted privately for each respondent, to ascertain that the individual responses are not influenced by the presence of others. A detailed survey description of the DLHS 2 and DLHS 3 is available from (http://rchiips.org/PRCH-2.html) and (http://rchiips.org/Manuals.html), respectively.

[12]The state of Nagaland was left out of the DLHS 3 survey. In addition, between 2004 and 2007, several districts were split into two, and new districts were formed from sections of existing districts. Please refer to "http://www.statoids.com/yin.html" for detailed information on the districts of India.

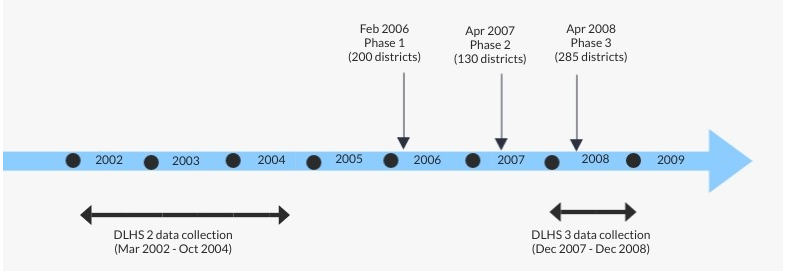

Figure 2.1: Timeline for NREGS implementation and DLHS survey

As previously stated, the three measures devised by the Planning Commission of India, based on which districts were deemed eligible for NREGS, were available for 447 districts.[13] In either round 2 or 3, DLHS was not conducted in 5 of the 447 districts. As a result, these five districts were also left out of the study. The final data therefore contains information on the 442 districts. NREGS phase 1 was implemented in 175 of the 442 districts, NREGS phase 2 was implemented in 100 of them, while NREGS 3 was implemented in 167 of these districts. Table 2.1 shows the number of districts where NREGS was implemented in stages, as well as the number of districts for which data is available for analysis. According to 2011 census data of India and author's calculation based on the rural population percentage, these 442 districts comprise about 85 percent of the total rural population of India.[14]

Figure 2.1 shows a timeline for the DLHS data collection and the NREGS implementation in phases. Phase 1 and phase 2 districts had received the program by the time DLHS 3 data collection process had started. Phase 3 districts were in the process of receiving the program towards the end of DLHS 3 data collection. So, there exists some overlap between the NREGS implementation and data collection which can potentially create a problem in estimation. This problem existed for other studies that utilized DLHS and National Sample Survey data.[15]

[13]The Planning commission report calculates the backwardness measure of districts belonging to 17 out of 29 states. The Union territories were also excluded. The total number of districts that were ranked is 447.

[14]Information for district based population was collected from the Ministry of Statistics and Programme Implementation, India website.

[15]A significant number of studies assessing the impact of NREGS used National Sample Survey (NSS)

In general three different approaches have been observed to address this data issue. *1)* Restricting data so that the outcome variables are not exposed to the NREGS in phase 3 districts. Chari et al. (2019), Parmar and Banerjee (2019) and Islam and Sivasankaran (2015) used this method. Given that the majority of the data collection for both the DLHS 3 and the NSS 64th round was completed prior to the implementation of NREGS in phase 3 districts, the number of observations deleted is minor in comparison to the total data. *2)* Districts in phases 1 and 2 are considered early implementation districts, whereas districts in phase 3 are considered late implementation districts. The program's estimates are referred to as the effects of varying levels of exposure to the program. (Imbert and Papp, 2015; Shah and Steinberg, 2019; Ravi and Engler, 2015) used this approach in their analysis. *3)* Without any data modification, considering phase 1 and 2 districts as treatment districts and phase 3 districts as control districts. Few studies assumed that, despite the fact that phase 3 districts were brought under the program in April 2008, actual implementation would take longer due to the significant administrative costs and infrastructure requirements. As a result, even if there is some overlap between program implementation and data collection, NREGS may not have a major impact on the outcome variables studied in such a short period of time. Azam (2012) and Das and Singh (2013) in their papers took this approach, classifying phase 1 and 2 districts as treated and phase 3 districts as untreated.

This study follows the method used by Parmar and Banerjee (2019). The authors considered data up until March 2008, when the NREGS had been implemented in phase 1 and 2, but not in phase 3. Respondents in this study are limited to those who were questioned before April 2008 for the DLHS 3 data. By doing so, no additional districts were excluded and a little over 80 percent of the total respondents were retained in this analysis. By April 2008, the phase 1 and phase 2 districts had received the NREGS, therefore these districts are collectively called the "treatment districts". Phase 3 districts had received the program

data. The NSS is another nationally representative data set for India. The 64th round of NSS data was used in these research, which overlapped with the NREGS implementation for phase 3 districts by around 2 to 3 months.

Table 2.2: Distribution of the respondents according to the time and phase implementation

	Phase 1	Phase 2	Phase 3	Total
DLHS 2 (2002/04)	158,937	97,480	194,955	451,372
DLHS 3 (2007/08)	179,498	107,211	147,820	434,529

after April 2008, therefore these districts are referred to as the "control districts".

NREGS was implemented only in the rural areas of the country. As a result, only respondents from rural locations in each district are considered for this research. The respondents who live in urban areas are excluded. To make sure the composition of the respondents remain comparable, this study also excludes the unmarried woman respondents (interviewed only in DLHS-3) from analysis. The analysis is therefore conducted on the married respondents only. The issue of overlap between phase 3 NREGS implementation and DLHS 3 data collection is addressed by deleting observations for which the outcome variables may have been exposed to NREGS implementation, as described before. The distribution of the respondents included in this analysis is shown in table 2.2 by time period and NREGS phases.

2.4.3 Important variables

Main outcome variables: Primary outcome variables considered in this study are the infant mortality rate (IMR) and child mortality rate (CMR). These values are calculated using the birth and death records of the children of the women who were interviewed in both DLHS 2 and DLHS 3.

Additional outcome variables: To understand the mechanisms, through which NREGS could have affected the main outcome variables, several additional variables were chosen for the analysis. These are– the stillbirth rate and maternal death (imputed from birth

and death records of each child of the women and maternal death records, respectively); duration of exclusive breastfeeding (collected for the women with recent surviving child), number of ante-natal care (ANC) visits (collected for the last pregnancy); and, place of delivery (collected for the last pregnancy).

Control variables: The limited socioeconomic variables collected in both rounds of DLHS for the women and households were utilized as control measures. These are- age of the respondents; literacy and education level for the respondents and their husbands; total number of children and number of household members; religion and caste of the households.[16]

Control for NRHM health policy: Additionally, both rounds of DLHS collected information regarding facilities available at the Sub-Centre (SC), Primary Health Centre (PHC), Community Health Centre (CHC) and District Hospital (DH).[17] DLHS 3 has specifically collected information on important interventions of National Rural Health Mission (NRHM) introduced throughout the country in 2005.

The following variables were the relevant and comparable variables that were collected in both the rounds of DLHS. The variables were collected at different community levels (SC, PHC, CHC and DH). The information related to NRHM variables were collected during 2007/08 only (for DLHS 3) from all the districts that were interviewed.[18]

[16]Number of children in the households is likely to be endogenous as the NREGS can affect the intention of having children. To overcome this limitation, a control is introduced for the number of children in the households above 3 years of age. Since, NREGS was introduced in 2006, children aged 3 years in 2008 (when DLHS 3 was conducted) would be born by 2005, before the implementation of NREGS.

[17]Sub-centre (SC) is the most peripheral and first point of contact with health care in Indian public health system. SCs are established to cover a population of 5000 people in plain areas, and a population of 3000 people in hilly/remote areas. Each SC must have one auxiliary nurse midwife (ANM) and one male health worker. Primary Health Centre (PHC) is the first point of contact between a village and a medical officer. PHCs are established to cover a population of 30,000 in plain areas and 20,000 in hilly/remote areas. Each PHC must have one medical officer, supported by 14 other staff. Community Health Centre (CHC) is a referral centre for PHCs. Each CHC must have 4 medical specialists, supported by 21 more staff. CHCs are established to cover a population of 120,000 people in plain areas, and a population of 80,000 in hilly/remote areas. District Hospitals (DH) are considered the first referral unit. Each district in India is supposed to have one DH established. A facility is declared to be a fully operational first referral unit if it can provide all-time emergency obstetric, emergency newborn care and 24 hour blood storage facility.

[18]NRHM was introduced in 2005. Components related to NRHM did not exist during 2002/04 when DLHS 2 was conducted.

- Number of health workers in each SC, PHC, CHC and DH. (Both rounds)
- Number of PHCs, SCs, CHCs, DHs accessible to each village. (Both rounds)
- Number of visits conducted by mobile health clinics. (Both rounds)
- Number of Accredited Social Health Activists at each SC. (Collected in 2007/08 only)
- Whether flexible funding was received and utilized following NRHM implementation at each SC, PHC, CHC and DH. (Collected in 2007/08 only)
- Number of registered medical officers for AYUSH- Ayurveda, Yoga, Unani, Siddha, Homeopathy (Indian system of medicine). (Collected in 2007/08 only)
- Whether the Patient Welfare Committee (RKS) was established, at the CHC and DH level. (Collected in 2007/08 only)
- Number of JSY beneficiaries at the CHC and DH level. (Collected in 2007/08 only)

A principal component analysis (PCA) is done on the NRHM control variables to reduce the dimensionality of the data, with minimum loss in information (Jolliffe and Cadima, 2016; Shlens, 2014). The data set for NRHM controls has 18 variables. Following the PCA, depending on the eigenvalues, six principal components are chosen for the analysis. These six principal components explain approximately 81 percent of the total variations of the data.

Additional analysis was performed to see if the estimates on main outcome variables differed depending on the number of principal components included in the analysis. There were no significant changes in the estimated coefficients. Therefore, conforming to the objective of the PCA (reducing dimensionality with minimum loss in information), six principal components are included in the analysis.

Additional district control variables: The data on three measures based on which the status of backwardness was created for the districts are introduced as additional controls.

These measures were– Agricultural wages in 1996/97, Output per agricultural worker in 1990/93 and SC/ST population percentage in 1991 census. Despite the fact that it was not strictly maintained, it was believed that this ranking was one of the major criteria used to implement the NREGS in the districts.

DLHS identifies the households that belong to the SC/ST caste. Given that DLHS is a nationally representative data the SC/ST population percentage calculated from DLHS has significant correlation with the SC/ST population percentage used by the Planning Commission report. The results did not vary significantly when either of the measures were used. In this paper the SC/ST population measures obtained from DLHS are considered.

Calculation of IMR, CMR and SBR: These three variables are calculated based on the definition provided by Indrayan and Satyanarayana (2000). The infant mortality rate (IMR) is calculated as follows

$$\text{IMR} = \frac{\text{Death of infants}}{\text{Live births}} \times 1000 \tag{2.1}$$

Indrayan and Satyanarayana (2000) defines infant as a child who is less than 1 year of age.

Child mortality rate (CMR) is defined as

$$\text{CMR} = \frac{\text{Death of children aged 1 to 5 years}}{\text{Live births}} \times 1000 \tag{2.2}$$

The Stillbirth rate (SBR) is calculated as

$$\text{SBR} = \frac{\text{Stillbirths}}{\text{Stillbirths} + \text{Live births}} \times 1000 \tag{2.3}$$

The definition of stillbirth as provided by Indrayan and Satyanarayana (2000) is when the fetus or the infant is born dead and weighs at least 1000 gram or has body length of at least 25 cm.

The wealth status of the households are depicted by the standard of living index of the households. The Standard of Living Index (SLI) created by DLHS combines a range of household characteristics. SLI incorporates the *household amenities*, such as, source of drinking water, type of house, source of lighting, type of fuel used for cooking, and the *household possession of durable goods*, such as, cars or tractors, television, telephone, electric fan, radio or transistor, motorcycle, bicycle and sewing machine. DLHS allots points for each of these amenities and durable goods and combines them to obtain a SLI score. The score thus obtained ranges from 0 to 40. The households are then categorized into 3 levels of standard of living, low (below 9), medium (9 to 19) and high (above 19), depending on the overall scores obtained. This index is used to identify the households belonging to different wealth levels to run the sub-group analysis as discussed shortly.

Descriptive Statistics: The descriptive statistics for the main dependent variables are presented in table 2.3 (**Panel A**). Infant mortality rates (IMR) and child mortality rates (CMR) have both decreased dramatically over time. All of the variables exhibit a trend from phase 1 to phase 3, supporting the hypothesis that phase 1 districts are generally poorer than phase 2 districts, which are in turn poorer than phase 3 districts.

Table 2.3: Descriptive statistics for the outcome variables by NREGS phases and time

	Time 2002/04			**Time 2007/08**		
	Phase 1	**Phase 2**	**Phase3**	**Phase 1**	**Phase 2**	**Phase 3**
Number of districts	175	100	167	175	100	167
Panel A: Main outcome variables						
IMR	29.8 (13.9)	26.15 (15.52)	21.22 (13.28)	6.24 (3.58)	6.2 (4.12)	4.94 (3.79)
CMR	5.49 (4.07)	4.02 (3.56)	2.77 (3.04)	0.72 (0.73)	0.73 (0.71)	0.52 (0.7)
Panel B: Additional outcome variables						
SBR	22.31 (10.58)	22.29 (13.88)	19.72 (11.09)	15.52 (7.84)	16.53 (8.38)	16.38 (23.29)
Maternal death (per 1000 hh)	1.56 (2.4)	1.39 (2.3)	0.796 (1.57)	2.6 (2.44)	2.18 (2.14)	1.21 (2.17)
Breastfeeding duration (months)	2.71 (3.04)	2.98 (3.11)	3.74 (3.12)	2.72 (2.62)	2.42 (2.54)	2.54 (2.6)
Number of ANC visits	2.16 (2.58)	2.45 (2.84)	3.06 (3.01)	3.38 (2.11)	3.39 (2.16)	4.12 (2.86)
Proportion: Public/NGO delivery	0.12 (0.32)	0.16 (0.37)	0.2 (0.4)	0.2 (0.4)	0.22 (0.41)	0.27 (0.44)
Proportion: Private delivery	0.1 (0.3)	0.12 (0.32)	0.16 (0.37)	0.12 (0.32)	0.12 (0.32)	0.18 (0.39)
Proportion: Home delivery	0.78 (0.41)	0.72 (0.45)	0.64 (0.48)	0.69 (0.46)	0.66 (0.47)	0.54 (0.5)

Notes: The table provides the means and the standard deviations (in parenthesis) for the main outcome variables (panel A) and additional outcome variables (panel B) used in this analysis. The descriptive statistics are reported for the districts categorized by NREGS implementation, for two time periods 2002/04 and 2007/08.

The descriptive statistics for the additional dependent variables are provided in **panel B** of table 2.3. In all districts, the stillbirth rate (SBR) has decreased with the commencement of NREGS. However, the reduction in phase 1 and phase 2 districts is far more pronounced. In comparison to the other two districts, phase 1 had the lowest stillbirth rate after NREGS. Surprisingly, the number of maternal deaths per 1000 households has risen in every district. Maternal death has increased dramatically in both phase 1 and phase 2 districts over time, although not as much in phase 3 districts.

Before NREGS, the breastfeeding duration in months showed a gradient. Phase 1 districts had the shortest average breastfeeding time, whereas phase 3 districts had the longest. However, after NREGS, the gradient shifted in the reverse direction. Phase 1 districts had the longest average breastfeeding duration, while phase 3 districts had the shortest. Expectant mothers' average antenatal care (ANC) visits exhibited a gradient as well, with phase 1 districts having the lowest average ANC visits and phase 3 districts having the highest average ANC visits. In all three phases, the average number of ANC visits increased after the NREGS.

For the delivery locations, in all the phases for both time periods, the majority of the delivery was at home, followed by public/NGO deliveries, and private deliveries. In comparison to the previous time period, the proportion of deliveries in public/NGO facilities grew, while the proportion of deliveries at home decreased. Overall, there were no notable changes in the proportion of private deliveries.

Table 2.4: Descriptive statistics for the control variables by NREGS phases and time

	Time 2002/04			**Time 2007/08**		
	Phase 1	**Phase 2**	**Phase3**	**Phase 1**	**Phase 2**	**Phase 3**
Number of districts	175	100	167	175	100	167
Control variables						
Respondent_Primary education	0.38 (0.48)	0.44 (0.49)	0.52 (0.5)	0.38 (0.49)	0.44 (0.5)	0.52 (0.49)
Spouse_ Primary education	0.61 (0.48)	0.65 (0.48)	0.72 (0.45)	0.6 (0.49)	0.63 (0.48)	0.71 (0.45)
Age at first birth	18.39 (3.21)	18.86 (3.42)	19.44 (3.38)	24.9 (5.41)	25.43 (5.61)	25.01 (5.05)
Adult family members	3.38 (1.89)	3.39 (1.9)	3.48 (1.9)	3.29 (1.81)	3.29 (1.82)	3.6 (1.93)
Children in household	1.69 (1.68)	1.66 (1.7)	1.53 (1.6)	1.55 (1.61)	1.51 (1.59)	1.62 (1.56)
Hindu households	0.83 (0.38)	0.78 (0.42)	0.76 (0.3)	0.83 (0.38)	0.75 (0.43)	0.8 (0.39)
Muslim households	0.11 (0.31)	0.12 (0.32)	0.11 (0.31)	0.1 (0.3)	0.13 (0.34)	0.11 (0.31)
SC households	0.17 (0.38)	0.18 (0.38)	0.17 (0.37)	0.18 (0.39)	0.17 (0.38)	0.19 (0.39)
ST households	0.2 (0.4)	0.13 (0.34)	0.11 (0.32)	0.22 (0.42)	0.2 (0.4)	0.1 (0.29)
Proportion of low SLI	0.59 (0.49)	0.5 (0.5)	0.34 (0.48)	0.61 (0.49)	0.53 (0.5)	0.35 (0.48)
Proportion of medium SLI	0.24 (0.43)	0.29 (0.46)	0.36 (0.48)	0.24 (0.42)	0.27 (0.45)	0.34 (0.47)
Proportion of high SLI	0.17 (0.37)	0.21 (0.4)	0.3 (0.46)	0.16 (0.36)	0.2 (0.4)	0.31 (0.46)

Notes: The table provides the means and the standard deviations (in parenthesis) for the control variables used in this analysis. The descriptive statistics are reported for the districts categorized by NREGS implementation, for two time periods 2002/04 and 2007/08.

Table 2.5: Descriptive statistics for measures of backwardness. Standard deviation in parenthesis. (Exchange rate: 1 USD=INR 70)

Measures	**Phase 1**	**Phase 2**	**Phase 3**
SC/ST population % (1991 census)	35.99 (17.07)	24.73 (10.4)	19.26 (7.28)
Agricultural wages (USD/day) 1996-97	0.53 (0.16)	0.62 (0.15)	0.8 (0.32)
Output per agricultural worker (USD/worker) 1990-93	86.85 (56.71)	117.69 (86.79)	201.25 (160.45)

The descriptive statistics for the household specific controls at the district level are provided in table 2.4. From phase 1 to phase 3 districts, the household characteristics show a gradient, reflecting the backwardness measures obtained for these districts. For education, proportion of respondents and their spouses completing primary education is reported.[19] It is observed that on average, the proportion of respondents and their spouses completing primary education is lower in phase 1, compared to phase 3. Over time, the proportion remained the same for both the respondents and their spouses. Average age at first birth also shows a gradient from phase 1 districts to phase 3 districts. Earlier, women in phase 1 districts gave birth at younger age compared to women in phase 3 districts. Over time, the average age at first birth for women in all the phases increased significantly. The average number of adult family members and children decreased with time in phase 1 and phase 2 districts, but increased in phase 3 districts. In comparison to phase 3 districts, phase 1 districts have a higher proportion of SC/ST caste (marginalized castes) households and a lower proportion of low SLI households.

Table 2.5 provides the descriptive statistics for the three measures based on which measure of backwardness was calculated by the Planning Commission of India. The three measures also show a gradient from phase 1 to phase 3. Phase 1 on average has more SC/ST population, lower agricultural wage and lower agricultural output per worker compared to phase 2 and

[19]Primary education implies completion of grade 5.

phase 3.

2.5 Estimation Procedure

2.5.1 Identification Strategy

With the NREGS being phased in across the country, a "natural experiment" was created, with the phase 1 and phase 2 districts in the treatment group and the phase 3 districts in the control group. Since the data was collected over two time periods, 2002/04 and 2007/08, there is also a temporal variation in the data. Because of these two sources of variation, a Difference-in-Difference (DID) estimating approach can be used to examine the impact of the NREGS on children's health outcomes (Imbens and Wooldridge, 2009; Angrist and Pischke, 2008).[20]

Threat to the identification strategy: As previously stated, the program's implementation did not appear to be random. The goal was to provide employment guarantees to the poorest districts in the country. Although it was not stated explicitly, the Planning Commission of India's ranking of backwardness released in 2003 is thought to have been used in selecting the early districts. Furthermore, at least one district from each state was expected

[20]Recent research have identified a source of potential bias that may arise when a Two Way Fixed Effect (TWFE) model (usually used to implement DID) is utilized in assessing a treatment effect, when the treatment has staggered implementation (Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). The authors recommended to use a hetero-robust DID estimation to analyze the treatment effect in such cases. However, in this study, this bias is potentially mitigated since NREGS was implemented throughout the country within two years and the gaps between the phases were short. De Chaisemartin and D'Haultfoeuille (2022b) further shows that this bias is likely to be problematic in treatments with complicated designs (for example, non-binary treatment with multiple time periods), but not so much for treatments with simpler designs (for example, binary and staggered treatment, much like NREGS). De Chaisemartin and D'Haultfoeuille (2022b,a); De Chaisemartin and d'Haultfoeuille (2020) also show that in case of treatment with simpler designs, the TWFE and hetero-robust DID estimators often give similar results. This study therefore continues with the standard TWFE model to implement the DID estimation. As a future work this study will investigate the impact of NREGS using the hetero-robust DID estimation technique as suggested by Callaway and Sant'Anna (2021).

to receive the program. However, accounting for these two criteria still could not fully predict the program implementation across the country. Observationally similar districts had received the program in different stages.

The distribution of ranked districts in three phases of NREGS implementation is depicted in figure 2.2. Although the majority of low-ranking districts received NREGS in phase 1 and the majority of high-ranking districts received NREGS in phase 3, there is still a significant overlap between backwardness rankings and NREGS implementation.

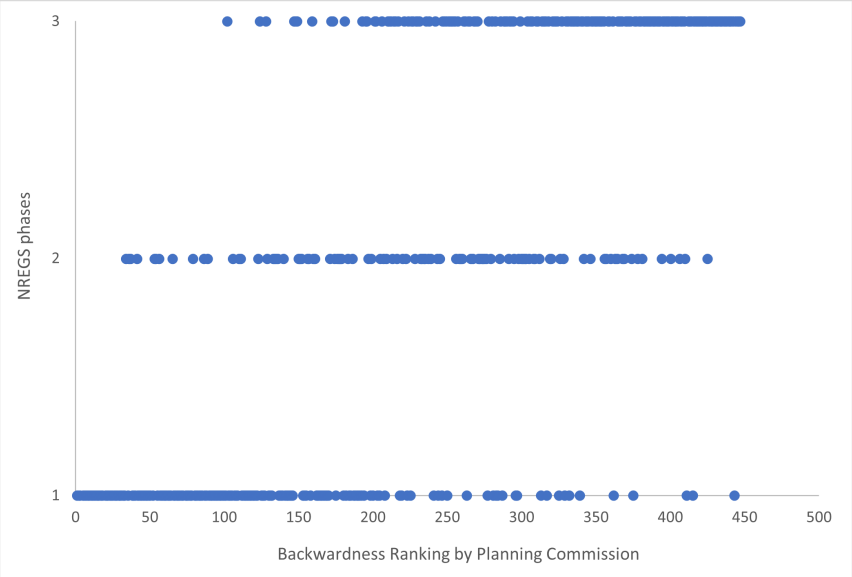

Figure 2.2: NREGS phases versus backwardness ranking for the districts
Source: Planning Commission of India, 2003
Note: The backwardness rank was constructed using three measures: Percentage of SC/ST population in 1991, output per agricultural worker in 1990/93 and daily agricultural wage in 1996/97 at the district level.

The difference-in-difference (DID) estimation relies on the assumption that the trend in the variation of the outcome variables in early and late implementing districts is similar. If the outcome variables in phase 1 and phase 2 districts (where NREGS was implemented by 2007) trend differently from the outcome variables in phase 3 districts, the DID estimates are likely to be biased. In an attempt to address this issue, three measures are included which can capture the differential changes across the districts. It introduces controls for the

three measures depending on which the backwardness status of the districts was calculated (SC/ST caste composition in 1991, agricultural wages in 1996/97 and agricultural output per worker in 1990/93).

These measurements are interacted with time to account for trends associated with these controls since they are time invariant. Because the NREGS implementation was not entirely based on them, the program dummy for the NREGS will not make these controls redundant.[21]

A previous round of DLHS conducted in 1998/99 (DLHS 1) was utilized to check for the parallel trend assumption that is crucial for the difference-in-difference estimation.

2.5.2 Estimation at the district level

The summary statistics of IMR and CMR show that these variables have a substantial number of 0 observations at the individual level.[22] When these types of data are evaluated at an individual level, they frequently suffer from sparse data issues, resulting in biased results (Greenland et al., 2000, 2016). Ovaskainen and Soininen (2011) and Greenland et al. (2000) recommend the use of an aggregated model in the presence of sparse data problems.

In addition, there is a considerable amount of research that examines the influence of various types of interventions on mortality rates at varying aggregated levels. Feng et al. (2012), for example, looked at the impact of various social, economic, political, and health policies in China, where the mortality rates were estimated at the provincial level. Aquino et al. (2009) investigated the influence of Brazil's Family Health Program on newborn mortality rates, which were estimated at the municipality level. Watson (2006), Rasella et al. (2021) and

[21] An OLS regression was performed to see how much of the phase-wise implementation of NREGS can be explained by the three backwardness indicators. This regression has an adjusted-R^2 score of 0.39. Table A.1 in the Appendix provides the result for this regression.

[22] In DLHS 2, 4 percent and 5 percent of the respondents had experienced infant death and child death, respectively. In DLHS 3, 1.5 percent and 1.7 percent of the respondents had experienced infant and child death, respectively.

Rose et al. (1992) are some additional examples of studies assessing the impact of several interventions on mortality rates at an aggregated level.[23]

District level policies are progressively being adopted by the government in response to the decentralization process, making district level analysis a valuable unit of analysis from a policy perspective (Menon et al., 2018). A district-level analysis also aids in capturing the program's social impact. Furthermore, the outcome variables considered, namely infant mortality rate and child mortality rate (stillbirth rate and maternal death rate for additional analysis) are better suited to be interpreted at the district level rather than at the individual level. These considerations do not rule out the possibility of doing an individual-level analysis. They simply argue that a district-level analysis is equally valid. The approaches might be viewed as complements rather than substitutes (Dreze and Murthi, 2001).

This paper analyzes the impact of NREGS on the children's health outcomes at the district level.[24] IMR, CMR and SBR at the district level is calculated in the following way,

$$\text{IMR at district level} = \frac{\text{Sum of infant deaths for each household of that district}}{\text{Sum of total live births for each household of that district}} \times 1000 \quad (2.4)$$

$$\text{CMR at district level} = \frac{\text{Sum of number of child deaths for each household of that district}}{\text{Sumd of total live births for each household of that district}} \times 1000 \quad (2.5)$$

$$\text{SBR at district level} = \frac{\text{Sum of stillbirths for each household of that district}}{\text{Sum of total births for each household of that district}} \times 1000 \quad (2.6)$$

[23] Watson (2006) looks at the impact of an improved sanitation infrastructure on the county level infant mortality rates in USA. Rasella et al. (2021) studies the impact of a Brazilian cash transfer program on maternal mortality rates at municipality level. And, Rose et al. (1992) assessed the impact of a food supplement and health care intervention program on the village level infant mortality in Guatemala.

[24] After aggregating at the district level it was observed that in DLHS 2 about 99% and 89% of the districts had positive IMR and CMR, respectively. While in DLHS 3, 94% and 63% of the districts had positive IMR and CMR, respectively.

2.5.3 Model

Based on the variables and identification strategy discussed above, the general form of the analyzed model is,

$$Y_{dt} = \alpha + \beta_1(NR_d \times T_t) + \beta_2 X_{dt} + \beta_3(Z_d \times T_t) + \delta_d + T_t + \epsilon_{dt} \tag{2.7}$$

Where,

Y_{dt} = Outcome variables indicating children mortality in district d, in the year t

T_t =Time fixed effect = $\begin{cases} 1, \text{ if year is 2007-08} \\ 0, \text{ if year is 2002-04} \end{cases}$

$NR_d = \begin{cases} 1, & \text{if NREGS was implemented in phase 1 or 2} \\ 0, & \text{otherwise} \end{cases}$

X_{dt} =Vector of time variant control variables at district level that can affect the dependent variables. It includes the average values of the individual and household control; It also includes the six variables that control for NRHM policy obtained using principal component analysis.

Z_d = Time invariant control variables at the district level. These are the measures depending on which the backwardness ranking of the districts were created. These are, agricultural output per worker and daily agricultural wage per worker. These variables are interacted with time.

δ_d =District fixed effect

ϵ_{dt} =Error term

The coefficient of interest for this analysis is β_1. It measures the effect of the interaction term $(NR_d \times T_t)$, which is essentially a dummy variable that takes the value of 1 for the districts in time period 1 (post-treatment) which had the NREGS introduced. β_1 captures the impact of the NREGS on the outcome variables at the district level.

The main outcome variables, IMR and CMR are highly positively skewed data. Silva and Tenreyro (2011) show that a Poisson pseudo-maximum likelihood (PPML) estimator is generally well behaved for this type of data, even with higher proportion of zeros in the sample. As a result, the impact of NREGS on the mortality rates are evaluated using PPML regression with fixed effects. However, a PPML estimator is not as easily interpretable as a linear estimator. Silva and Tenreyro (2006) provides the following method to calculate the marginal effect of the regressor of interest (x) on the outcome variable (y) following a PPML regression with fixed effect.[25]

Keeping everything else constant, a one unit change in the x, will lead to a $\left(100 \times \left(\exp^{\beta} - 1\right)\right)$ % change in the mean value of y. Where, β is the PPML estimated coefficient of the x variable. This formula is used to calculate the impact of NREGS on the chosen outcome variables where the coefficients were found to be significant.

Sub-group analysis: The marginalized caste households usually are the most deprived households in rural India. This has always been a concern for policymakers as demonstrated by the fact that the backwardness calculation for districts considers, amongst other things, the percentage of district population that was Scheduled Caste/Scheduled Tribe (SC/ST). Since its inception, NREGS has continually reported over 50 percent of SC/ST employment until the fiscal year 2010/11. It is evident that NREGS was also targeted to improve the livelihood of the marginalized caste households of the country. It is therefore prudent to speculate that the NREGS may have a dissimilar influence on the people having different

[25] A detailed discussion on PPML estimation with fixed effect, their assumption and coefficient interpretation can be found from Silva and Tenreyro (2006), the same authors' blog "The Log of Gravity page" obtained from https://personal.lse.ac.uk/tenreyro/LGW.html, and multiple discussions by Joao Santos Silva on Statalist forum.

levels of standard of living and on the people belonging to SC/ST households. As a result, additional analyses are carried out to determine the influence of NREGS on various outcome variables based on the standard of living index (SLI) and caste.[26]

The sub-group analysis by SLI and by caste provide the impact of NREGS on different outcomes within each group. Since NREGS provides participants with manual labour jobs, which is a deterrent for wealthy households; and because NREGS prioritizes employment for SC and ST households, it is likely that poorer households and SC/ST caste households will respond more strongly to NREGS implementation. Sub-group analyses are performed by examining equation 2.7 but for each sub-group such as low SLI, medium SLI, high SLI, as well as SC and ST households, to see this impact.

The following section discusses the results for the analyses performed for this study.

2.6 Results

2.6.1 Baseline estimates

The baseline estimates for the infant mortality rate (IMR) in column 1 and the child mortality rate (CMR) in column 2 are provided in **panel A** of table 2.6. There is a considerable increase in the IMR following the implementation of NREGS, but no major influence on the CMR is observed. Based on the stated coefficient, the average IMR grew by 20.96 percent for the districts that had access to NREGS (phases 1 and 2).[27]

[26]Despite the fact that both the Scheduled Caste (SC) and the Scheduled Tribe (ST) have historically been India's poorest socioeconomic groups, there is still a significant difference between the two. People from Scheduled Castes are Hindus by faith, although they do not belong to the Hindu religion's four primary castes (Brahman, Kshatriya, Baishya and Shudra). The four main castes labeled them "untouchables," and as a result, they endured (and still face) social, educational, and economic isolation. Scheduled Tribes, on the other hand, are primarily indigenous Indian tribes. They are usually of different faiths. Even if they follow Hinduism, their customs are distinct and unique to their locality. ST people face geographical isolation in addition to social, educational, and economic isolation.(Vishnu, 2018)

[27]The percentage effect is calculated by using the formula: $100 \times (e^{\beta} - 1)$. Where β is the estimated coefficient of the PPML regression. (Silva and Tenreyro, 2006)

Putting these values in context may give a better idea of the actual effect. In 2007/08, the average IMR was 5.7. A 20.96 percent rise in this number implies that the infant mortality increased by 1.2 infants per 1000 live births. This is similar to the estimate of Chari et al. (2019), where the authors' showed that after the implementation of NREGS, there were 2 additional neonatal deaths per 1000 live births.[28]

2.6.2 Sub-group analysis

By SLI: The regression results by Standard of Living Index are reported in **panel B** of table 2.6. SLI is categorized into 3 groups, which are classified from poorest to wealthy. Following the implementation of NREGS, IMR has increased significantly among the poorest of the population (low SLI). There is no discernible effect on CMR. NREGS has a 25.3 percent intent-to-treat (ITT) effect on IMR in low SLI households. In 2007/08, the average IMR for low SLI households was 6.75. Following NREGS, there was an increase of around 1.71 infant deaths per 1000 live births for these poorest households.

There is no substantial influence on IMR and CMR for medium SLI households following NREGS implementation. High SLI households, on the other hand, exhibit a considerable drop in CMR, although it is only marginally significant. The average CMR for high SLI households reduced by 85.2 percent after NREGS. With an average CMR of 0.32 child deaths per 1000 live births, this means that the CMR in high SLI households reduced by 0.27 child deaths per 1000 live births after NREGS implementation.

The drop in CMR for households with a high SLI is unsurprising. NREGS was created with the intention of assisting underprivileged rural households. Therefore, respondents from families with a high SLI are unlikely to engage in NREGS (atleast, compared to the low and medium SLI households). As a result, respondents from households with a high SLI are

[28] In the regression analyses for this study, children under the age of one year are considered *infants*; children between the ages of one and five years are referred to as *child*. Chari et al. (2019) referred to the children under the age of one month as *neonatal*.

less likely to be directly affected by NREGS. However, they can benefit from the program through improved infrastructure and a rise in the local wage rate (raising household income), which could explain why the CMR for high SLI households has decreased.

By caste: The regression results by household caste are reported in **panel C** of table 2.6. The focus here is on households belonging to the SC and ST castes, as these two castes were encouraged to apply for NREGS jobs. Following the implementation of the NREGS, IMR in SC households surged significantly. The ITT impact calculation reveals a 61.6 percent rise in IMR. With an average IMR of 6.69, this means that SC households experienced 4.12 additional infant deaths per 1000 live births after NREGS implementation. There was no significant effect of NERGS on CMR for the SC households.

For the ST households, however, the results show that NREGS had no significant impact on IMR or CMR.

2.6.3 Pre-trend Analysis

A crucial assumption for the difference-in-difference (DID) analysis is that the trend in the variation of the outcome variables between the early and late implementing districts would have been similar in the absence of the program. And therefore, any deviation from the existing trend is because of the implementation of the program. This is the "parallel trend" assumption of the DID model. Unfortunately, there is no way to determine if the trend would continue to be parallel after the program was implemented. What can be done, however, is to check if the trend in the outcome variables moved in tandem before the program was implemented. If the trend moved in tandem before the program was implemented, we can assume that the same movement would have continued if the program was not implemented.

To test this "parallel trend" assumption, a "falsification test" is performed. The same DID model as Equation 2.7 is performed but the time period is now 1998/99 (data obtained

Table 2.6: ITT impact of NREGS on children's health indicators (PPML regressions at district level)

	1 IMR	2 CMR
Number of observations	871	871
Panel A		
Full sample	0.190** (0.091) *ITT:20.9%*	0.06 (0.233)
Panel B: By SLI		
Low	0.226** (0.108) *ITT: 25.3%*	0.41 (0.283)
Medium	0.028 (0.134)	-0.599 (0.385)
High	0.266 (0.29)	-1.909* (1.02) *ITT:-85.2%*
Panel C: By caste		
HH caste: SC	0.480*** (0.175) *ITT: 61.6%*	-0.061 (0.406)
HH caste: ST	-0.295 (0.271)	-0.352 (0.534)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Robust standard errors are in parenthesis. PPML regressions are performed at the district level. Estimated Intent-to-treat (ITT) effect of NREGS is reported in the table for the coefficients that were significant. For the PPML regression models, ITT imply the effect of NREGS on average value of the outcome variable. All regression models include time fixed effect, district fixed effects and district controls (NRHM variables, agricultural wage, agricultural output). Additional controls include individual variables (education, age at first birth) and household controls (number of children, number of adults, proportion of Hindu households and Muslim households, proportion of SC and ST households) at the district level.

from DLHS 1) and 2002/04 (DLHS 2). So, both the time periods considered are before the NREGS implementation. The same treatment and control districts as the original model are considered. So, the analysis is performed using the same model as 2.7. Except now the time fixed effect is considered as

$$T_t = \text{Time fixed effect} = \begin{cases} 1, \text{ if year is 2002-04} \\ 0, \text{ if year is 1998-99} \end{cases}$$

If the outcomes were following a parallel trend before the implementation of the program, we would not expect the coefficient of interest, β_1, to be significantly different from 0. If however, β_1 is found to be significantly different from 0, then the "parallel trend" assumption will be violated.

Column 1 and 2 of table 2.7 provides the results for the falsification test. It is observed that the coefficients for the interaction term are not significant in any of the cases. So, we do not reject the parallel trend assumption. This implies that the DID method can be applied to analyze the impact of NREGS on IMR and CMR.

In this context, it is critical to stress the importance of accounting for the three measures used to calculate the backwardness of the districts. The three measures were – Agricultural wages in 1996/97, Output per agricultural worker in 1990/93 and SC/ST population percentage. Column 3 and 4 of table 2.7 presents the "falsification test" without any control for these three measures. It demonstrates that, in the absence of controls for these three district indicators, the IMR has a pre-trend (although there was no pre-trend for CMR). The parallel-trend assumption would have been violated if the DID estimation had not taken these factors into account. As a result, the impact of NREGS on IMR would have been erroneous.

Table 2.7: Falsification Test (PPML regressions at district level)

	With the district controls		Without the district controls	
	1	2	3	4
	IMR	**CMR**	**IMR**	**CMR**
Number of observations	748	748	748	748
NREGS (ITT)	0.065 (0.051)	0.043 (0.173)	-0.094** (0.046)	0.004 (0.148)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Robust standard errors are in parenthesis. The dependent variables are infant mortality rates (IMR) and child mortality rates (CMR). These measure the number of infant death and child death per 1000 live births occurred between the earlier two time periods (1998/99 and 2002/04), before the NREGS was implemented. PPML regressions are performed at the district level. The table presents the results for the full sample. All regression models include time fixed effect, district fixed effects and district controls (NRHM variables). Additional controls include individual variables (education, age at first birth) and household controls (number of children, number of adults, proportion of Hindu households and Muslim households, proportion of SC and ST households) at the district level. Regression models for column 1 and 2 additionally introduced the district controls based on which the status of backwardness of the districts were measured. Regression models for column 3 and 4 excluded these district controls.

2.6.4 Channels or Mechanisms

The results from the previous section reveal that NREGS has resulted in an increase in IMR in general. This effect was also seen in households that were more likely to enroll in the NREGS program (poor and marginalized caste households). As a result, it is clear that NREGS' negative program effect is superseding any potential positive program effect in terms of the infant mortality, at least for the targeted demographic. This section aims to decipher some of the mechanisms by which NREGS has resulted in an increase in the observed IMR.

There are two primary methods via which NREGS may have a negative impact on infant or child health, as mentioned in section 2.3. First, there is a time substitution effect. The opportunity cost of women's time rises as employment opportunities increase. This can lead to a reduction in activities that enhance child and/or infant health, which can negatively impact their health. Second, there's the detrimental health impact. NREGS-mandated

manual labour may have a negative impact on a mother's health. Increased physical activity can cause health problems for pregnant women and new mothers, which can have a negative impact on fetal or infant health, respectively.[29]

Furthermore, rather than being mutually exclusive, these two negative channels might interact with one another to amplify their detrimental impact. For example, if a new mother already has less time to invest in her child's healthcare as a result of her NREGS employment, her ability to care for her child will be impaired further if she suffers from health problems resulting from the manual labour needed by NREGS employment. Although it is difficult to isolate the mechanisms individually, an attempt was made to observe the resulting impact of the interplay between the mechanisms to make some inference related to them.

Time substitution effect: The influence of NREGS on several other outcome variables is explored in order to better understand the time substitution effect. The findings are presented in table 2.8. The regressions were initially run at the district level, where no significant NREGS effects were found. As a result, the regressions in table 2.8 are done at an individual level. There are some fascinating results observed in this case. For the ease of discussion, only those results are provided in table 2.8 for which significant impacts were seen in the main results (table 2.6). Panel A displays the results for the overall data, panel B displays the results for low and high SLI households, and panel C displays the results for SC households, respectively, in table 2.8.

[29]The income effect and infrastructure effect outlined in section 2.3 can also have a positive impact on infant or child health. However, the primary results in sections 2.6.1 and 2.6.2 suggest that NREGS has a higher negative program effect. As a result, efforts are made to separate the negative channels via which NREGS affects the IMR.

Table 2.8: ITT impact of NREGS on different channels (Regressions at individual level)

	Channel 1		Channel 2		
	1	2	3	4	5
	Poisson	Poisson	LPM	LPM	LPM
	Breastfeeding duration	ANC visits	Public/NGO delivery	Private delivery	Home delivery
A: Full sample	0.077 (0.281)	0.114 (0.102)	0.603***(0.128)	-0.377***(0.07)	-0.237* (0.128)
B: By SLI					
Low SLI	0.140 (0.353)	0.114 (0.116)	-0.079* (0.046)	-0.029 (0.035)	0.108* (0.061)
High SLI	0.040 (0.146)	0.039 (0.256)	0.227 (0.182)	-0.332***(0.12)	0.105 (0.213)
C: By Caste					
SC	-0.229 (0.514)	0.059 (0.15)	-0.099* (0.058)	-0.054 (0.042)	0.153** (0.069)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. All regressions are performed at individual level. Regressions on the channels are performed for those level and sub-groups, for which significant results were observed in table 2.6. The table shows the intent-to-treat (ITT) effect of NREGS. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (NRHM variables, agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, age at birth, number of children) and household controls (number of adults, religion and caste).

Channel 1: The impact of NREGS on exclusive breastfeeding duration and the frequency of ANC visits by respondents is examined in Channel 1 of table 2.8 (columns 1 and 2). When women choose NREGS jobs, they are devoting time away from other activities. These activities can be separated into two groups for ease of understanding. *1) Direct health-promoting activities*– these are activities that have a direct impact on child health, such as ANC visits and exclusive breastfeeding. 2) *Any other time-consuming activities*– these are all the other activities that women engage in that may have an indirect impact on the health of their children. Household chores, farm work, water or fuel collection, and so on are examples of such activities. If women are diverting their time away from directly health-promoting activities, then post-NREGS a negative intent-to-treat effect on exclusive breastfeeding or ANC visits can be expected for channel 1.

Panel A shows the findings for the full sample for channel 1 (columns 1 and 2). There was no discernible effect of the NREGS on exclusive breastfeeding duration or the number of ANC visits. **Panel B** looks into the impact of NREGS on exclusive breastfeeding and ANC visits in households with low and high SLI. For these two types of households, there is no significant effect on the outcome variables. **Panel C** shows the results for the SC households based on the same outcome variables. Again, no discernible effect was discovered. Post-NREGS, none of these results demonstrate any significant difference in the exclusive breastfeeding duration or in the frequency of ANC visits.

Lack of any significant impacts on exclusive breastfeeding duration and the frequency of ANC visits suggest that women who had access to NREGS may not be substituting time away from direct health promoting activities outlined earlier. Coupled with unfavourable program impact of NREGS in primary results, lack of significant impacts on these variables rather suggests that, these women are probably substituting time away from other activities. This may have no direct effect on child health, but it is likely to have an indirect harmful impact.

Channel 2: In table 2.8, channel 2 further supports these findings observed for channel 1. Channel 2 investigates the impact of NREGS on the probability of institutional delivery (columns 3 and 4) and home delivery (column 5). The impact is observed for deliveries at both public/NGO facilities (column 3) and private facilities (column 4) separately.[30]

Following information about rural healthcare facilities of India will be helpful in understanding the results for channel 2. Panel A in table 2.9 provides information about the accessibility of health facilities in the rural villages in India. This data was collected for all the villages (PSUs) that were chosen to be surveyed in the DLHS round 3 (as explained in the data section). It can be seen that about 44.3 percent of the villages have at least one government health centre located within the village.[31] 5.6 percent of the villages have a government hospital or district hospital located in the village. And, 20.4 percent of the villages have at least one private clinic or private hospital located within the village.

Even in villages where health centres are not located within the village, the average distance to a sub-centre or primary health centre is still shorter than the distance to a private health centre (clinic or hospital). Although, on average, the district hospital or a government hospital is the farthest away from these villages. As a result, for most rural households, visiting a public/NGO healthcare centre is more convenient and less time-consuming than visiting a private healthcare facility. Because there are fewer private institutions, the commuting time to a private facility is likely to be longer for any particular household.

Figure 2.3 shows the distribution of per 1000 childbirth by delivery location in rural India, over the expenditure category of the respondents. The source of this data is National Sample Survey Organisation (2006). The report collected information on the monthly per capita

[30]NGOs are Non-Government Organizations. Unlike private healthcare facilities, NGOs are typically non-profit organizations. NGOs are active suppliers of different health care services in rural India. As a result, the government frequently offers assistance or subsidies to these organizations in order to promote their services (Das et al., 2018; Baru and Nundy, 2008). Therefore, NGO and public facilities are considered together in this analysis.

[31]Government health centres are the Sub-Centres (SC), Primary Health Centres (PHC) and Community Health Centres (CHC)

Table 2.9: Information on available health facilities

Description		Mean (s.d.)
Panel A: Accessibility of Health Facilities (Source: DLHS 3)		
Proportion of villages with-	Atleast one government Health centre†	0.443 (0.5)
	District/Government Hospital	0.056 (0.23)
	Atleast one Private clinic or hospital	0.204 (0.403)
For villages with no health centre distance (in kms) to the-	Nearest SC	4.81 (5.44)
	Nearest PHC	10.08 (9.23)
	Nearest CHC	18.51 (16.21)
	Nearest District or Government hospital	36.77 (24.13)
	Nearest Private clinic	13.18 (14.94)
	Nearest Private hospital	20.39 (18.66)
Panel B: Costs at Health Facilities (Source: NSS, 2006)		
Mean expenditure (in USD¤) on childbirth at-	Government hospital	16.64
	Private hospital	59.1
	At home	5.91

Note: Standard deviations (S.D.) are reported in parenthesis.
†Government health centres are Sub-Centre (SC), or Primary Health Centre (PHC), or Community Health Centre (CHC).
¤Exchange rate: 1 USD= INR 70

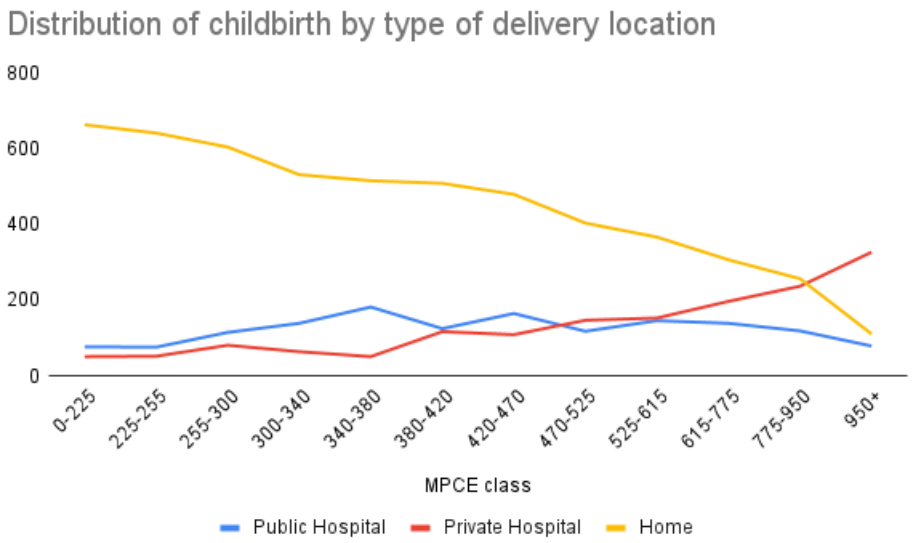

Figure 2.3: Distribution of per 1000 childbirth by delivery location over income category in Rural India
Source: Data for this graph is obtained from (National Sample Survey Organisation, 2006)
Note: By hospital, the report considers any medical institution that had the provision to admit sick patients as inpatient for treatment. Public hospitals include community health centres, primary health centres and any other public hospitals. Private hospitals include private clinics, private nursing homes and private hospitals. MPCE: Monthly Per Capita Expenditure. NSS collects data on consumption expenditure in its survey. The respondents are categorized by their MPCE. Higher the MPCE for a respondent, the richer the respondent is. MPCE reported in the graph is in INR.

expenditure (MPCE) for the respondents' households. The respondents are then categorized by their MPCE. The higher the MPCE category, the richer the respondents are. It can be seen from the figure that, in general, the proportion of home births is higher than the proportion of any institutional birth, for the most part of the MPCE category. This was also evident in the descriptive statistics presented for the DLHS data (in table 2.3).

As households become wealthier, however, the desire for home delivery declines, while that for private facility delivery rises. For public facilities, a different pattern is seen. Initially, with increased income, the preference for delivery at a public facility grows. However, at higher income status, the preference for delivering at a public facility begins to decrease.

Institutional delivery at either or both private and public/NGO institutions should grow if NREGS have a net positive program effect (due to more income and better infrastructure). It is also possible that home delivery will decline. However, it is evident from the major findings on IMR that the program has a net negative effect. A thorough examination of the outcomes for institutional delivery reveals how these negative mechanisms interact with one another.

In this regard, **panel A** of table 2.8 again presents the results for the full sample. It can be seen that after the NREGS, the probability of delivery at a public/NGO facility rises by roughly 60.3 percent. The probability of having a baby in a private facility, on the other hand, drops by roughly 37 percent. Home delivery is also less likely by about 23.3 percent, though this effect is weakly significant.

The significant rise in the probability of delivery at a public/NGO facility and a decrease in the probability of home delivery, could have been attributed to the net positive program effect of NREGS. The presence of a significant reduction in the probability of delivery in private facilities, on the other hand, indicates the presence of a strong negative time substitution effect. The question now is whether women are spending time away from either direct health-promoting activities or other time-consuming activities.

A decrease in the probability of a home birth and an increase in the probability of a birth in a public/NGO facility suggest that the women are not devoting time away from direct health-promoting activities. However, the increase in the likelihood of a public/NGO delivery and the decrease in the probability of a private delivery suggest that, when available, these women are opting for less time-consuming options. This result supports the findings from channel 1, indicating that women are likely devoting time away from other time-consuming activities.

Although there was no significant impact observed for channel 1, results from channel 2 are consistent with an increase in income, and possibly an increase in the opportunity cost of time brought about by NREGS employment. It is encouraging to see that the women are not reducing their time investment in direct health promoting activities. However, they are responding to the substitution effect by taking time away from other time-intensive activities, like institutional delivery at private facilities. These activities may have an indirect detrimental impact on children's health, as evidenced by the main results for infant mortality rates.

In **panel B** of table 2.8, the results for channel 2 for low and high SLI households are also presented. Similar to the results in panel A, following NREGS, there are no significant changes in breastfeeding duration and number of ANC visits for the respondents in low SLI households. However, there is a significant decrease in the probability of public/NGO facility based delivery (by 7.9 percent) and the probability of home delivery has increased (by 10.7 percent), although both impacts are weakly significant.

The lack of significant results for channel 1 and opposite effects for channel 2 in low SLI households suggest that the women in these households are spending time away from other time-intensive activities. This effect is strong enough to influence these women to deliver at home rather than opting for institutional delivery. Choosing home birth over institutional birth can have a negative impact on an infant's health (Vellakkal et al., 2017; Kamal et al.,

2015). And this is shown in the primary findings, where low SLI households have a higher IMR increase than the baseline model.

For the high SLI households, it is not surprising that there is no significant impact of NREGS on channel 1 (**panel B** in table 2.8). Since respondents from high SLI households are the least likely participants of NREGS, it is unlikely that NREGS would lead to any change in their breastfeeding duration and number of ANC visits. However, one intriguing result can be found for channel 2 of these households. The probability of delivery at a private facility has fallen by 33.2 percent for households with a high SLI. There were no notable changes in the probability of public/NGO or home delivery. This decrease in the likelihood of a private delivery for high SLI households is puzzling, especially given high SLI households have seen a considerable decrease in child mortality. Even though the probability of private delivery for these respondents has reduced, the quality of treatment appears to be unaffected. Because households with a high SLI are unlikely to engage in the NREGS, they are more likely to benefit from improved rural infrastructure, such as road connectivity. In such circumstances, these respondents are likely using other services (such as urban hospitals) that are considered to deliver higher-quality care (Shah et al., 2009).

The results for the channels for SC households are provided in **panel C** of table 2.8. These households also show no significant impact of NREGS on the breastfeeding duration and the number of ANC visits. Although the effect is weakly significant, there is a reduction in the probability of public/NGO delivery for these households (approximately 10 percent less likely). The probability of a private delivery remained the same, but the probability of a home delivery increased by 15.3 percent. These findings, together with the lack of significant alterations in channel 1, suggest that the time substitution effect that SC women experience is quite robust. In response, these women are substituting time away from other time-intensive activities. This action is so intense, that women are opting for home birth over institutional birth. This is likely to have a negative impact on infant health once again. This

is reflected in the primary findings, where SC households experienced the greatest increase in IMR.

The rationale that the women from low SLI households and SC households are responding to time substitution effect by choosing home delivery over institutional delivery is supported by research reported by Navaneetham and Dharmalingam (2002) on two Indian states– Andhra Pradesh and Tamil Nadu, Sharma et al. (2007) on respondents from Nepal, and Haider et al. (2003) on respondents from US. These authors show that when women participate in the labour market, they are less likely to utilize maternal health care services, especially at a facility. It is because, with an increase in employment, the opportunity cost of time for these women increases.

Detrimental health effect: Another way by which NREGS might have a negative impact on child health is the detrimental health effect, as stated in section 2.3. The influence of NREGS on the stillbirth rate (SBR) and maternal death is studied to examine the impact of NREGS through this mechanism.

SBR is an indicator of fetal health. An increase in SBR following NREGS implementation would indicate that physical exertion or stress caused by NREGS employment can adversely affect a fetus, before even being born. If this is true, then an infant has less chance of survival to begin with. This could lead to an increase in infant mortality.

Maternal death, on the other hand, is an indicator of maternal health. Maternal death refers to the deaths of women during pregnancy, during abortion or child birth, and within six weeks of abortion or child birth in each household. An adverse effect of NREGS on maternal death would imply that the physical exertion experienced by these women through NREGS employment has negatively affected their health. If that is true, a new mother has lesser physical ability (in worse case, resulting in death) to take care of her infant. Which also can result in infant mortality.

Table 2.10: ITT impact of NREGS on Stillbirth Rate (SBR) and maternal death (PPML regressions at district level)

	1 SBR	2 Maternal death per 1000 households
Number of observations	871	871
Panel A:		
Full sample	0.052 (0.088)	0.715** (0.32) *ITT: 104.4%*
Panel B: By SLI		
Low SLI	0.006 (0.1)	1.371*** (0.448) *ITT: 293.8%*
High SLI	0.107 (0.18)	0.160 (0.453)
Panel C: By caste		
HH caste: SC	-0.366** (0.148) *ITT:-30.62%*	0.960*** (0.363) *ITT: 161.2%*

Note: (*** p<0.01, ** p<0.05, * p<0.1). Robust standard errors are in parenthesis. PPML regressions are performed at the district level. Regressions on SBR and maternal death are performed for those level and sub-groups, for which significant results were observed in table 2.6. Estimated Intent-to-treat (ITT) effect of NREGS is reported in the table for the coefficients that were significant. All regression models include time fixed effect, district fixed effects and district controls (NRHM variables, agricultural wage, agricultural output). Additional controls include individual variables (education, age at first birth) and household controls (number of children, number of adults, proportion of Hindu households and Muslim households, proportion of SC and ST households) at the district level.

Table 2.10 presents the results for the impact of NREGS on SBR (column 1) and maternal death (column 2). Similar to the main analysis these regressions are performed at the district level. Again, for the ease of discussion, only those results are reported in the table 2.10 for which significant effects were observed in the main results (table 2.6).

Panel A represents the results for the impact of NREGS on SBR and maternal death for the full sample. Following NREGS implementation, there was no significant impact on SBR. However, maternal death increased significantly. The ITT effect of NREGS on maternal death is 104.4 percent. This has a significant and worrying consequence. Putting this result in context would help to understand its impact. Average maternal death in 2007/08 was

approximately 2 per 1000 households. An increase of 104.4 percent in this average implies that there was an additional 2.1 maternal deaths per 1000 households following NREGS implementation (implying a 0.21 percent increase in maternal deaths).

Panel B shows the impact of NREGS on SBR and maternal death for households with a low SLI. There is no significant impact of NREGS on SBR for low SLI households. However, the influence on maternal mortality is both positive and significant. With an average maternal death rate of 1.93 per 1000 households, this increase means that maternal death rates for low SLI households increased by 5.8 per 1000 households after NREGS implementation.

For both these cases, lack of any significant impact on SBR; but a strong positive impact on maternal death together implies NREGS has a detrimental health effect on the mothers' health, not necessarily on the fetus health. This effect is stronger for low SLI households, which is also reflected in higher increase in IMR for low SLI households.[32]

Panel C presents the results for the impact of NREGS on SBR and maternal death, for SC households. It is encouraging to see that for the SC households, there is a significant reduction in SBR. The average value of SBR for SC households in 2007/08 was 17.1. Following NREGS, there were 4.8 fewer stillbirths per 1000 total births occurred for the women in SC households. For these households, however, there was a significant increase in maternal death. With an average of 2.1 maternal deaths per 1000 households, the result indicates that following NREGS, the SC households have experienced 3.36 more maternal deaths per 1000 households.

The considerable impact of NREGS on SBR in SC households corroborates the results seen in the previous section for time substitution mechanisms. Respondents from SC households do not substitute time away from activities that can have a direct influence on infant health, according to the findings. Similarly, even though the SC households' IMR has increased,

[32]For high SLI households there is no significant impact on SBR or maternal death following NREGS. Again, this is not surprising, since respondents from high SLI households are least likely participants of NREGS. Therefore, they are unlikely to be affected by the detrimental health effects of NREGS.

the SBR has declined. So, the respondents are not deliberately choosing activities that may have a direct negative impact on the health of infants (or, fetal health in case of SBR). The negative impact on infant health is primarily due to indirect effects. As evidenced by the fact that SC households have a higher rate of maternal death. Participants must conduct manual labour while working at NREGS. This type of work causes physical effort or stress for pregnant women or new mothers, which can affect their ability to care for their child. This could be a reason why an increase in IMR has been observed after NREGS implementation.

2.7 Discussion

This research analyzes the impact of NREGS implementation on child health outcomes. To assess this impact, an empirical analysis is required, as NREGS theoretically can have an ambiguous impact on health. On the one hand, the positive income and infrastructure effects of NREGS may improve child health. On the other hand, child health may suffer as a result of the negative program effect, which comprises the time substitution and detrimental health effect of the NREGS.

The research was conducted using two rounds of nationally representative DLHS data. The phased implementation of the NREGS over time provides an opportunity to employ the difference-in-difference technique to analyze the impact of NREGS on the infant and child mortality rates, as indicators of children's health.

The pre-trend assumption is crucial for the difference-in-difference analysis. This assumption requires that the trend in the variation of the outcome variables between the early and late implementing districts would have been similar in the absence of the program. Since the NREGS implementation was not random, the differential trend was controlled by introducing three measures based on which the backwardness ranking of the districts were calculated. A "falsification test" was performed to check if the pre-trend assumption would hold. The test

shows that the pre-trend assumption was not violated, which increases the confidence in the results from the analysis.

This study shows that following NREGS, there is no significant impact on the child mortality rate. However, there is a significant increase in the infant mortality rate (IMR). The effect being 1.2 more infant deaths per 1000 live births. This finding is similar to that of Chari et al. (2019), who observed that after NREGS, neonatal mortality increased by 2 per 1000 live births. The discrepancy in these values can also be explained. As a result of the NREGS work opportunity, mothers now have less time to dedicate to childcare activities. Newborns are at their most vulnerable stage of life, requiring continual attention and care from their mothers. If mothers had less time to spend on childcare, the detrimental impact on neonatal would be the highest. An infant's vulnerability is lower than that of a neonatal. As a result, when the amount of time spent caring for infants is reduced, the effect may not be as severe as it is for newborns.

Similarly, children aged one to five years are stronger than newborns and infants. Despite the fact that they require child care, they have a better chance at survival than the other two groups. In comparison to infants and neonates, if time spent in child care is reduced, the detrimental impact on a child should be less. As a result, it is possible that there will be no major impact on the child mortality rate. Therefore, the observed gradient in the effect of NREGS on mortality rates at various age levels is plausible.

NREGS had a greater negative impact on IMR in households with a low SLI (1.71 more infant deaths per 1000 live births) and scheduled caste households (4.12 more infant deaths per 1000 live births). Poor and marginalized caste households were the targeted group of NREGS employment. While official data and literature show that the employment for these groups have increased, this study highlights the unintended negative consequence of the program.

The channels by which NREGS affect infant health are quite similar to those proposed by

Chari et al. (2019). But in contrast, this study shows a different way through which the women are substituting their time away from health-inputs. Chari et al. (2019) claimed that women who are exposed to NREGS have fewer antenatal care (ANC) visits and are less likely to use institutional delivery. Based on these findings, they suggest a "crowd-out" hypothesis, that "maternal work displaces time-intensive health inputs". But, the results presented by the authors show that, while the coefficients were negative (for both ANC visits and institutional delivery), they were not significant at any conventional level.

This study, like Chari et al. (2019), finds no significant effect of NREGS on ANC visits and exclusive breastfeeding duration for the women. Moreover, rather than considering the institutional delivery (public/NGO and private) together, this study examines the impact of NREGS on public/NGO and private delivery separately. This showed that, whereas private delivery has declined after the implementation of NREGS, delivery at public/NGO institutions has increased significantly. These findings imply that women are not necessarily displacing any time-intensive health inputs (as suggested by Chari et al. (2019)). Rather, they are substituting time away from time-intensive activities that may have an indirect negative impact on infant health. Examples of such activities could include household chores, cooking meals and collecting fresh water.

Investigating the mechanism by which NREGS has a negative impact on infant health reveals two channels which have the greatest impact. Following NREGS, women are devoting time away from time-consuming activities that might have an indirect negative impact on infant health. Furthermore, the manual labour necessitated by NREGS has a detrimental impact on the health of pregnant women and new mothers. These women's ability to nurture their infant children, who are at their most vulnerable, is compromised. As a result, there is a higher infant mortality.

These findings are consistent with those of (Shah and Steinberg, 2019; Parmar and Banerjee, 2019; Li and Sekhri, 2013), who state that if the outcome variables under consideration

require time commitment, particularly from women, a strong negative effect of NREGS is observed. As a result, income security alone is insufficient to encourage health-promoting behaviours.

2.8 Conclusion

Over time, Employment Guarantee Schemes (EGSs) have gained popularity as a social safety net program since different countries often utilize EGSs to address the risks associated with income insecurity. Hagen-Zanker et al. (2011) and Subbarao et al. (2012) present several instances of EGSs of various dimensions and types that have been implemented by countries all over the world. Although the fundamental goal of these programs is to provide a safety net for the nation's poorest inhabitants against economic shocks, they frequently have unintended, but major spillover effects on other social or developmental objectives.

This study highlights the unintended negative impact of the world's largest social protection program, the NREGS, which was implemented in India in 2005, on the infant and child mortality rates for the districts that were exposed to the program. It is observed that following the implementation of NREGS, the infant mortality rates have increased considerably. This negative effect is more pronounced for the poorer households and the scheduled caste households, which were the intended target groups of the program.

Participants in EGSs are frequently required to perform manual labour. Women who participate in such programs have less time to invest in their households, resulting in a time substitution effect. Manual labour also may have a detrimental health effect. These effects are not country or location specific; rather they are based on the nature of EGSs' employment. Miller and Urdinola (2010) and Bhalotra (2010) show that when women participate in the labour market in response to a shock (both positive and negative shocks), it results in an increase in infant mortality rate (IMR). Therefore, while the magnitudes may differ, the negative effects reported in this study could be detected in other EGSs as well.

Despite the fact that programs like NREGS have a variety of positive impacts (see, for example, Bose (2017); Zimmermann (2012); Azam (2012)), this study, as well as Shah and Steinberg (2019); Chari et al. (2019); Parmar and Banerjee (2019) highlight the adverse implications of such programs. Policymakers might use a variety of measures to offset the harmful effects of NREGS. Pregnant women and new mothers can be placed on flexible work schedules so that they are not forced to compromise time spent caring for their children. Although childcare services are available in certain locations, they should be given more importance in the implementation of the NREGS. To counteract the indirect effects of time substitution, a specific awareness campaign geared to new mothers and pregnant women might be implemented. Such a campaign can emphasize the importance of activities such as drinking clean water and following good feeding habits, among others. To counteract the detrimental health impact, pregnant women and new mothers might be allocated to tasks that involve less manual labour.

This study acknowledges that the observed effects of NREGS on infant mortality are short-term. NREGS can have a variety of long-term effects, hopefully beneficial. In the long run, improved work and money may provide women more bargaining power, lowering fertility and improving children's well-being (Broeck and Maertens, 2015). Therefore, future research should look into the effect of NREGS on long-term infant or child health outcomes. Future research, in conjunction with this study, might aid in the development of a comprehensive picture of the unintended consequences of an EGSs on children's health in society. This will aid policymakers in anticipating the harmful impacts of EGSs and preparing mitigation measures.

3 Impact of an employment guarantee program on the reproductive behaviours of women in rural India

3.1 Introduction

India as a country continues to strive to reduce poverty and raise the living standards of its citizens. In this regard, India has implemented a number of initiatives throughout the years to reduce poverty levels across the country. In 2005, India launched a nationwide job guarantee program to give rural households 100 days of work each year. This program is known as Mahatma Gandhi National Rural Employment Guarantee Scheme (in short NREGS).

Multiple studies have shown the influence of the NREGS on various outcomes including wage, consumption, health, children's education and women's empowerment. The majority of these studies suggest that the program had a favourable impact on rural people's social outcomes. However, till now, no study has looked at the influence of the NREGS on any fertility metrics, particularly at the national level. The purpose of this study is to address this gap in the literature by examining the influence of NREGS on several aspects of reproductive behaviour, including fertility.[33]

It is important to research the influence of such initiatives on fertility. Reduced fertility rates are frequently linked to a country's economic progress (Ashraf et al., 2013; Glowaki and Richmond, 2007). Conversely, it is common to find that poor nations are usually densely populated. India is no different, being a densely populated country with a high poverty rate.

[33]The following terminology is used throughout this study. The actual fertility results, such as the number of births, fertility rates, and so on, are referred to as "fertility outcomes." The term "fertility preference" refers to fertility-related behaviours that can affect fertility. Age at marriage, age at birth, contraceptive usage, and so on are some examples of "fertility preference". The term "fertility intention" refers to any fertility-related behaviour that has the potential to influence future reproductive outcomes. For example, future contraceptive usage, future child preference, and so on. All of these aspects are collectively referred to as "reproductive behaviours or reproductive outcomes."

As a result, every policy aimed to reduce the population may have a spillover influence in lowering poverty levels. Various measures are necessary to reduce population growth. Reducing fertility is frequently suggested as one such strategy to alleviate poverty (Arokiasamy, 2002).

India has implemented various health policies, the most notable of which was the National Rural Health Mission (NRHM) in 2005. The target of NRHM was to improve the health of the rural population and to educate them about family planning, in order to control the country's high population growth which is primarily driven by rural areas. Fertility reduction has a multi-level and multi-dimensional impact on poverty. To begin with, using contraceptives helps to avoid high-risk births, which decreases the incidence of child and maternal death (Cleland et al., 2012). Second, contraceptives assist to extend the time between births, which benefits both child and maternal health (Cleland et al., 2012). Third, if the number of children is reduced, women will have more time to pursue other activities, potentially leading to employment opportunities. This, in turn, can empower women (Upadhyay and Karasek, 2012). Fourth, lowering the number of children allows families to invest more money. They may put money into enhancing the health of their current children and themselves, which will benefit them in the short and long run. They can also put more money into savings, asset creation, or enterprises to promote their overall financial situation (Broeck and Maertens, 2015; Canning and Schultz, 2012). So, it is evident that lowering the fertility rate, particularly in rural India, may benefit the country by alleviating hunger, improving child and maternal health, empowering women, and reducing poverty.

As of 2019, high income countries show a fertility rate of 1.6 births per woman, while in India it is 2.2 births per woman (Source: World Bank data). Within India, different fertility measures show that the fertility rates have decreased both in rural and urban areas during the last decade. It is encouraging to see that the rate of decrease in different fertility rates was higher in rural areas. However, the fertility rate in rural India is still higher than its

urban counterparts. For example, in 2016, Total Fertility Rate (TFR) was 2.5 in rural India, while it was 1.8 in urban India.[34] General Fertility Rate (GFR) in rural India in 2016 was 81.8, while in urban areas it was 59.5.[35] The Age Specific Fertility Rate (ASFR) for the women in age group 25-29 (group with the highest number of ASFR) was 180.2 in rural areas, while it was 139.1 in urban areas (Census of India, 2016).[36]

Low income, lack of old-age security, high infant or child mortality rates and religion, are some major factors that influence rural fertility preferences (Munshi and Myaux, 2006). In rural India, there are no national social security or life insurance policies in place. The insurances that are offered are either exclusively available to urban residents, or are too complicated to be availed by persons with low education. As a result, most individuals rely on their children to look after them when they are older (Broeck and Maertens, 2015). Direct measures targeting the supply side to lower fertility rates (for example, improving access to contraceptives, strengthening health facilities, etc.) will not have the full intended impact if these concerns are not addressed (Dreze and Murthi, 2001).

Raising female work levels is one measure that can have a major influence on fertility preferences. According to Broeck and Maertens (2015), female employment can lower fertility rates through a variety of mechanisms. For starters, working women have a higher opportunity cost of childbearing. This is referred to as the substitution effect. The fertility rate is expected to drop as a result of this factor. Second, the empowerment effect occurs when women earn more money and have more decision-making authority in their households. According to some studies, when women have more negotiating power, they tend to have fewer children (Basu, 2006; Upadhyay and Karasek, 2012). Third, increased female employment means increased family income. Depending on the desires of the parents, this income effect

[34]TFR is the average number of children expected to be born per woman throughout the course of her reproductive life, assuming that the age-specific fertility rates to which she is exposed remain constant and that no death occurs.

[35]General Fertility Rate is defined as number of live births per thousand women in the reproductive age group 15-49 years.

[36]ASFR is defined as number of live births per thousand women in a specific age group.

may have a positive or negative impact on the number of children. Couples may want to have additional children when they have more income. Alternatively, they may decide to spend on their children's nutrition, education, and health, raising the expense of having another child and, as a result, limiting fertility. Several studies have shown that fertility usually decreases with higher levels of income (Beguy, 2009; Fang et al., 2013; Ahn and Mira, 2002; Kalwij, 2000). Negative economic shocks, on the other hand, promote contraceptive usage, decreasing fertility, according to Alam and Portner (2018).

The Mahatma Gandhi National Rural Employment Guarantee Scheme, commonly known as NREGS, is the world's largest social protection program. In India, it was first launched in 2005. It guarantees a member of the rural household 100 days of unskilled wage employment. Some aspects were established to encourage women's involvement, such as equal pay for men and women employees, a mandatory requirement women receive at least 33 percent of the jobs, as well as offering daycare at some workplaces.

It has been shown in several studies that NREGS has promoted women's labour force participation (Azam, 2012; Zimmermann, 2012) as well as women's empowerment (Pankaj and Tankha, 2010; De Mattos and Dasgupta, 2017; Khera and Nayak, 2009; KrN, 2016). Studies on the influence of this increased work opportunities, particularly for women, on reproductive patterns in rural India are lacking in the literature. NREGS has the ability to influence fertility preferences, since it has already demonstrated a considerable impact on women's labour force involvement and empowerment. The purpose of this study is to examine the impact of NREGS on the reproductive behaviour of women in rural India and specifically whether it has led to reduced fertility. If this is the case, employment programs, when combined with supply-side policies to reduce fertility, can have considerable spillover effects in other dimensions, which might be advantageous to the country in terms of reducing population and eradicating severe poverty.

This study exploits the spatial and temporal variations in the implementation of the NREGS

and uses a difference-in-difference (DID) technique to perform the analysis. Four different outcome variables are chosen that represent different aspects of reproductive behaviour. These variables are– Children born in the past 3 years, as a measure of fertility outcome; contraceptive use probability and duration, as measures of fertility preference; and intention of having another child, as a measure of fertility intention. The study is conducted using data from two waves of nationally representative District Level Household and Facility Survey (DLHS). A pre-trend analysis is also performed using data from an earlier wave of the DLHS. The lack of pre-trend increases the confidence in the DID method's ability to assess the impact of NREGS on the reproductive behaviours of rural women in India.

The impact of NREGS on reproductive behaviours varies depending on the household composition. Following the introduction of NREGS, women from Scheduled Tribe (ST) households have adopted fertility-promoting reproductive behaviours such as lowering contraceptive use and showing higher intention of having additional children.[37] Alternatively, women in low and middle income households are more likely to reduce their fertility.[38] The number of children born decreased by 0.299 for women in medium income households (average value = 0.773). The number of children born to women aged 15 to 17 years decreased by 0.27 (average value = 0.351). Women in this age group also engage in fertility-reducing reproductive behaviours such as increased duration of contraception use and a reduced desire to have additional children.

To investigate the channels through which NREGS could affect the reproductive behaviours, additional analyses was done on exclusive breastfeeding duration, number of ante-natal care visits, probability of different facilities deliveries and probability of home delivery, completed years of schooling for children aged 7-14 years, age at first birth and age at marriage. It is observed that the impact of NREGS on these variables differ significantly based on the type of

[37]Scheduled Tribe households are historically the most deprived population in India. NREGS targeted to provide employment to these households to promote their well-being.

[38]Low and Middle income households are identified based on their Standard of Living Index (SLI). SLI is discussed in section 3.4.3.

respondents or their households. The results show that the NREGS have a quantity income effect on women in ST households. As a result of this effect, respondents from ST households adopt fertility-promoting behaviours. Women in both low and medium SLI households want to have fewer children. A larger time substitution effect, along with the quality income effect, influence the reaction of women in low SLI households, whereas a stronger quality income effect influences the responses of women in the medium SLI households.

An indirect time substitution effect and a strong quality income effect influence the fertility responses of women aged 15 to 17 years. These women have higher intention to invest in the quality of their lives, which leads to reduced fertility. Additionally, there is an effect of "hope" for these women. Because these women are assured of a job opportunity in the near future, they respond to this "hope" by reducing their current fertility. This line of thinking is supported by their present and future fertility intentions. However, due to the lack of data, this impact could not be investigated further in this study.

The remainder of this chapter is structured as follows. The background for this study is presented in section 3.2. It includes a review of relevant literature, a brief introduction of NREGS program and a summary of the NRHM health policy that is extremely relevant to this study. The conceptual framework for the analyzed model is presented in section 3.3. Section 3.4 presents the information on the data, providing a description of the survey, a discussion of the sample and a discussion on the variables considered in the analysis. Section 3.5 describes the estimation procedure with a discussion on the identification strategy and the utilized model. The results of the analysis are presented in section 3.6. Section 3.7 provides a discussion of the results, while section 3.8 concludes.

3.2 Background

3.2.1 Literature Review

Impact of other employment guarantee schemes on reproductive behavior: EGSs (Employment Guarantee Schemes) are types of social protection programs commonly employed by low- and middle-income nations to provide a pathway to reduce poverty. However, as Hagen-Zanker et al. (2011) and Subbarao et al. (2012) note, these programs differ greatly in their design, execution, context, and target population. As a result, the effects of these initiatives on poverty and other development indices vary greatly. A general comparison of the program will be useless and misleading, according to Hagen-Zanker et al. (2011), because of the significant variation in several elements of EGSs among nations. However, reviewing the papers that investigate the effects of EGSs on reproductive behaviour is informative. Although the effects are expected to vary substantially due to the factors indicated above, a study of these papers can provide insight on the potential pathways by which EGSs might influence many aspects of reproductive behaviour.

To the best of our knowledge, there are few studies that evaluate the influence of an EGS on fertility measures. Hoddinott and Mekasha (2020) analyzed the influence of Ethiopia's Public Safety Net Program (PSNP) on household size and discovered that membership in the PSNP reduces the chance of a female adult giving birth by 8.1 percentage points. Mahmud (1994) used logistic regression to examine the impact of women's engagement in employment-generating initiatives run by government and non-government organizations in different villages in Bangladesh. In comparison to non-program members, program participants were 2.15 times more likely to use sterilization, according to the author. The author suggests a few channels via which greater female employment might have influenced the outcome variable. These are— an increase in the return to women's labour, access to external help, and mobility outside the house. As a result, these studies suggest that if the EGS increases

women's labour force involvement, it usually encourages fertility-reducing behaviours.[39]

Impact of increase in women's employment on fertility: Several research studies suggest an empirical relation between female employment opportunities and fertility behaviours. However, they are mostly based on high-income nations or urban regions of developing countries. In general, these studies suggest that increasing women's employment opportunities encourages them to reduce their fertility. Such impacts have been documented in high-income nations such as the Netherlands (Kalwij, 2000), Germany (Paule-Paludkiewicz, 2020), the United States (Schaller, 2016; Jones, 1981), the OECD group of countries (Adsera, 2004), and urban regions of developing nations (Beguy, 2009; Shapiro and Tambashe, 1997). However, depending on other associated conditions, the impact differs greatly.

For example, Schaller (2016) discovered that a 1 percent increase in predicted female employment reduces the birth rate by 0.2 to 3.6 percent. The effect varies with female education and ethnicity. Beguy (2009) investigated the influence of wage employment in two developing nations' metropolitan districts. They discovered that wage-earning women were 27 percent less likely to give birth than self-employed women. In rural China, Fang et al. (2013) investigated the influence of off-farm female employment on fertility choice and actual fertility. Using an Instrumental Variable method, the authors showed that with off-farm employment for women, the preferred number of children decreases by 0.35, but the actual number of children decreases by 0.50. Women who have a son as their first child have a greater decline. The authors of all of these studies emphasize that when women's employment levels rise, so

[39]PSNP was targeted to food-insecure households in six Ethiopian regions. The participants were required to perform 180 days of manual labour, and the payment was made in cash or food. Additionally, households with limited labour capacity received unconditional cash support. Temporary unconditional cash support was also provided to households with pregnant women and new mothers with infant children. In 2015, more than 7 million people were the beneficiary of the program (Cochrane and Tamiru, 2016). In contrast, NREGS offered 100 days of manual work to any individual belonging to a rural household in India. There was no provision of direct support to any household or individual, other than the unemployment allowance, which was paid only if employment could not be provided in a stipulated time. The scope of NREGS was also huge compared to PSNP. In 2014, over 121 million individuals benefited from the NREGS program (Ministry of Rural Development, 2015).

does their opportunity cost of time. The empowerment effect is also apparent, although it is more pronounced in communities or cultures where women are less likely to work. The substitution and empowerment effects have a significant impact on fertility reduction.

Empirical research on the influence of women's employment on fertility behaviour in developing nations' rural areas is scarce. Because of the differences in demographics, the relationship between female employment and fertility in developing nations, particularly in rural regions, may differ from that in developed ones. Developing nations are often at an early stage of demographic transformation (Mason, 1997). Because of the low cost of childbearing, different reproductive norms, lower female employment, and a lack of social security, the effects would also be different (Broeck and Maertens, 2015). Even within a country, the impact on fertility might vary between rural and urban areas. In a city, both the opportunity and financial costs of childbearing are often higher (Martine et al., 2013). Women also have more opportunities for education and mobility, which empowers them and leads to a lower fertility rate. Furthermore, modern family planning methods may be efficiently implemented in urban locations with concentrated local populations (Lerch, 2019).

As previously mentioned, only a few studies have investigated the relationship between female employment and fertility in rural areas of developing countries. Among these are Broeck and Maertens (2015) for rural Senegal and Jensen (2012) for rural India. Both of these studies have a small sample size since they focus on specific communities or villages within the country.[40] Both studies indicate that higher female work opportunities alter women's reproductive behaviour in these locations, resulting in reduced fertility. According to Broeck and Maertens (2015), higher employment reduces the number of births (point estimates range between -0.22 and -0.33). According to Jensen (2012), increased employment opportunities make women approximately 6 percent less likely to marry or have children. The number of children they intend to have also decreases by 0.35.

[40]Study sample for Broeck and Maertens (2015) included responses of 1500 women from 34 villages in Saint Louis region of north Sengal. Study sample for Jensen (2012) included 3200 households from 160 villages situated close to the country capital, Delhi.

Both studies highlight the empowerment effect that comes with increased employment for women as a driver of reducing fertility. Jensen (2012) also finds that improved employment opportunities for women affect their parents' behaviour. If parents perceive that their daughters have job prospects, they may invest more in human capital and postpone their daughters' marriages. Both results imply that there is an important link between female employment and fertility behaviour that should be recognized. It might be used as a means of limiting population growth, particularly by the nations where population growth is a major concern.

General impact of NREGS: The NREGS is the world's largest social safety program ever enacted. In India, it was first launched in 2005. It guaranteed a member of the rural household 100 days of unskilled wage employment. Certain features were adopted to encourage women involvement, such as equal pay for men and women employees, a mandatory requirement that 33% of workers be women, and childcare facilities at some workplaces. Several studies have shown that NREGS has helped to increase women labor force participation (Azam, 2012; Imbert and Papp, 2015) and improved women empowerment (Pankaj and Tankha, 2010; De Mattos and Dasgupta, 2017; Khera and Nayak, 2009; KrN, 2016). Multiple studies look at the impact of NREGS on consumption (Bose, 2017; Liu and Deininger, 2010; Bagavathinathan and Chaurey, 2020), child education (Shah and Steinberg, 2019; Li and Sekhri, 2013), and health (Parmar and Banerjee, 2019; Chari et al., 2019).

These studies are performed on different scales ranging from analysis at village level to the country level. In general, these studies suggest that household income and status in terms of consumption and nutrition have improved as a result of NREGS implementation. However, negative effects are identified for those components that need specific time commitment from the women of the household (health, education, meal intake, etc.).

To date, there has been no research on the impact of NREGS on reproductive behaviours

in rural India. NREGS has the ability to influence reproduction, including preferences and intentions, since it already had a positive impact on women's labour force participation and empowerment (Imbert and Papp, 2015; De Mattos and Dasgupta, 2017). It would be interesting to examine if NREGS has an influence on rural India's reproductive behaviours, ideally resulting in a decrease in fertility. If this is the case, employment programs, when combined with supply-side efforts to reduce fertility, can have considerable spillover effects in other dimensions, which can assist the country to reduce population and remove extreme poverty.

3.2.2 NREGS overview

In September 2005, India passed the National Rural Employment Guarantee Act, also known as the Mahatma Gandhi National Rural Employment Guarantee Act. The states of the country have implemented public employment schemes based on this legislation, which were collectively termed National Rural Employment Guarantee Schemes (NREGS). At least one adult member of every rural household that applied for the job received 100 days of guaranteed wage employment every fiscal year. The program is designed to supply unskilled manual work at a minimum wage that is equivalent to the current market wage rate. After applying, the candidate must be offered a job within 15 days, and the location must be within a five-kilometer radius of the applicant's village; otherwise, the state government must provide the applicant with either unemployment benefits or an extra salary to cover travel and lodging costs.[41] NREGS supports gender equality by requiring a 33 percent female participation rate in each fiscal year and paying female participants the same as their male counterparts (Sharma, 2010).

NREGS was introduced in phases beginning in February 2006 with 200 poor districts. In

[41] In the fiscal year 2006/07, on average over 98% of the jobs demanded at NREGS were met. So, the incidence of providing unemployment allowance is quite low. The NREGS data does not further identify who received unemployment allowance and who received the job (Ministry of Rural Development, 2007).

the fiscal year 2006-2007, employment was supplied to 21 million families. In April 2007, the program was expanded to 130 more districts, resulting in 33.9 million households being employed throughout that fiscal year. In April 2008, the plan was expanded to cover 289 additional districts, resulting in the employment of 45.1 million households. NREGS currently covers the whole nation, with the exception of districts with only urban residents.

According to the Act, NREGS was expected to be implemented in districts based on their level of backwardness. Although it is not mentioned officially, the official ranking of the districts produced by the Planning Commission of India in 2003 is thought to have been adopted as the measure of backwardness. The Planning Commission study from 2003 was created primarily to identify the country's backward districts. In addition, this metric was provided closest to the implementation of the NREGS program. The ranking was derived from the number of Scheduled Castes (SC) and Scheduled Tribes (ST) in each district in 1991, the output per agricultural worker in 1990-93 for each district, and agricultural wages in 1996-97 (Planning Commission, 2003). Along with the goal of providing guaranteed employment to the poorest regions through NREGS, another goal was expressly stated: NREGS should be implemented in at least one district of each state in the country. The above two criteria, however, cannot adequately account for the implementation of NREGS. Some of the districts that received NREGS in phase 1 ranked much lower than some other districts in phase 3. Districts that were observationally similar were assigned to different phases of implementation (Bose, 2017).

Since inception, NREGS has provided social security to the most disadvantaged and marginalized groups in rural India, by providing an unparalleled quantity of employment opportunities. To guarantee women's involvement in NREGS, several measures were implemented, including easy access to employment, equal salary rates, good working conditions, and representation in decision-making bodies. Women's involvement rates have been relatively high, ranging between 40 and 48 percent, much higher than the required 33 percent. The partic-

ipation of the society's underprivileged castes (SC and ST) was also significant, accounting for more than half of total NREGS employment. Figure A.1 in subsec:Appendix-B shows the percentage of employment for women, SC and ST from the year 2006 to 2011.

As a result, it is clear that NREGS may have a significant influence on India's rural population's overall well-being. NREGS might alter reproductive behaviour in places where it is implemented by improving employment opportunities, especially for women.

3.2.3 National Rural Health Mission (NRHM)

Despite two decades of sustained economic progress, India continues to struggle with social development, particularly in rural regions. In April 2005, India began the National Rural Health Mission (NRHM) to deliver quality health care in the country's remote rural areas. The goal of this initiative was to provide rural residents, particularly disadvantaged populations, with accessible, inexpensive, and accountable health care. The focus was on improving this population's reproductive, maternal, newborn, and child health (RMNCH).

The main approaches taken by NRHM to achieve these goals were to: 1) Decentralize the health-care system by engaging local government agencies and non-governmental organizations in the provision of health-care services, 2) Provide flexible financing at each level of health care centres, to be utilized as needed to improve health care infrastructure and services. Also, specific funding should be made available for the Janani Suraksha Yojana (JSY), which is a safe motherhood program that promotes institutional delivery. 3) Increasing the number of health-care workers to improve administration and services. In addition, for community management of public hospitals, Patient Welfare Committees (also known as Rogi Kalyan Samiti, or RKS) were established. 4) Provide new and existing healthcare workers with skill-based training (Ministry of Health & Family Welfare, 2005).

According to the (Ministry of Health & Family Welfare, 2009), the provision of health care

in rural India was so insufficient and neglected, that any action would take a long time to make a substantial difference in the country's health and social development. This research investigates the responses of people living in rural India in the years 2007-08, when the NRHM had only been operating for roughly two years. In such a short time, NRHM is unlikely to have a major influence on the response variables considered in this research. Nonetheless, it remains a significant external factor. Data was collected in order to account for the effects of NRHM. The data section will go into the specifics of these variables.

3.3 Conceptual Framework

From the outset, it is impossible to predict what effect increased work opportunities, particularly for women, brought about by NREGS would have on reproductive behaviours. The literature identifies 3 ways in which increased work prospects can alter reproductive behaviours. *1) Income Effect:* A higher level of employment means a higher level of family income. According to the quantity/quality trade-off theory, the effect of higher income on reproductive behaviours is uncertain. The fertility outcome will depend on couples' decision to either have more children (quantity), or invest in the well-being of their children (quality). In general, it has been observed that with higher income, fertility decreases (Canning and Schultz, 2012). *2) Time Substitution Effect:* As the employment opportunities grow, so does the opportunity cost of having children, especially for women. This effect is expected to have a negative impact on fertility. *3) Women's empowerment effect:* If women's employment is the source of higher household income, women will have more intra-household bargaining power. A number of authors have argued that women prefer to have fewer children than their husbands (Mason, 1997; Schaller, 2016; Upadhyay and Karasek, 2012). As a result, the empowerment effect is likely to have a negative impact on fertility.

For the ease of discussion, this study will use the term "negative program effect" to collectively refer to the negative impact of the NREGS on fertility, which includes the quality income

effect, the time substitution effect, and the women empowerment effect. As the discussion demonstrates, if NREGS have a positive influence on fertility, it is most likely due to a larger quantity income effect.

Theoretically, NREGS-induced increase in employment opportunities will have an ambiguous impact on reproductive behaviours. To identify the effects of NREGS on reproductive behaviour, an empirical investigation is therefore necessary (Basu, 2006; Broeck and Maertens, 2015).

3.4 Data

3.4.1 Survey Description

This study utilizes data from two waves of India's District Level Household and Facility Survey (DLHS). The DLHS is a nationally representative, cross-sectional survey that is conducted on a regular basis. The primary goal of DLHS is to collect information on mother and child healthcare service usage and quality perceptions.

The survey was undertaken by a total of 12 research institutions, with the International Institute of Population Science serving as the nodal agency. All of the country's districts were surveyed. A systematic, multi-stage stratified sampling approach was used to choose 40 Primary Sampling Units (PSUs) within each district. A Circular Systematic Random Sampling (CSRS) approach was used to choose 28 residential households within each PSU. The sample was inflated by 10% to account for the non-response issues. DLHS 2 was conducted in 593 districts between 2002 and 2004 (before the implementation of NREGS). A total of 620,107 households were contacted for an interview. Approximately 67 percent of the households questioned were from rural areas of the country. 507,622 currently married women (aged 15-44 years) were questioned from these households.

The sample design for DLHS 3 was identical to that of DLHS 2. Fifty PSUs were chosen from each district. In addition, 22 to 33 households were questioned within each PSU. The number of households interviewed in each district ranged from 1000 to 1500. From December 2007 to December 2008, fieldwork was conducted in 601 districts across the country. The state of Nagaland was not included in the DLHS 3 survey. According to the 2011 census, Nagaland accounted for 0.16 percent of India's total population. A total of 720,320 households were surveyed in this study. Around 77 percent of the households surveyed were from the country's rural areas. A total of 643,944 ever married women aged 15-49 years and 166,260 unmarried women aged 15-24 years were questioned from these households.

In both the rounds, the married women respondents were surveyed on their use of and perceptions of the quality of maternity and child healthcare services. Additionally, information on their children was gathered, including their date of birth, gender, and death age (if relevant). DLHS 3 collected birth records for married women, since January 1, 2004. Both of these surveys also gathered information on the respondents' family planning habits, such as contraception use and fertility preferences. A limited amount of socioeconomic data for these women and their households was obtained in both rounds.[42]

3.4.2 Sample

The sample used for this study is identical to the one utilized for chapter 2. For convenience, the sample is discussed in this section as well. But essentially, this discussion is identical to the one discussed in the section 2.4.2.

A closer comparison of the districts in the two rounds of DLHS revealed that there was a disparity between the numbers of districts in each state which were interviewed.[43] A careful

[42]DLHS interviews were conducted privately for each respondent, to ascertain that the individual responses are not influenced by the presence of others. A detailed survey description of the DLHS 2 and DLHS 3 is available from (http://rchiips.org/PRCH-2.html) and (http://rchiips.org/Manuals.html), respectively.

[43]The state of Nagaland was excluded from the DLHS 3 survey. In addition, between 2004 and 2007,

inspection revealed that both the DLHS 2 and DLHS 3 surveys were carried out in 585 districts. In the majority of these districts, NREGS was implemented in three phases. 194 districts (33%) were in phase 1, 121 districts (21%) were in phase 2, and 254 (43%) were in phase 3. NREGS was not implemented in 16 of these 585 districts, as they were 100 percent urban districts. As a result, observations from these 16 districts were excluded from the study as well.

As mentioned earlier, the three measures created by Planning Commission of India, based on which the districts were considered to be selected to obtain NREGS was available for 442 districts.[44] In either round 2 or 3, DLHS was not conducted in 5 of the 447 districts. As a result, these five districts were also left out of the study. The final data therefore contains information on the 442 districts. Out of these 442 districts, NREGS phase 1 was introduced in 175 districts and NREGS phase 2 was introduced 100 districts by 2006. Table 2.1 provides information on the number of districts where NREGS was implemented in phases and the corresponding number of districts on which data is available for the analysis. According to 2011 census data of India and author's calculation based on the rural population percentage, these 442 districts covers about 85 percent of the total rural population of India.[45]

Figure 2.1 depicts a timeline for DLHS data collection and phased NREGS implementation. By the time the DLHS 3 data collection procedure began, phase 1 and phase 2 districts had received the program. Towards the end of DLHS 3 data collection, phase 3 districts were in the process of acquiring the program. As a result, there is some overlap between the NREGS implementation and data collection, which might cause estimation issues. This problem existed for other studies that utilized DLHS and National Sample Survey data.[46]

several districts were split into two, and new districts were established from sections of existing districts. Please refer to [http://www.statoids.com/yin.html] for detailed information on the districts of India.

[44]The Planning commission report calculates the backwardness measure of districts belonging to 17 out of 29 states. The Union territories were also excluded. The total number of districts that were ranked is 447.

[45]Information for district based population was collected from Ministry of Statistics and Programme Implementation, India website.

[46]The National Sample Survey (NSS) data was utilized in a large number of studies evaluating the impact of NREGS. The National Sample Survey (NSS) is another nationally representative data set for India. The

In general three different approaches have been observed to address this data issue. *1)* Restricting data so that the outcome variables are not exposed to the NREGS in phase 3 districts (Chari et al., 2019; Islam and Sivasankaran, 2015; Parmar and Banerjee, 2019). Given that the majority of the data collection for both the DLHS 3 and the NSS 64th cycle was completed prior to the implementation of NREGS in phase 3 districts, the number of observations deleted is relatively small in comparison to the total data. *2)* Districts in phases 1 and 2 are considered early implementation districts, whereas districts in phase 3 are considered late implementation districts. The program's estimations are referred to as the effects of varying levels of exposure to the program (Imbert and Papp, 2015; Shah and Steinberg, 2019; Ravi and Engler, 2015). *3)* Without any data manipulation, considering phase 1 and 2 districts as treatment group and phase 3 districts as control group. Few studies assumed that, despite the fact that phase 3 districts were admitted to the program in April 2008, real implementation would take longer owing to the significant administrative costs and infrastructure requirements. As a result, even if there is some overlap between program implementation and data collection, NREGS may not have a major impact on the outcome variables studied in such a short period of time. Azam (2012) and Das and Singh (2013) in their papers took this approach and considered phase 1 and 2 districts as treated and phase 3 districts as the untreated districts. This study addresses the issue of overlap by following the first approach.

The approach adopted by Parmar and Banerjee (2019) is followed in this study. The authors analyzed data up until March 2008, when the NREGS had been implemented in phase 1 and 2, but not in phase 3 districts. Similarly, respondents in this study are limited to those who were interviewed before April 2008 for the DLHS 3 data. By following this step, no additional districts were excluded and a little over 80 percent of the total respondents were retained. By April 2008, NREGS was implemented in the phase 1 and phase 2 districts.

64th cycle of NSS data was used in most of these studies, which overlapped with the NREGS implementation for phase 3 districts by around 2 to 3 months.

Therefore, these districts are collectively called the "treatment districts". Phase 3 districts had received the program after April 2008, therefore these districts are referred to as the "control districts".

NREGS was exclusively implemented in the country's rural areas. As a result, only respondents from rural locations in each district are considered for this research. The respondents who live in urban areas are excluded. To make sure the composition of the respondents remain comparable, this study also excludes the unmarried woman respondents (interviewed only in DLHS-3) from analysis. The analysis is therefore conducted on the married respondents only. The issue of overlap between phase 3 NREGS implementation and DLHS 3 data collection is addressed by deleting observations for which the outcome variables may have been exposed to NREGS implementation, as described before. The distribution of the respondents included in this analysis is shown in table 2.2 by time period and NREGS phases.

3.4.3 Important variables

Main outcome variables: There are four key outcome variables chosen for this research, each representing some aspect of reproductive behaviour. These are:

- **Children born in the previous 3 years**: For DLHS 3, children born to women after 2006 are taken into consideration. Since, NREGS was announced to be introduced in 2005, children born in 2006, 2007 and 2008 were likely to be exposed to the program. To make a similar comparison with DLHS 2, the date of the survey was noted. And then children born to respondents within 3 years prior to the interview date were taken into consideration. This is a fertility outcome.
- **Intention to have any more children**: DLHS asked the women about their fertility intention. It is a binary variable.

- **Contraceptive use:** DLHS Questionnaire asks if the respondent and/or her spouse is using any contraceptive method. It is a binary response. This is a measure of fertility preference.

- **Contraceptive use duration**: Contraceptive use duration in months is collected for those who are using contraceptives. This is also a measure of fertility preference.

Additional outcome variables: To understand the mechanisms, through which NREGS could have affected the main outcome variables, some additional variables were chosen for the analysis. These are– Duration of exclusive breastfeeding (collected for the women with a recent surviving child), number of ante-natal care visits (collected for the last pregnancy); place of delivery (collected for the last pregnancy); completed years of schooling for the children aged 7-14 years (collected from household member information); age at marriage and age at first birth for the women.

Control variables: The limited socioeconomic variables collected in both rounds of DLHS for the women and households were utilized as control measures. These are- age of the respondents; literacy and education level for the respondents and their husbands; if the women have experienced any child death (obtained from the birth and death records of each children of the respondent), total number of children[47] and number of household members; religion and caste of the households.

Control for NRHM health policy: Furthermore, both rounds of the DLHS gathered data on the facilities available at the Sub-centre (SC), Primary Health Centre (PHC), Community Health Centre (CHC), and District Hospital (DH).[48] DLHS 3 has specifically gathered data

[47]Because the NREGS may influence the desire to have children, the number of children in the family is likely to be endogenous. To overcome this limitation, a control is introduced for the number of children in the households above 3 years of age. Since NREGS was implemented in 2006, children aged 3 years in 2008 (when DLHS 3 was administered) would have been born in 2005, before NREGS was implemented.

[48]In the Indian public health system, the sub-centre (SC) is the most peripheral and initial point of contact with health care. SCs are set up to serve a population of 5000 people in plain regions and 3000 persons in hilly/remote areas. One auxiliary nurse midwife (ANM) and one male health worker are required for each

on key interventions of National Rural Health Mission (NRHM) policy that were implemented across the nation in 2005.

The following variables were collected in both rounds of the DLHS and were relevant and comparable. The variables were collected at various levels of the community (SC, PHC, CHC and DH). The information related to NRHM variables were collected during 2007/08 only (for DLHS 3) from all the districts that were interviewed.[49]

- Number of health workers in each SC, PHC, CHC and DH. (Both rounds)
- Number of PHCs, SCs, CHCs, DHs accessible to each village. (Both rounds)
- Number of visits conducted by mobile health clinics. (Both rounds)
- Number of Accredited Social Health Activists at each SC. (Collected in 2007/08 only)
- Whether flexible funding was received and utilized following NRHM implementation at each SC, PHC, CHC and DH. (Collected in 2007/08 only)
- Number of registered medical officers for AYUSH- Ayurveda, Yoga, Unani, Siddha, Homeopathy (Indian system of medicine). (Collected in 2007/08 only)
- Whether the Patient Welfare Committee (RKS) was established, at the CHC and DH level. (Collected in 2007/08 only)
- Number of JSY beneficiaries at the CHC and DH level. (Collected in 2007/08 only)

SC. A village's initial point of contact with a medical officer is the Primary Health Centre (PHC). PHCs are designed to serve 30,000 people in plain regions and 20,000 people in hilly/remote areas. Each PHC must have one Medical Officer and 14 additional employees. PHCs use the Community Health Centre (CHC) as a referral centre. Each CHC must have four medical specialists and a total of twenty-one additional employees. CHCs are set up to serve a population of 120,000 people in plain regions and 80,000 people in hilly/remote areas. District Hospitals (DH) are the first referral unit. Each district in India is supposed to have one DH established. If a facility can provide 24/7 emergency obstetric and newborn care, as well as 24 hour blood storage, it is designated as a fully operational first referral unit (Ministry of Health & Family Welfare, 2009).

[49]NRHM was introduced in 2005. Components related to NRHM did not exist in 2002/04 when DLHS 2 was conducted.

Additional district control variables: The data on three measures used to create the status of backwardness for the districts are obtained from the Planning Commission report (2003). These measures were– Agricultural wages in 1996/97, Output per agricultural worker in 1990/93 and SC/ST population percentage in 1991 census. Though it was not exclusively followed, it was believed that this ranking was one of the major criteria based on which the NREGS was implemented in the districts. These variables were included in the study as control variables to improve the model's accuracy.

DLHS identifies the households that belong to the SC/ST caste. Given that DLHS is a nationally representative dataset the SC/ST population percentage calculated from DLHS has significant correlation with the SC/ST population percentage used by planning commission report. The results did not vary significantly from each other when either of the measures were used. In this paper the SC/ST population measures obtained from DLHS are considered.

The wealth status of the households are depicted by the standard of living index of the households. The Standard of Living Index (SLI) created by DLHS combines a range of household characteristics. This index is used to identify the households belonging to different wealth levels to run the sub-group analysis as discussed shortly.

Descriptive Statistics: The descriptive statistics for the primary outcome variables evaluated in this study are described in **panel A** of table 3.1. Before NREGS, phase 1 districts had the greatest average number of children born in the previous three years, while after NREGS, phase 1 districts had the lowest average number of children born in the previous three years. Regardless of NREGS implementation, the probability of contraceptive usage and use duration decreased on average in all the districts. In all the phases, respondents' desire to have additional children declines over time. So, the fertility outcome and intention have decreased over time. Surprisingly, fertility preference has decreased as well (in terms of

contraceptive usage and duration).

The descriptive statistics for the additional dependent variables are provided in **panel B** of table 3.1. Prior to NREGS, there had been a gradient in breastfeeding duration measured in months. Phase 1 districts had the shortest average breastfeeding time, whereas phase 3 districts had the longest. However, after NREGS, the gradient shifted in the reverse direction. Phase 1 districts had the longest average breastfeeding duration, while phase 3 districts had the shortest. Expectant mothers' average antenatal care (ANC) visits exhibited a gradient as well, with phase 1 districts having the lowest average ANC visits and phase 3 districts having the highest average ANC visits. In all three periods, the average number of ANC visits rose after the NREGS.

In terms of delivery locations, the majority of deliveries were conducted at home in all phases for both time periods, followed by public/NGO facility based deliveries and private facility based deliveries. Compared to earlier time period, the proportion of deliveries in public/NGO facilities grew, while the proportion of deliveries at home decreased. Overall, there were no notable changes in the proportion of private facility based deliveries.

The education of children is measured in years of schooling completed. In comparison to phase 3 districts, children in phase 1 districts have received less education on average. For districts in all phases, the number of completed years of schooling by children aged 7 to 14 years decreased with time.

Table 3.1: Descriptive statistics for the outcome variables by NREGS phases and time

	DLHS 2 (2002/04)			DLHS 3 (2007/08)		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Number of respondents	158,937	97,480	194,955	179,498	107,211	147,820
Panel A: Dependent Variables						
Children born in last 3 years	2.132 (2.14)	2.099 (2.108)	1.972 (1.975)	0.789 (0.545)	0.815 (0.556)	0.804 (0.565)
If respondent want anymore children	0.618 (0.486)	0.599 (0.489)	0.602 (0.489)	0.518 (0.5)	0.48 (0.5)	0.466 (0.499)
Contraceptive: Current use	0.509 (0.5)	0.543 (0.498)	0.596 (0.491)	0.219 (0.414)	0.26 (0.439)	0.307 (0.461)
Contraceptive: Duration in months	53.969 (36.525)	51.841 (37.247)	53.575 (37.127)	26.661 (11.092)	26.442 (11.256)	27.153 (11.243)
Panel B: Additional Outcome Variables						
Breastfeeding duration	2.71 (3.04)	2.98 (3.11)	3.74 (3.12)	2.72 (2.62)	2.42 (2.54)	2.54 (2.6)
Number of ANC visits	2.16 (2.58)	2.45 (2.84)	3.06 (3.01)	3.38 (2.11)	3.39 (2.16)	4.12 (2.86)
Proportion: Public/NGO delivery	0.12 (0.32)	0.16 (0.37)	0.2 (0.4)	0.2 (0.4)	0.22 (0.41)	0.27 (0.44)
Proportion: Private Delivery	0.1 (0.3)	0.12 (0.32)	0.16 (0.37)	0.12 (0.32)	0.12 (0.32)	0.18 (0.39)
Proportion: Home Delivery	0.78 (0.41)	0.72 (0.45)	0.64 (0.48)	0.69 (0.46)	0.66 (0.47)	0.54 (0.5)
Children (7-14 years) education	3.86 (2.29)	3.9 (2.31)	4.25 (2.28)	3.7 (2.32)	3.67 (2.35)	4.17 (2.37)

Notes: The table provides the means and the standard deviations (in parenthesis) for the main outcome variables (panel A) and additional outcome variables (panel B) used in this analysis. The descriptive statistics are reported for the respondents categorized by NREGS implementation, for two time periods 2002/04 and 2007/08.

The descriptive statistics for the control variables used in this research are presented in table 3.2. From phase 1 to phase 3 districts, the household characteristics show a gradient, reflecting the backwardness metrics obtained for these districts. Prior to NREGS, women in phase 1 districts were more likely to marry and have children at a younger age, were less educated, had more sons, and were more likely to experience the death of a child. A similar gradient can be seen in other household variables. In comparison to phase 3 districts, phase 1 districts have a greater number of SC/ST caste (marginalized castes) households and a higher proportion of low SLI households. For the most part, the gradient is still visible after NREGS. For all phases, the average age for first birth has risen. In addition, the number of sons and the number of children who have died has decreased. Surprisingly, the share of households with a low SLI has risen across all the districts.

Table 3.2: Descriptive statistics for the conrol variables by NREGS phases and time

	DLHS 2 (2002/04)			DLHS 3 (2007/08)		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Number of respondents	158,937	97,480	194,955	179,498	107,211	147,820
Control variables						
Age at marriage	16.63 (2.86)	17.14 (3.19)	17.87 (3.22)	17.17 (2.87)	17.61 (3.14)	17.91 (3.07)
Age at first birth	18.39 (3.22)	18.86 (3.42)	19.44 (3.38)	19.41 (3.05)	19.75 (3.21)	19.94 (3.15)
Respondent_Primary education	0.38 (0.48)	0.44 (0.49)	0.52 (0.5)	0.38 (0.49)	0.44 (0.5)	0.52 (0.49)
Total number of sons	1.49 (1.08)	1.473 (1.023)	1.441 (1.023)	1.374 (1.148)	1.411 (1.187)	1.346 (1.087)
Children in HH	1.694 (1.682)	1.663 (1.7)	1.527 (1.611)	1.602 (1.637)	1.578 (1.622)	1.677 (1.575)
Child death for the respondent	1.368 (0.894)	1.37 (0.904)	1.333 (0.853)	1.105 (0.341)	1.1 (0.329)	1.105 (0.34)
HH religion: Hindu	0.827 (0.378)	0.777 (0.416)	0.75 (0.433)	0.848 (0.359)	0.769 (0.422)	0.829 (0.377)
HH religion: Muslim	0.111 (0.314)	0.12 (0.324)	0.112 (0.315)	0.092 (0.289)	0.124 (0.33)	0.083 (0.276)
HH caste: SC	0.173 (0.378)	0.18 (0.384)	0.166 (0.372)	0.189 (0.392)	0.185 (0.389)	0.2 (0.4)
HH caste: ST	0.2 (0.4)	0.129 (0.335)	0.115 (0.319)	0.249 (0.433)	0.212 (0.408)	0.11 (0.313)
HH sli: low	0.587 (0.492)	0.501 (0.475)	0.345 (0.475)	0.687 (0.464)	0.616 (0.486)	0.424 (0.494)
HH sli: medium	0.244 (0.43)	0.294 (0.479)	0.357 (0.479)	0.227 (0.419)	0.269 (0.443)	0.356 (0.479)
HH sli: high	0.169 (0.375)	0.205 (0.404)	0.299 (0.458)	0.086 (0.281)	0.115 (0.319)	0.22 (0.415)
HH members	5.849 (3.155)	5.813 (3.196)	5.758 (3.046)	5.597 (3.021)	5.572 (2.984)	6.085 (2.953)
Spouse Education	2.992 (1.977)	3.267 (1.978)	3.599 (1.978)	1.828 (1.204)	2.001 (1.274)	1.933 (1.278)
Respondent Age	29.306 (7.566)	29.724 (7.545)	30.298 (7.363)	31.001 (8.624)	31.363 (8.691)	31.76 (8.555)

Notes: The table provides the means and the standard deviations (in parenthesis) for the control variables used in this analysis. The descriptive statistics are reported for the respondents categorized by NREGS implementation, for two time periods 2002/04 and 2007/08.

The descriptive data for the three measures based on which the Planning Commission of India determined the measure of backwardness are provided in table 2.5. From phase 1 to phase 3, the three measurements likewise exhibit a gradient. In comparison to phases 2 and 3, phase 1 has a higher proportion of SC/STs, lower agricultural wages, and poorer agricultural production per worker.

3.5 Estimation Procedure

3.5.1 Identification strategy

With the NREGS being phased in across the country, a "natural experiment" was created, with the phase 1 and phase 2 districts in the treatment group and the phase 3 districts in the control group. Because the data was gathered over two time periods, 2002/04 and 2007/08, there is also a temporal variation in the data. Because the data has two sources of variation, a Difference-in-Difference (DID) estimation technique can be used to examine the impact of the NREGS on the reproductive behaviours of women who had access to the NREGS (Imbens and Wooldridge, 2009; Angrist and Pischke, 2008).[50]

The DLHS data does not identify if anyone has availed the NREGS employment opportunities. Furthermore, increasing employment availability in places where NREGS were

[50]Recent research have identified a source of potential bias that may arise when a Two Way Fixed Effect (TWFE) model (usually used to implement DID) is utilized in assessing a treatment effect, when the treatment has staggered implementation (Callaway and Sant'Anna, 2021; Sun and Abraham, 2021). The authors recommended to use a hetero-robust DID estimation to analyze the treatment effect in such cases. However, in this study, this bias is potentially mitigated since NREGS was implemented throughout the country within two years and the gaps between the phases were short. De Chaisemartin and D'Haultfoeuille (2022b)further shows that this bias is likely to be problematic in treatments with complicated designs (for example, non-binary treatment with multiple time periods), but not so much for treatments with simpler designs (for example, binary and staggered treatment, much like NREGS). De Chaisemartin and D'Haultfoeuille (2022b,a); De Chaisemartin and d'Haultfoeuille (2020) also show that in case of treatment with simpler designs the TWFE and hetero-robust DID estimators often give similar results. This study therefore continues with the standard TWFE model to implement the DID estimation. As a future work this study will investigate the impact of NREGS using the hetero-robust DID estimation technique as suggested by Callaway and Sant'Anna (2021).

implemented impacts both participants and non-participants by influencing the local labour market (Imbert and Papp, 2015; Zimmermann, 2012; Azam, 2012). Therefore, the goal of this study is to look at the "intent-to-treat" (ITT) effect of NREGS.[51] It examines how the individual's response to the outcome variables changes when they have the access to NREGS employment opportunities, compared to those who do not have the access.

Threat to the identification strategy: As previously stated, the program's implementation did not appear to be random. The goal was to provide employment guarantee to the poorest communities in the country. Although it was not mentioned officially, the Planning Commission of India's assessment of backwardness issued in 2003 is thought to have been used in selecting the early districts. Furthermore, at least one district from each state was expected to get the program. However, accounting for these two criteria still could not fully predict the program implementation across the country. Observationally similar districts had gotten the program in different stages.

The distribution of ranked districts in three phases of NREGS implementation is depicted in figure 2.2. Although the majority of low-ranked districts received NREGS in phase 1 and the majority of high-ranking districts received NREGS in phase 3, there is still a significant overlap between backwardness rankings and NREGS implementation.

The difference-in-difference (DID) estimation relies on the assumption that the trends in the variations of the outcome variables in early and late implementing districts are similar. If the outcome variables in phase 1 and phase 2 districts (where NREGS was implemented) trend differently from the outcome variables in phase 3 districts, the DID estimates are likely to be biased. Three measures are included in an effort to solve this issue, each of which can capture the differential changes across the districts. It introduces controls for the three

[51] Intent-to-treat effect is the difference in average outcomes between the treatment group, computed over all those that are assigned to the treatment group, irrespective of actually receiving the treatment; and the control group, computed over all assigned to the control group that is not supposed to receive the treatment (Mani, 2016).

measures used to determine the districts' backwardness status (SC/ST caste composition, agricultural wages, and agricultural output per worker). These measurements are interacted with time to account for trends correlated with these controls, since they are time invariant. Because the NREGS implementation was not wholly reliant on them, the program dummy for the NREGS will not render these controls redundant. [52]

A previous round of DLHS conducted in 1998/99 (DLHS 1) was utilized to check for the parallel trend assumption that is crucial for the difference-in-difference estimation.

3.5.2 Model

Based on the variables and identification strategy discussed above, the general form of the analyzed model is,

$$Y_{idt} = \alpha + \beta_1(NR_d \times T_t) + \beta_2 X_{idt} + \beta_3(Z_d \times T_t) + \beta_4 W_{dt} + \delta_d + T_t + \gamma_{st} + \epsilon_{idt} \quad (3.1)$$

Where,

Y_{idt} = Different measures of reproductive behaviors for respondent i, in district d, in the year t.

$$T_t = \text{Time fixed effect} = \begin{cases} 1, \text{ if year is 2007-08} \\ 0, \text{ If year is 2002-04} \end{cases}$$

$$NR_d = \begin{cases} 1, & \text{if NREGS was implemented in phase 1 or 2} \\ 0, & \text{otherwise} \end{cases}$$

[52] An OLS regression was performed to see how much of the phase-wise implementation of NREGS can be explained by the three backwardness indicators. This regression has an adjusted-R^2 score of 0.39. Table A.1 in the Appendix provides the result for this regression.

X_{idt} = Vector of time variant control variables at individual level and household level.

Z_d = Time invariant control variables at the district level. These are the measures depending on which the backwardness ranking of the districts were created. These are, agricultural output per worker and daily agricultural wage per worker. These variables are interacted with time.

W_{dt} = Time variant control variables at the district level. These include the variables to control for the impact of NRHM.

δ_d = District fixed effect.

γ_{st} = State-specific linear time trend (allows states to follow different trends)

ϵ_{idt} = Error term (clustered at district level to adjust for serial correlation in district outcomes over time.)

The coefficient of interest for this analysis is β_1. It measures the effect of the interaction term ($NR_d \times T_t$), which is essentially a dummy variable that takes the value of 1 for the districts in time period 1 (post-treatment) which had the NREGS introduced in the first phase. β_1 captures the impact of the NREGS on the chosen outcome variables.

The main focus of this study, the impact of NREGS is captured by an interaction term. In non-linear logit or probit models, interpretation of the interaction term can be controversial. They tend to change in both direction and magnitude depending on the level of covariates (Ai and Norton, 2003). To avoid this issue for the binary outcome variables, a linear probability model is chosen.

The outcome variable– "number of children born in last 3 years", is a count data. A Poisson regression with fixed effect is used to estimate these outcomes. However, a Poisson estimator with fixed effect is not as directly interpretable as the coefficients for a linear model. Silva and Tenreyro (2006) provides the following formula to calculate the marginal effect of the

regressor of interest (x) on the outcome variable (y) following a Poisson regression with fixed effect.[53]

Keeping everything else constant, a one unit change in the x, will lead to a $\left(100 \times \left(\exp^{\beta} - 1\right)\right)$ % change in the mean value of y. Where, β is the Poisson estimated coefficient of the x variable. This formula is used to calculate the impact of NREGS on the chosen outcome variables where the coefficients were found to be significant.

Sub-group analysis:

- **By Standard of Living Index**: The nature of the NREGS program's implementation across India made it clear that the program's target population was those living in rural regions, particularly the percentage of the population living in poverty. As a result, it is safe to anticipate that the NREGS may have varying effects on populations with varying levels of living standards. Therefore, this paper utilizes the Standard of Living Index (SLI) calculated for each DLHS data to perform the analysis at a sub-level.

The Standard of Living Index (SLI) calculated by DLHS incorporates a variety of household factors. SLI includes *home amenities* such as drinking water, type of dwelling, lighting, and cooking fuel, as well as *household possession of durable items* like vehicles or tractors, television, telephone, electric fan, radio or transistor, motorcycle, bicycle, and sewing machine. To calculate the SLI score, DLHS assigns points to each of these facilities and durable products. The resultant score ranges from 0 to 40. Based on the total results, the household is then classified into three categories of standard of living: low (below 9), medium (9 to 19), and high (above 19).

[53]Discussions about Poisson estimation with fixed effect, their assumption and coefficient interpretation can be found from Silva and Tenreyro (2006), Hilbe (2014), and multiple discussions by Joao Santos Silva on Statalist forum. For example, (Interpretation of poisson with FE).

- **By Marginalized Caste:** In rural India, marginalized caste households are typically the poorest. This had long been a source of concern for policymakers. The proportion of SC/ST (Scheduled Caste/ Scheduled Tribe) population in the districts was even used as a criterion for calculating the status of backwardness for the districts. Since its beginning, NREGS has consistently recorded above 50 percent of SC/ST employment till the fiscal year 2010/11. NREGS was clearly designed to enhance the living conditions of the country's disadvantaged caste households. This analysis is also carried out by categorizing families by caste and then examining how the main two disadvantaged castes (specifically, Scheduled Caste and Scheduled Tribe) respond to reproductive behaviours following the implementation of NREGS.[54]

- **By Age:** It is also possible that the response to reproductive behaviors will differ across the respondents depending on their age. This study therefore categorizes the respondents into the following six different age groups.

Age group 1: age 15-17,

Age group 2: age 18-24,

Age group 3: age 25-29,

Age group 4: age 30-34,

Age group 5: age 35-39,

Age group 6: age 40-44

[54]Despite the fact that both the Scheduled Caste (SC) and the Scheduled Tribe (ST) have historically been India's poorest socioeconomic groups, there is still a significant difference between the two groups. People from Scheduled Castes are Hindus by faith, although they do not belong to any of the Hindu religion's four primary castes (Brahman, Kshatriya, Baishya and Shudra). The four main castes labeled them "untouchables," and as a result, they endured (and still face) social, educational, and economic isolation. Scheduled Tribes, on the other hand, are mostly Indian indigenous tribes. They are frequently of different faiths. Even if they practice Hinduism, their customs are distinct and unique to their locality. ST persons experience geographical isolation in addition to social, educational, and economic isolation.(Vishnu, 2018)

The analysis is then conducted for each age group to identify how their responses differ. The sub-group analyses are performed by running the regression depicted by equation 3.1, but for each sub-groups by SLI, caste and age group.

The following section discusses the results for this study.

3.6 Results

3.6.1 Baseline Estimates

The baseline estimates for the two primary outcome variables chosen to reflect the fertility outcome and fertility intention are provided in the table 3.3. In addition, the results for two outcome variables reflecting fertility behaviours, whether or not a respondent is using any contraceptive and the duration of contraceptive use, are shown in columns 3 and 4. It is observed that NREGS had no significant impact on any of the outcome variables at the baseline level.

Table 3.3: ITT impact of NREGS on reproductive behaviours

	Fertility Outcome	Fertility Intention	Fertility behaviour	
	1	2	3	4
	Poisson	LPM	LPM	OLS
	Children born in last 3 years	Want anymore children	If using contraceptive	Use duration (in months)
Number of observations	458,436	360,495	533,786	355,455
Full Sample	-0.013 (0.027)	0.011 (0.01)	-0.022 (0.023)	-0.044 (0.761)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table shows the intent-to-treat (ITT) effect of NREGS. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (NRHM variables, agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, age at birth, number of children) and household controls (number of adults, religion and caste).

3.6.2 Sub-level Analysis

By SLI: The regression results by Standard of Living Index (SLI) of the households are reported in **Panel A** of table 3.4. SLI is divided into three groups, ranging from the poorest to the wealthiest households in the country's rural areas. Implementation of the NREGS increased the probability of contraception use by 16.5 percent for women in low SLI households (column 3). The fertility outcome for women in medium SLI households drops by 13.2 percent (column 1). With an average of 2.27, the number of children born to women in these households reduced by 0.299. However, among medium SLI households, the duration of contraceptive usage (column 4) has decreased by 8.56 months. Although this effect is weakly significant.

The above results show that following NREGS, the women in low and medium SLI households have opted for fertility-reducing reproductive behaviours (higher probability of contraception use and reduced fertility outcome, respectively). Therefore, the negative program effect of NREGS appears to be larger for women in both low and medium SLI households.

NREGS was created to provide employment to the poorest members of the rural community. NREGS's manual labour requirements are likely to dissuade women from affluent families. As a result, NREGS is unlikely to have an impact on the reproductive behaviours of women in higher-income households. This reasoning is supported by the sub-level study for households with a high SLI. For the women in high SLI households, NREGS had no significant influence on any of the outcome variables (columns 1 to 4 for high SLI households).

Table 3.4: ITT impact of NREGS on reproductive behaviours by SLI, castes and age groups

	1	2	3	4
	Fertility Outcome	Fertility Intention	Fertility Behaviour	
	Poisson	LPM	LPM	OLS
	Children born in last 3 years	Want anymore children	If using contraceptive	Use duration (in months)
A: By SLI				
Low SLI	0.047 (0.044)	-0.269 (0.229)	0.165*** (0.032)	-3.235 (3.552)
Medium SLI	-0.141** (0.069)	-0.063 (0.066)	0.016 (0.079)	-8.560* (4.907)
	ITT: -13.2%			
High SLI	0.098 (0.107)	0.286 (0.218)	0.128 (0.150)	10.968 (12.368)
B: By Caste				
SC households	0.035 (0.067)	-0.003 (0.077)	0.106 (0.059)	-3.897 (5.499)
ST households	0.108 (0.114)	0.214* (0.124)	-0.273*** (0.096)	9.408 (11.406)
C: By Age group				
Age 15–17	-1.464** (0.590)	-0.169** (0.066)	-0.367*** (0.112)	17.169** (8.305)
	ITT: -76.9%			
Age 18–24	0.012 (0.036)	0.008 (0.045)	-0.034 (0.067)	4.412 (4.537)
Age 25–29	0.030 (0.046)	0.027 (0.066)	0.054 (0.073)	3.475 (3.236)
Age 30–34	0.001 (0.090)	-0.041 (0.087)	0.012 (0.084)	-1.924 (5.016)
Age 35–39	0.199 (0.156)	-0.104 (0.098)	-0.146* (0.076)	-1.05 (1.08)
Age 40–44	0.638 (0.709)	0.059 (0.054)	-0.0008 (0.078)	-1.189 (1.11)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table shows the results for the the impact of NREGS on different reproductive behaviours at sub-level. The table shows the intent-to-treat (ITT) effect of NREGS. Panel A present the results for sub-level analysis by SLI (low, medium and high). Panel B presents the results for sub-level analysis by caste (SC and ST). And, panel C presents the results for sub-level analysis by age group of the respondents. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (NRHM variables, agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, age at birth, number of children) and household controls (number of adults, religion and caste). Panel B excludes caste from the household controls.

By marginalized caste: The results for respondents belonging to the two primary marginalized castes – Scheduled Caste (SC) and Scheduled Tribe (ST), are reported in **Panel B** of table 3.4. NREGS had no significant influence on any of the outcome variables for respon-

dents from SC households.

The fertility intention of respondents from ST households, on the other hand, has grown significantly (column 2). The probability of wanting additional children increased by roughly 21.4 percent, which is weakly significant. Furthermore, the probability of contraception use declined by roughly 27.3 percent (column 3). As a result, for women in ST households, the influence of quantity income effect on fertility outweighs other effects.

By age group: **Panel C** of table 3.4 presents the results of the age group specific analyses. As before, the ITT of the Poisson regression models imply the impact of NREGS on percentage change in average outcome. For all of the outcome factors investigated, the age group 15 to 17 years shows significant results. NREGS has resulted in a 76.9 percent drop in the average fertility (column 1). For this age group, the average number of children born in the previous three years was 0.35. This number has decreased by 76.9 percent, indicating that the average fertility outcome for this age group has decreased by 0.27 children. The probability of an intended additional child is also reduced by roughly 16.9 percent (column 2). Despite the fact that the probability of using contraception has reduced by roughly 36.7 percent (column 3), the length of contraception usage has increased by around 17.2 months (column 4). Overall, the results suggest that, as a result of NREGS, women in this youngest age group are choosing reproductive behaviours that reduce fertility.

Surprisingly, there is no noticeable impact of NREGS on the reproductive behaviours of women in the age ranges 18-34. The age group 35-39 shows the next significant influence. It is not surprising that this age group experiences little influence on fertility outcome. Given their early marriage age and early age at first birth, it is reasonable to assume that these women probably have already achieved their reproductive goals. The probability of contraceptive use for women in the 35-39 age range has decreased by roughly 14.6 percent (column 3). However, this effect is weakly significant.

Women between the ages of 40 and 44 have no significant influence on their reproductive behaviours. It is hardly unexpected, given that the majority of these women may also have achieved their reproductive goals.

3.6.3 Pre-trend Analysis

A crucial assumption for the difference-in-difference (DID) analysis is that, the trend in the variation of the outcome variables between the early and late implementing districts would have been similar in the absence of the program. As a result, any variation from the current trend is due to the program's implementation. This is the DID model's "parallel trend" assumption. Unfortunately, there is no way to determine if the parallel trend would continue once the program was implemented. What can be done, however, is to see if the outcome variables' trends aligned prior to the program's implementation. It can be assumed that if the trend moved in tandem before the program was established, it would have continued if the program had not been implemented.

A "falsification test" is performed to examine this "parallel trend" assumption. The same DID model is used again, but this time the time periods are 1998/99 (data from DLHS 1) and 2002/04 (DLHS 2). As a result, both of the time periods analyzed are prior to the commencement of the NREGS. The treatment and control districts considered are also the same as the original model.

The analysis is performed using the same model as equation 3.1. Except now the time fixed effect is considered as

$$T_t = \text{Time fixed effect} = \begin{cases} 1, \text{ if year is 2002-04} \\ 0, \text{ if year is 1998-99} \end{cases}$$

If the outcomes had been trending parallely prior to the program's implementation, we wouldn't expect the coefficient of interest, β_1, to be significantly different from zero. The

"parallel trend" assumption will not hold if β_1 is found to be significantly different from zero. The results of the falsification test are reported in table 3.5.

Table 3.5: Falsification test

	1 Poisson Children born in last 3 years	2 LPM If using contraceptive	3 OLS Use duration	4 LPM Want anymore children
Number of observations	506,347	486,364	388,234	539,384
NREGS (ITT)	-0.053 (0.038)	-0.029 (0.019)	-0.67 (1.53)	-0.014 (0.015)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. In this table, two earlier time periods (1998/99 and 2002/04) are considered, before the NREGS was implemented. The table presents the results for the full sample. The table shows the intent-to-treat (ITT) effect of NREGS. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, number of children) and household controls (religion and caste).

The coefficient for the interaction term is not significant in any of the instances, as seen in the table 3.5. As a result, the parallel trend assumption is not rejected. The changes in fertility behaviour responses that were observed in the original analysis are indeed resulting from implementation of NREGS.

3.6.4 Channels or Mechanisms

NREGS can alter reproductive behaviours through four distinct mechanisms, as mentioned in section 3.3. On the one hand, there is the quantity income effect, because of which NREGS can have a positive impact on fertility promoting behaviours. NREGS, on the other hand, might have a negative influence on fertility-promoting behaviours due to the quality income effect, time substitution effect, and women empowerment effect. These channels through

which NREGS might have a detrimental influence on fertility-promoting behaviours are collectively referred to as the "negative program effect" for the convenience of understanding.

Since women from ST caste households are choosing fertility-promoting behaviours as a result of NREGS implementation, it seems that the quantity income effect is the strongest for these respondents. While for the women in low and medium SLI households; and for women aged 15-17 who are opting for fertility lowering behaviours post-NREGS, the negative program effect is exceeding the quantity income effect for them (positive effect). In this section, attempts are made to understand some of the channels by which NREGS may have caused the effects seen in different households and among women aged 15-17 years.

For each of the tables 3.7, 3.8 and 3.10 the influence of NREGS on exclusive breastfeeding duration and the frequency of ANC visits by the respondents is examined in Channel 1 (column 1 and 2). Channel 2 focuses on the respondents' delivery locations. The results for this channel are reported in columns 3, 4, and 5. In addition, channel 3 examines the influence of NREGS on completed school years for children aged 7 to 14 years in the households.

Following information about rural healthcare facilities of India will be helpful in understanding the results for channel 2. Panel A in table 3.6 provides information about the accessibility of health facilities in the rural villages in India. This data was collected for all the villages (PSUs) that were chosen to be surveyed in the DLHS round 3 (as explained in the data section). It can be seen that about 44.3 percent of the villages have at least one government health centre located in the village.[55] 5.6 percent of the villages have a government hospital or district hospital located in the village. And, 20.4 percent of the villages have at least one private clinic or private hospital located inside the village.

Even in villages where health centres are not located within the village, the average distance to a sub-centre or primary health centre is still shorter than the distance to a private health

[55]Government health centres are the Sub-Centres (SC), Primary Health Centres (PHC) and Community Health Centres (CHC)

Table 3.6: Information on available health facilities

Description		Mean (s.d.)
Panel A: Accessibility of Health Facilities (Source: DLHS 3)		
Proportion of villages with-	Atleast one government Health centre	0.443 (0.5)
	District/Government Hospital	0.056 (0.23)
	Atleast one Private clinic or hospital	0.204 (0.403)
For villages with no health centre distance[¥] to the-	Nearest SC	4.81 (5.44)
	Nearest PHC	10.08 (9.23)
	Nearest CHC	18.51 (16.21)
	Nearest District or Government hospital	36.77 (24.13)
	Nearest Private clinic	13.18 (14.94)
	Nearest Private hospital	20.39 (18.66)
Panel B: Costs at Health Facilities (Source: NSS, 2006)		
Mean expenditure (in USD[¤]) on childbirth at-	Government hospital	16.64
	Private hospital	59.1
	At home	5.91

Note: Standard deviations (S.D.) are reported in parenthesis.
[†]Government health centres are Sub-Centre (SC), or Primary Health Centre (PHC), or Community Health Centre (CHC).
[¥] Distances to the nearest facilities are reported in Kilometers (KM).
[¤]Exchange rate: 1 USD= INR 70

centre (clinic or hospital). Although, on average, the district hospital or a government hospital is the farthest away from these villages. As a result, for most rural households, visiting a public/NGO healthcare centre is more convenient and less time-consuming than visiting a private healthcare facility. Because there are fewer private institutions, the commuting time to a private facility is likely to be longer for any particular household. Additionally, as can be observed from panel B, the average costs for childbirth at home is least expensive, followed by public facility based childbirth. Childbirth at private facilities is the most expensive.

Response for women from ST households: The impact of NREGS on different channels among ST households is shown in table 3.7. For channel 1 (columns 1 and 2), there is no evidence that NREGS had a significant impact on the duration of breastfeeding or the number of antenatal care visits for these respondents. For channel 2 (columns 3 to 5), it is observed that the probability of public/NGO based delivery decreased significantly by 27.3 percent. Channel 3 (column 5) further shows that the number of completed years of education for older female children declined by 10.2 percent in ST families. Although this effect is weakly significant.

A significant decrease in the probability of public/NGO based delivery provides suggestive evidence that the NREGS' quality income effect may not be strong enough. If it was strong, the negative impact on the schooling of the older female children should not have been observed. Collectively, these findings suggest that there is a stronger quantity income effect for ST households, as shown by the fertility-promoting behaviour in the main results.

Table 3.7: ITT impact of NREGS on different channels for ST households

	Channel 1		Channel 2			Channel 3
	1	2	3	4	5	6
	Poisson	Poisson	LPM	LPM	LPM	Poisson
	Breastfeeding duration	ANC visits	Public/NGO delivery	Private delivery	Home delivery	Years of schooling (for older female children)
Number of observations	45,023	44,520	56,125	56,125	56,125	144,685
For ST households						
NREGS (ITT)	0.005 (0.146)	-0.079 (0.103)	-0.273** (0.127)	0.069 (0.056)	0.205 (0.140)	-0.097* (0.051)
						ITT: -10.2%

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table presents the results for the Scheduled Tribe household respondents only. The table shows the intent-to-treat (ITT) effect of NREGS. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, age at birth, number of children) and household controls (number of adults and religion).

Response of Low and Medium SLI households:

Table 3.4 shows that women from low SLI households had a higher probability of using contraception once the NREGS was implemented. In addition, the number of children born in middle SLI households declined by 13.2 percent. In both of these households, the women chose fertility-reducing behaviours. This negative impact of NREGS might arise when the negative program effect of NREGS overcomes the positive quantity income effect, as discussed in section 3.3. The negative program effect is the envelope term to denote possible mechanisms through which NREGS can have a negative impact on the outcome variables. These mechanisms were– quality income effect, time substitution effect and the women empowerment effect of NREGS.

The results from channels 1, 2 and 3 in table 3.8 give insights into this interplay of mechanisms through which NREGS influenced reproductive behaviours of women in low and medium SLI households.

Low SLI households: The results for low SLI households are shown in table 3.8. While there was no significant influence of NREGS on channel 1 (columns 1 and 2), low SLI households had a significant decrease in the probability of public/NGO delivery (by 7.9 percent) and a significant rise in the probability of home delivery (by 10.8 percent). If the quality income effect and the women empowerment effect (part of the negative program effect) were stronger, it would have resulted in an increase in institutional delivery. As a result, the opposite effect for low SLI households implies that the negative time substitution effect outweighs all other negative consequences. Women in households with a low SLI face a larger opportunity cost of time.

The results for the impact of NREGS on completed years of education for children aged 7-14 years in low SLI households are presented in column 6 of table 3.8. The number of completed school years for older female children in low SLI households rose by 4.4% after

Table 3.8: ITT impact of NREGS on different channels for low and medium SLI households

	Channel 1		Channel 2			Channel 3	
	1	2	3	4	5	6	7
	Poisson	OLS	LPM	LPM	LPM	Poisson	Poisson
	Breastfeeding duration	ANC visits	Public/NGO delivery	Private delivery	Home delivery	Years of schooling (for older female children)	Years of schooling (for older children)
NREGS (ITT effect)							
Low SLI	0.140 (0.353)	0.095 (0.210)	-0.079* (0.046)	-0.029 (0.035)	0.108* (0.061)	0.043* (0.023)	
						ITT: 4.4%	
Number of observations	156,442	147,363	186,168	186,168	186,168	477105	
Medium SLI	0.587 (0.472)	0.307 (0.351)	0.136** (0.057)	-0.079 (0.052)	-0.057 (0.058)		0.035* (0.018)
							ITT: 3.5%
Number of observations	66,359	69,372	77,522	77,522	77,522		230,919

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table presents the results for the low SLI and medium SLI respondents. The table shows the intent-to-treat (ITT) effect of NREGS. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, age at birth, number of children) and household controls (number of adults, caste and religion).

NREGS implementation. This shows a preference towards improving the quality of children's well-being, highlighting the presence of quality income effect.

It is encouraging to observe that NREGS, rather than having a detrimental influence, led to an improvement in children's schooling for low SLI households. This shows that there is a quality income effect of the program. But results from channel 2 suggest that there is a strong time substitution effect for these women. Coupled with a lack of significant results for channel 1, it can be speculated that the women in low SLI households are not substituting time away from activities that may have a direct impact on their children's well-being. They are probably diverting time away from other time-intensive activities, such as choosing institutional delivery, which may have an indirect influence on their children's well-being.[56]

Medium SLI households: The results for medium SLI households can also be seen in table 3.8. For channel 1, no significant effect of NREGS was detected for medium SLI households (column 1 and 2). These households, however, show a large increase in the probability of public/NGO delivery for channel 2 (13.6 percent more likely). This indicates the presence of a stronger quality income effect. The impact of NREGS on completed years of education for younger children in medium SLI households is shown in column 7. The number of completed years of schooling for younger children increased by 3.5 percent after NREGS. This result also suggests the existence of a higher quality income effect.

These results indicate that the observed decline in fertility outcome for medium SLI households is most likely the consequence of a larger quality income effect of the NREGS.

[56]Other examples of such activities that may have an indirect impact on child well-being are collecting clean drinking water, cooking nutritious meals and so on.

Response of women aged 15 to 17 years:

Although women aged 35-39 years had a weakly significant impact on the probability of contraceptive use, these women have no significant impact on fertility outcomes. The results for women aged 15 to 17 years were the most intriguing. For the sake of brevity, only this age group's responses are explored, as well as the mechanisms by which NREGS may have influenced these women's reproductive behaviours.[57]

Table 3.4 shows that women aged 15 to 17 years have reacted to NREGS by decreasing fertility outcomes considerably (76.9 percent reduction). Furthermore, they have shown a reduced desire to have additional children (16.9 percent decrease in probability). Their fertility behaviour reveals that, while the probability of contraceptive usage reduced (36.7 percent), the length of contraceptive use rose by 17.2 months. With the exception of the probability of contraceptive usage, these results demonstrate that women in this age group choose reproductive behaviours that reduce fertility in general.

This negative impact of NREGS on fertility can be observed due to a greater negative program effect than the positive quantity income effect, as explained in section 3.3. The quality income effect, time substitution effect, and women empowerment effect of NREGS

[57]NREGS showed a weakly significant impact in reducing the probability of contraceptive usage for the women aged 35-39 years. These women were 14.6 percent less likely to use contraception. This shows a preference for fertility promoting reproductive behaviour. Which implies that for these women the quantity income effect might be stronger than the overall negative program effect. Table A.2 in the Appendix provides the results for the channels through which NREGS may have such an impact. For women aged 35-39 years, the probability of public/NGO facility based delivery increased significantly (by 45.8 percent), but that of home delivery decreased significantly (by 39.5 percent). Impact on breastfeeding duration, ANC visits and probability of private facility based delivery was not significant. These results together suggest a presence of stronger income effect, following NREGS implementation. This income effect may have a quantity (positive) or quality (negative) effect on the fertility promoting reproductive behaviours of these women. Given early marriage age and early age at first birth, the existing children of these women are likely to have grown up. Therefore, the cost of bearing another child may not be as high for these women as other younger women. As a result, an increase in income may motivate these women to have an additional child. To further investigate this conjecture, columns 6 to 9 in table A.2 interact the treatment with the presence of children for these women. It is observed that the impact of NREGS does not vary with the presence of children. These results seem plausible since having a grown up child may not significantly alter these women's responses in their reproductive behaviours. Therefore, it seems plausible that following NREGS, the women aged 35-39 years may want to have additional children, resulting in reduction in the probability of contraceptive usage.

are collectively referred to as the negative program effect. The challenge now is to identify through which of these channels NREGS can affect the reproductive behaviours of these women aged 15 to 17 years.

Time substitution effect: Only the adult members of the household were given NREGS jobs. Women aged 15 to 17 years are unlikely to have worked for NREGS. As a result, it is safe to assume that NREGS will have no direct influence on these women's time allotment. However, women aged 15 to 17 years may have an indirect time substitution effect. If other adult members of the household, particularly adult women, opt for NREGS employment; the women aged 15 to 17 years will be obliged to devote more time to domestic chores. These women, for example, would be expected to look after the young children in their households. If this is the case, the responses of women aged 15 to 17 years to reproductive behaviours may vary depending on whether or not there are other children residing in the households.

This hypothesis is explored by looking at whether the impact of NREGS on the main outcome variables varies depending on whether there are other children in the households. Table 3.9 displays the results of this test.

Table 3.9 shows that the impacts of NREGS on the number of children born, fertility intention, and contraceptive usage probability for women aged 15 to 17 years are unaffected by the presence of other children in the household. It does, however, have a considerable influence on the length of contraceptive usage. When there are other children at home, the contraceptive usage duration of women aged 15 to 17 years increases significantly by 2.5 months after NREGS implementation. While other adult members participate in NREGS, it is probable that the burden of caring for young children falls on the women aged 15 to 17. It raises the opportunity cost of time for these women. This perceived rise in the opportunity cost of time, however, is transient. As a consequence, there is no discernible difference in fertility outcome or intention. Only variations in contraceptive usage duration are observed,

Table 3.9: ITT impact of NREGS on reproductive behaviours of women aged 15-17 by the presence of other children in the households

	1	2	3	4
Sub-level: Women aged 15 to 17 years	Number of children born in last 3 years	Want anymore children	If using contraceptive	Contraceptive use duration (in months)
Number of observations	11,256	15,147	15,379	1258
NREGS (ITT) (by the presence of other children in the household)	0.623 (0.445)	-0.015 (0.047)	-0.006 (0.121)	2.545** (1.163)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table presents the results for the women aged 15 to 17 years only. The table shows the intent-to-treat (ITT) effect of NREGS by the presence of other children in the households. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education) and household controls (number of adults, caste and religion).

which can be readily modified if the women's household situation changes.

Quality income and Women Empowerment effect: The other two methods by which NREGS may influence the reproductive behaviour of women in the 15 to 17 age group are the quality income and women empowerment effects. These mechanisms are also likely to interact among themselves, reinforcing each other. A woman with more bargaining power at home, for example, will have a greater opportunity to invest in enhancing the quality of child welfare. Unfortunately, due to data limitations, it is impossible to distinguish the processes individually. However, an attempt was made to observe the resulting impact of the interplay between these mechanisms to make a logical inference related to the observed results.

Table 3.10: ITT impact of NREGS on different channels

	Channel 1		Channel 2		
	1	2	3	4	5
	Poisson	OLS	LPM	LPM	LPM
	Breastfeeding duration	ANC visits	Public/NGO delivery	Private delivery	Home delivery
Number of observations	4511	5291	5950	5950	5950
D: By Age group					
Age 15–17	-0.406 (0.272)	-0.315 (0.387)	-0.186** (0.078)	0.167*** (0.057)	0.020 (0.081)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. The table presents the results for the women aged 15 to 17 years only. The table shows the intent-to-treat (ITT) effect of NREGS by the presence of other children in the households. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education) and household controls (number of adults, caste and religion).

In table 3.10, it is observed that there are no significant changes in exclusive breastfeeding duration or the frequency of ANC visits (columns 1 and 2 respectively) for these women. This supports the earlier conjecture that the time substitution effect of NREGS on these women is only temporary.

For channel 2 (columns 3 to 5), although the probability of having a public/NGO birth decreased for these women (by 18.6 percent), the probability of having a private delivery rose dramatically (by 16.7 percent). Private health care facilities in rural India provide superior health care, but they are also more expensive (Goli et al., 2021; Khetrapal et al., 2019). It is also possible that visiting a private health care centre would take longer. As a result of these findings, it can be concluded that the NREGS has a substantial quality income effect (possibly in addition to the empowerment effect) on women aged 15 to 17 years.

Empowerment effect: The empowerment effect, as previously noted, may have an impact on the reproductive behaviour of these women who have access to NREGS jobs. Women can be empowered by improved intra-household bargaining power when their income rises in tandem with their employment. Such an empowering effect is likely to encourage activities that lead to a better quality of life. However, it is difficult to isolate the empowering effect. To begin with, the empowerment effect is likely to be slow. It necessitates a shift in social and cultural attitudes. As a result, it is possible that the empowerment effect will take longer to initiate and become effective. Second, the income and substitution effects are experienced more rapidly. Therefore, the slow growth of empowerment effect associated with the NREGS opportunity, is likely to be engulfed by the other two effects which are more immediate.

With this in mind, several additional regressions are conducted to investigate the empowerment effect, as shown in table 3.11. The impacts of NREGS on the age at marriage and the age at first birth are examined in columns 1 and 2. If NREGS has a substantial empowerment effect, these coefficients should have a considerable negative influence on these outcome

variables. The findings for four primary outcome variables are reported in columns 3 to 6 in table 3.11, but here the heterogeneous effect of women's education is observed. Women who have acquired some formal education are more likely to be empowered than women who are illiterate, according to this argument. If this effect is strong, the impact of NREGS through women's education should be significant.

None of the coefficients in the table 3.11 are found to be significant. These findings do not rule out the possibility of an empowerment effect of NREGS. It is possible that NREGS' empowerment effect is still not powerful enough to provide significant results.

Effect of hope: The responses of women aged 15 to 17 years can be driven by another important factor– "Hope". NREGS mandates a 33 percent women participation in all districts. Figure A.1 in the Appendix illustrates that the women's participation percentage in NREGS has continuously been greater than the stipulated 33 percent since its inception. Studies show that women's participation in the labour market, as well as their real wage rate, increased dramatically when the NREGS were implemented (van den Berg et al., 2010; Imbert and Papp, 2015; Azam, 2012). Women's actual wages are expected to rise by 8 percent, according to Azam (2012). According to De Mattos and Dasgupta (2017), NREGS provided the first paid employment opportunity for a significant number of women. These results provide the women with hope.

Women aged 15 to 17 years are aware that, while they are now ineligible, a guaranteed job with a fixed wage rate will be available in the near future. Having a young child at home might make it difficult for them to work for NREGS. This "hope" of guaranteed employment may explain why the fertility rate of women aged 15 to 17 years is significantly lower. The fact that these women also have a decreased intention of having children in the future gives evidence for this effect of "hope". Unfortunately, owing to data limitations, further analysis of this channel is not feasible.

Table 3.11: Investigating empowerment effect for women aged 15-17 years

	1	2	3	4	5	6
	Poisson	Poisson	Poisson	LPM	LPM	OLS
Sub level: 15 -17 years	Age at marriage	Age at first birth	Children born in last 3 years by education	Want anymore children by education	If using contraceptive by education	Use duration by education
Number of observations	19,158	6,032	11,256	15,147	15,379	1,258
NREGS (ITT) by education	-0.007 (0.033)	-0.005 (0.011)	-0.591 (0.765)	0.019 (0.081)	-0.061 (0.181)	-0.116 (0.464)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. This table investigates the empowerment effect of NREGS on several reproductive behaviours of women aged 15 to 17 years. The dependent variables in column 1 and column 2 are age at marriage and age at first birth in years, respectively. Dependent variables in columns 3-6 are the four main outcome variables considered in this research. The coefficients are the heterogeneous ITT effect of NREGS by education, on all the outcome variables. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (NRHM variables, agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, number of children) and household controls (number of adults, religion and caste). However, columns 1 and 2 exclude the control for number of children. Columns 3-6 exclude the control for education.

Presence of children

Presence of a child is an important determinant of fertility. Therefore, additional regressions were performed to examine if the impact of NREGS on various reproductive behaviours varied depending on whether or not the women already had a child. The regressions were carried out on both the full sample and at various sub-levels. No significant results were observed. As a result, the presence of a child seems to have no influence on the effect of NREGS on women's reproductive behaviours.

3.7 Discussion

This research analyzes the impact of NREGS implementation on the reproductive behaviours of women who have the access to NREGS employment opportunity, with an expectation that the NREGS would preferably lead to a reduction in fertility or promote behaviours that would reduce fertility. Theoretically, NREGS would have an ambiguous effect on reproductive behaviours. There exists a quantity income effect because of which women may prefer to have more children. But, there is also the negative program effect, which comprises the quality income effect, time substitution effect and empowerment effect, which collectively can lead to a decrease in the preference for having children.

Two rounds of nationally representative DLHS data was utilized to perform the analyses. The phased implementation of the NREGS over time provides an opportunity to employ the difference-in-difference technique to analyze the impact of NREGS.

The pre-trend assumption is crucial for the difference-in-difference analysis. This assumption requires that the trend in the variation of the outcome variables between the early and late implementing districts would have been similar in the absence of the program. Since the NREGS implementation was not random, the differential trend was controlled by introducing

three measures based on which the backwardness ranking of the districts were calculated. A "falsification test" was performed to check if the pre-trend assumption would hold. The test shows that the pre-trend assumption was not violated, which increases the confidence in the results from the analysis.

There was no impact observed at the overall level, but there were varying effects at the sub-level analysis. This highlights the diversity of NREGS' effects. This corroborates the claims made by Subbarao et al. (2012) and Hagen-Zanker et al. (2011) that the impact of specific EGSs varies so considerably among target population, locations, and other factors that they must be evaluated individually and carefully.

Women in Scheduled Tribe households did not have a significant impact on their fertility outcomes, but these women have adopted reproductive behaviours that promote fertility. Further investigation into the mechanisms reveals that NREGS have a strong quantity income effect on the reproductive behaviours of the women in these households, which might lead to increased fertility. On the other hand, post-NREGS, women in both low and medium SLI households show an intention to reduce fertility. Women in medium SLI households actually had 0.299 fewer children. The mechanisms that generate these consequences, however, differ among low and medium SLI households. Due to the high time substitution effect of NREGS, women in low SLI households show an inclination to lower fertility. Women in medium SLI households, on the other hand, prefer to reduce their fertility outcome due to a stronger quality income effect of NREGS.

Households belonging to disadvantaged castes, such as ST, are typically the poorest.[58] It is interesting to note that following NREGS, although women from ST households have a preference towards higher fertility, women from low or middle SLI households prefer lower fertility. This result highlights, the significance of customs and community traditions in rural India. Despite the fact that ST households in rural India are generally poorer, the community

[58]According to data from DLHS 3, 91.7 percent of ST households were either a low or medium SLI household.

influence is significant enough to modify fertility reaction to NREGS in the opposite direction. This result supports the findings of (Chattopadhyay and Goswami, 2007; Dreze and Murthi, 2001; Jejeebhoy and Sathar, 2001), where the authors emphasize that women from similar socioeconomic, religious, and educational backgrounds may react differently to demographic concerns such as fertility, female autonomy, and so on depending on the community or culture they belong to.

The results for women aged 15 to 17 years are the most significant and intriguing. They demonstrate a significant change in all of the reproductive behaviours investigated in this research, resulting in a significant decrease in fertility. In the preceding three years, these women had on average given birth to 0.27 fewer children.

The analyses on the mechanisms reveal that, while NREGS has an indirect time substitution effect on these women, it also has a substantial quality income effect. In India, out-of-pocket expense for institutional delivery is significant (Goli et al., 2021; Khetrapal et al., 2019). Although public/NGO delivery is likely to be subsidized, it is still much more expensive than home delivery. The high income effect of the NREGS on institutional delivery for the youngest age group is captured by a large fall in the probability of public/NGO delivery, a corresponding rise in the probability of private delivery, and no change in the probability of home delivery. Overall, there is a strong quality-income effect for this age group. Both of these effects combine to result in a considerable decrease in fertility outcome. Furthermore, these women aged 15 to 17 years are more likely to respond to the prospect of guaranteed employment in the near future by reducing their current fertility outcome. This reasoning is supported by their current and future intentions to reduce fertility. Due to a lack of data, this impact could not be investigated further in this study.

Broeck and Maertens (2015), who looked at the influence of female work opportunities on fertility in Senegalese rural regions, is a close comparison for this research. The point estimates of the decline in the number of children found by the authors ranged from -0.22

to -0.33. In their paper, the authors could identify women who opted for the employment, whereas this study examines the program's intent-to-treat effect on all respondents who had access to it. Given this disparity, the estimations in this research do not appear to be too far off from those in Broeck and Maertens (2015).

3.8 Conclusion

Over time, Employment Guarantee Schemes (EGSs) have gained popularity as a social safety net program since different countries often utilize EGSs to address the risks associated with income insecurity. Hagen-Zanker et al. (2011) and Subbarao et al. (2012) present several instances of EGSs of various dimensions and types that have been implemented by countries all over the world. Although the fundamental goal of these programs is to provide a safety net for the nation's poorest inhabitants against economic shocks, they frequently have major spillover effects on other social or developmental elements.

This study shows the spillover effects of the world's largest social protection program, the NREGS, which was implemented in India in 2005, on women's reproductive behaviour in rural India. The program appears to have had a considerable impact on these women's reproductive responses, although the degree and direction of the impact differs depending on the household composition.

Despite the fact that marginalized caste households (such as, ST households) are also poor, the contrasting responses in reproductive behaviour of women from ST households highlight the relevance of rural India's customs and community traditions. This is an important point that policymakers should consider when developing various family planning policies. Due to this unanticipated negative impact of NREGS on fertility, it may be beneficial to develop a policy targeted at these marginalized caste households, which would raise awareness and counteract against the intention for higher fertility.

Women from low and middle SLI households, as well as young women (aged 15 to 17 years), have demonstrated a desire for decreased fertility. Women in the age group 15 to 17 years have even limited their fertility in the hopes of finding employment in the near future. This has positive spillover effects. Policymakers in the field of family planning might take note of this impact and respond by raising awareness and encouraging women to engage in EGSs or other possible work opportunities. NREGS, when combined with supply-side methods of family planning, can help to reduce fertility, which will enhance people's and the country's overall quality of life.

This study acknowledges that the observed effects of NREGS on a variety of reproductive behaviours are short-term effects. Because of the time frame used, several crucial aspects of reproductive behaviour, such as birth spacing, could not be studied. As a result, future study should focus on the influence of NREGS on various reproductive behaviours in the long-run, such as long-term fertility, birth spacing, and so on. Such future research, in conjunction with this study, can assist to develop a complete picture of the unintended implications of EGSs on society, and hence the country, in terms of reproductive behaviour and fertility.

Bibliography

References

Adsera, A. (2004). Changing fertility rates in developed countries. the impact of labor market institutions. *Journal of population economics 17*(1), 17–43.

Afridi, F., A. Mukhopadhyay, and S. Sahoo (2016). Female labor force participation and child education in india: evidence from the national rural employment guarantee scheme. *IZA Journal of Labor and Development 5*.

Ahn, N. and P. Mira (2002). A note on the changing relationship between fertility and female employment rates in developed countries. *Journal of population Economics 15*(4), 667–682.

Ai, C. and E. C. Norton (2003, 7). Interaction terms in logit and probit models. *Economics Letters 80*, 123–129.

Alam, S. A. and C. C. Portner (2018, 3). Income shocks, contraceptive use, and timing of fertility. *Journal of Development Economics 131*, 96–103.

Alderman, H., J. Hoddinott, and B. Kinsey (2006). Long term consequences of early childhood malnutrition. *Oxford Economic Papers 58*.

Angrist, J. D. and J. Pischke (2008). *Mostly harmless econometrics*. Princeton university press.

Aquino, R., N. F. De Oliveira, and M. L. Barreto (2009). Impact of the family health program on infant mortality in brazilian municipalities. *American journal of public health 99*(1), 87–93.

Arokiasamy, P. (2002). Gender preference, contraceptive use and fertility in india: Regional and development influences. *International Journal of Population Geography 8*, 49–67.

Ashraf, Q. H., D. N. Weil, and J. Wilde (2013). The effect of fertility reduction on economic growth. *Population and development review 39*(1), 97–130.

Azam, M. (2012). The impact of indian job guarantee scheme on labor market outcomes: Evidence from a natural experiment. *SSRN Electronic Journal*.

Bagavathinathan, K. S. and R. Chaurey (2020). Workfare programs and children's meals intake: Evidence from india. *Food Policy 95*, 101942.

Baru, R. V. and M. Nundy (2008). Blurring of boundaries: public-private partnerships in health services in india. *Economic and Political Weekly*, 62–71.

Basu, K. (2006, 4). Gender and say: A model of household behaviour with endogenously determined balance of power. *The Economic Journal 116*, 558–580.

Beguy, D. (2009, 5). The impact of female employment on fertility in dakar (senegal) and lome (togo). *Demographic Research 20*, 97–128.

Belete, G. Y. (2021, 4). Impacts of social protection programmes on children's resources and wellbeing: Evidence from ethiopia. *Child Indicators Research 14*, 681–712.

Berhane, G., J. F. Hoddinott, and N. Kumar (2017). *The impact of Ethiopia's productive safety net programme on the nutritional status of children: 2008-2012*, Volume 1604. Intl Food Policy Res Inst.

Bhalotra, S. (2010). Fatal fluctuations? cyclicality in infant mortality in india. *Journal of Development Economics 93*, 7–19.

Bhupal, G. and A. Sam (2014). Female income and expenditure on children: impact of the national rural employment guarantee scheme in india. *Applied Econometrics and International Development 14*.

Bianchi, S. M. (2000). Maternal employment and time with children: dramatic change or surprising continuity? *Demography 37*, 401–414.

Bose, N. (2017). Raising consumption through india's national rural employment guarantee scheme. *World Development 96*, 245–263.

Broeck, G. V. D. and M. Maertens (2015, 3). Female employment reduces fertility in rural senegal. *PLoS ONE 10*.

Callaway, B. and P. H. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics 225*(2), 200–230.

Canning, D. and T. P. Schultz (2012). The economic consequences of reproductive health and family planning. *The Lancet 380*(9837), 165–171.

Census of India, I. (2016). Chapter - 3 estimates of fertility indicators.

Chari, A. V., P. Glick, E. Okeke, and S. V. Srinivasan (2019, 5). Workfare and infant health: Evidence from india's public works program. *Journal of Development Economics 138*, 116–134.

Chattopadhyay, A. and B. Goswami (2007). Status of women in two bengals: Evidence from large scale surveys. *Journal of Biosocial Science 39*(2), 276–286.

Cho, Y. and U. H. Ruthbah (2018). Does workfare work well? the case of the employment generation program for the poorest in bangladesh. *World Bank Policy Research Working Paper*.

Cleland, J., A. Conde-Agudelo, H. Peterson, J. Ross, and A. Tsui (2012). Contraception and health. *The Lancet 380*(9837), 149–156.

Cochrane, L. and Y. Tamiru (2016). Ethiopia's productive safety net program: power, politics and practice. *Journal of International Development 28*(5), 649–665.

Crepinsek, M. K. and N. R. Burstein (2004). Maternal employment and children's nutrition: Volume i, diet quality and the rose of the cacfp. *Economic Research Service, U.S. Department of Agriculture, Washington, DC*.

Das, A., J. Friedman, and E. Kandpal (2018). Does involvement of local ngos enhance public service delivery? cautionary evidence from a malaria-prevention program in india. *Health economics 27*(1), 172–188.

Das, S. and A. Singh (2013). The impact of temporary work guarantee programs on children's education: Evidence from the mahatma gandhi national rural guarantee act from india. *Available at SSRN 2368011*.

De Chaisemartin, C. and X. d'Haultfoeuille (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review 110*(9), 2964–96.

De Chaisemartin, C. and X. D'Haultfoeuille (2022a). Difference-in-differences estimators of intertemporal treatment effects. Technical report, National Bureau of Economic Research.

De Chaisemartin, C. and X. D'Haultfoeuille (2022b). Two-way fixed effects and differences-in-differences with heterogeneous treatment effects: A survey. Technical report, National Bureau of Economic Research.

De Mattos, F. B. and S. Dasgupta (2017). Mgnrega, paid work and women's empowerment. Technical report.

Dercon, S. and C. Porter (2014). Live aid revisited: long-term impacts of the 1984 ethiopian famine on children. *Journal of the European Economic Association 12*(4), 927–948.

Devereux, S. and C. Solomon (2006). Employment creation programmes : The international experience. *ILO Issues in Employment and Poverty*.

Dreze, J. and M. Murthi (2001). Fertility, education and development: Evidence from india. *Population and Development Review 27*, 33–63.

Dwarkanath, P., S. Muthayya, M. Vaz, T. Thomas, A. Mhaskar, R. Mhaskar, A. Thomas, S. Bhat, and A. Kurpad (2007). The relationship between maternal physical activity during pregnancy and birth weight. *Asia Pacific journal of clinical nutrition 16*(4), 704–710.

Fang, H., K. N. Eggleston, J. A. Rizzo, and R. J. Zeckhauser (2013). Jobs and kids: female employment and fertility in china. *IZA Journal of Labor and Development 2*, 12.

Favara, M., C. Porter, and T. Woldehanna (2019). Smarter through social protection? evaluating the impact of ethiopia's safety-net on child cognitive abilities. *Oxford Development Studies 47*.

Feng, X. L., E. Theodoratou, L. Liu, K. Y. Chan, D. Hipgrave, R. Scherpbier, H. Brixi, S. Guo, W. Chunmei, M. Chopra, et al. (2012). Social, economic, political and health system and program determinants of child mortality reduction in china between 1990 and 2006: a systematic analysis. *Journal of global health 2*(1).

Ferreira, F. and N. Schady (2009). Aggregate economic shocks, child schooling, and child health. *World Bank Research Observer 24*, 147–181.

Glowaki, T. and A. K. Richmond (2007). How government policies influence declining fertility rates in developed countries. *Middle States Geographer 27*(40), 20.

Goli, S., Moradhvaj, J. Pradhan, and T. Reja (2021). The unending burden of high out-of-pocket expenditure on institutional deliveries in india. *Public Health 193*.

Greenland, S., M. A. Mansournia, and D. G. Altman (2016). Sparse data bias: a problem hiding in plain sight. *British Medical Journal 352*.

Greenland, S., J. A. Schwartzbaum, and W. D. Finkle (2000). Problems due to small samples and sparse data in conditional logistic regression analysis. *American journal of epidemiology 151*(5), 531–539.

Hagen-Zanker, J., A. McCord, R. Holmes, F. Booker, and E. Molinari (2011). Systematic review of the impact of employment guarantee schemes and cash transfers on the poor. *London- Overseas Development Institute*.

Haider, S. J., A. Jacknowitz, and R. F. Schoeni (2003). Welfare work requirements and child well-being: Evidence from the effects on breast-feeding. *Demography 40*(3), 479–497.

Hilbe, J. M. (2014). *Modeling count data*. Cambridge University Press.

Hoddinott, J., J. A. Maluccio, J. R. Behrman, R. Flores, and R. Martorell (2008). Effect of a nutrition intervention during early childhood on economic productivity in guatemalan adults. *The lancet 371*(9610), 411–416.

Hoddinott, J. and T. J. Mekasha (2020). Social protection, household size, and its determinants: Evidence from ethiopia. *Journal of Development Studies 56*.

Imbens, G. W. and J. M. Wooldridge (2009). Recent developments in the econometrics of program evaluation. *Journal of Economic Literature 47*, 5–86.

Imbert, C. and J. Papp (2015). Labor market effects of social programs: Evidence from india's employment guarantee. *American Economic Journal: Applied Economics 7*, 233–263.

Indrayan, A. and L. Satyanarayana (2000). Essentials of biostatistics. 7. measures of morbidity and mortality in children. *Indian pediatrics 37*, 515–521.

Irenso, A. A. and G. E. Atomsa (2018). Implications of ethiopian productive safety net programme on household dietary diversity and women's body mass index: A cross-sectional study. *Food and Nutrition Research 62*.

Islam, M. and A. Sivasankaran (2015). How does child labor respond to changes in adult work opportunities? evidence from nrega. *Harvard University, Cambridge, MA*.

Jejeebhoy, S. J. and Z. A. Sathar (2001). Women's autonomy in india and pakistan: the influence of religion and region. *Population and development review 27*(4), 687–712.

Jensen, R. (2012, 5). Do labor market opportunities affect young women's work and family decisions? experimental evidence from india. *The Quarterly Journal of Economics 127*, 753–792.

Jolliffe, I. T. and J. Cadima (2016). Principal component analysis: a review and recent developments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 374*(2065), 20150202.

Jones, E. F. (1981). The impact of women's employment on marital fertility in the us, 1970-75. *Population studies 35*(2), 161–173.

Kalwij, A. S. (2000). The effects of female employment status on the presence and number of children. *Journal of Population Economics 13*, 221–239.

Kamal, S. M., C. H. Hassan, and G. M. Alam (2015). Determinants of institutional delivery among women in bangladesh. *Asia Pacific Journal of Public Health 27*(2), 1372–1388.

Khera, R. and N. Nayak (2009). Women workers and perceptions of the national rural employment guarantee act. *Economic and Political Weekly*, 49–57.

Khetrapal, S., A. Acharya, and A. Mills (2019). Assessment of the public-private-partnerships model of a national health insurance scheme in india. *Social Science and Medicine 243*, 112634.

Klonner, S. and C. Oldiges (2012). Employment guarantee and its welfare effects in india. In *Eighth Annual Conference on Economic Growth and Development, Indian Statistical Institute (ISI), New Delhi.*

KrN, A. (2016). Empowerment effects of the mgnrega on women workers: A case study of

four village panchayats of majuli, jorhat district. *South Asian Journal of Multidisciplinary studies 3*, 62–69.

Lal, R., S. Miller, M. Lieuw-Kie-Song, and D. Kostzer (2010). Public works and employment programmes : Towards a long term development approach. *International Policy Centre for Inclusive Growth*.

Lerch, M. (2019). Regional variations in the rural-urban fertility gradient in the global south. *PloS one 14*(7).

Li, T. and S. Sekhri (2013). The unintended consequences of employment based safety net programs. *World Bank Economic Review (forthcoming)*.

Liu, Y. and K. Deininger (2010). Poverty impacts of india's national rural employment guarantee scheme: Evidence from andhra pradesh. *No. 320-2016-10232*.

Mahmud, S. (1994). The role of women's employment programmes in influencing fertility regulation in rural bangladesh. *The Bangladesh Development Studies 22*.

Mani, S. (2016). How has mnrega impacted the lives of women and children in india?

Martine, G., J. E. Alves, and S. Cavenaghi (2013). *Urbanization and fertility decline: cashing in on structural change*. International Institute for Environment and Development.

Mason, K. O. (1997). Explaining fertility transitions. *Demography 34*, 443–454.

Menon, P., D. Headey, R. Avula, and P. H. Nguyen (2018). Understanding the geographical burden of stunting in india: A regression-decomposition analysis of district-level data from 2015-16. *Maternal and child nutrition 14*(4).

Miller, G. and B. P. Urdinola (2010). Cyclicality, mortality, and the value of time: The case of coffee price fluctuations and child survival in colombia. *Journal of Political Economy 118*(1), 113–155.

Ministry of Health & Family Welfare, I. (2005). National rural health mission: Framework for implementation 2005-2012.

Ministry of Health & Family Welfare, I. (2009). Four years of national rural health mission: 2005-2009.

Ministry of Rural Development, I. (2007). Mgnrega public data portal. Accessed on March 25, 2022.

Ministry of Rural Development, I. (2010). Mgnrega 2005: Report to the people (2006-2010).

Ministry of Rural Development, I. (2015). Mgnrega 2005: Report to the people (2015).

Munshi, K. and J. Myaux (2006). Social norms and the fertility transition. *Journal of Development Economics 80*, 1–38.

Nair, M., P. Ariana, E. O. Ohuma, R. Gray, B. de Stavola, and P. Webster (2013). Effect of the mahatma gandhi national rural employment guarantee act (mgnrega) on malnutrition of infants in rajasthan, india: A mixed methods study. *PLoS ONE 8*.

Nair, M., P. Ariana, and P. Webster (2014). Impact of mothers' employment on infant feeding and care: a qualitative study of the experiences of mothers employed through the mahatma gandhi national rural employment guarantee act. *BMJ open 4*.

National Sample Survey Organisation, I. (2006, March). Morbidity, health care and the condition of the aged.

Navaneetham, K. and A. Dharmalingam (2002). Utilization of maternal health care services in southern india. *Social science and medicine 55*(10), 1849–1869.

Ovaskainen, O. and J. Soininen (2011). Making more out of sparse data: hierarchical modeling of species communities. *Ecology 92*(2), 289–295.

Pankaj, A. and R. Tankha (2010). Empowerment effects of the nregs on women workers: A study in four states. *Economics and Political Weekly 45*, 45–55.

Parmar, D. and A. Banerjee (2019). Impact of an employment guarantee scheme on utilisation of maternal healthcare services: Results from a natural experiment in india. *Social Science and Medicine 222*, 285–293.

Paule-Paludkiewicz, H. (2020). Does the right to work part-time affect mothers' labor market outcomes?

Planning Commission, I. (2003). Report of the task force.

Porter, C. and R. Goyal (2016). Social protection for all ages? impacts of ethiopia's productive safety net program on child nutrition. *Social Science and Medicine*.

Rao, S., A. Kanade, B. M. Margetts, C. S. Yajnik, H. Lubree, S. Rege, B. Desai, A. Jackson, and C. H. Fall (2003). Maternal activity in relation to birth size in rural india. the pune maternal nutrition study. *European journal of clinical nutrition 57*(4), 531–542.

Rasella, D., F. J. O. Alves, P. Rebouças, G. S. de Jesus, M. L. Barreto, T. Campello, and E. S. Paixao (2021). Long-term impact of a conditional cash transfer programme on maternal mortality: a nationwide analysis of brazilian longitudinal data. *BMC medicine 19*(1), 1–9.

Ravi, S. and M. Engler (2015). Workfare as an effective way to fight poverty: The case of india's nregs. *World Development 67*, 57–71.

Rose, D., R. Martorell, and J. Rivera (1992). Infant mortality rates before, during, and after a nutrition and health intervention in rural guatemalan villages. *Food and Nutrition Bulletin 14*(3), 1–6.

Schaller, J. (2016). Booms, busts, and fertility testing the becker model using gender-specific labor demand. *Journal of Human Resources 51*(1), 1–29.

Schultz, T. P. (2005). Fertility and income. *Yale University Economic Growth Center Discussion Paper 925*.

Shah, A., S. Jose, et al. (2009). *Asset Creation and Local Economy under NREGS: Scope and Challenges*. Gujarat Institute of Development Research.

Shah, M. and B. M. Steinberg (2019). Workfare and human capital investment: Evidence from india. *Journal of Human Resources*, 1117–9201R2.

Shapiro, D. and B. O. Tambashe (1997). Education, employment, and fertility in kinshasa and prospects for changes in reproductive behavior. *Population Research and Policy Review 16*, 259–287.

Sharma, A. (2010). Mahatama gandhi national rural employment guarantee act, 2005: A rights-based law for inclusive growth. *Ministry of rural Development*.

Sharma, S. K., Y. Sawangdee, and B. Sirirassamee (2007). Access to health: women's status and utilization of maternal health services in nepal. *Journal of biosocial science 39*(5), 671–692.

Shlens, J. (2014). A tutorial on principal component analysis. *arXiv preprint arXiv:1404.1100*.

Silva, J. S. and S. Tenreyro (2006). The log of gravity. *The Review of Economics and statistics 88*(4), 641–658.

Silva, J. S. and S. Tenreyro (2011). Further simulation evidence on the performance of the poisson pseudo-maximum likelihood estimator. *Economics Letters 112*(2), 220–222.

Subbarao, K., C. Del Ninno, C. Andrews, and C. Rodriguez-Alas (2012). *Public works as a safety net: design, evidence, and implementation*. World Bank Publications.

Sukhtankar, S. et al. (2016). India's national rural employment guarantee scheme: What do we really know about the world's largest workfare program? In *India Policy Forum*, Volume 13, pp. 2009–10.

Sun, L. and S. Abraham (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics 225*(2), 175–199.

Tsaneva, M. and U. Balakrishnan (2019). The effect of a workfare programme on psychological wellbeing in india. *Journal of Development Studies 55*, 2593–2609.

United Nations Development Programme, I. (2015). Mgnrega sameeksha ii: An anthology of research studies (2012-2014).

Upadhyay, U. and D. Karasek (2012). Women's empowerment and ideal family size : An examination of dhs empowerment measures in sub-saharan africa. *International Perspectives on Sexual and Reproductive Health 38*, 78–89.

van den Berg, G., A. Bergemann, and S. Gupta (2010). Impact of an affimative action program in employment on child mortality in india.

Vellakkal, S., H. Reddy, A. Gupta, A. Chandran, J. Fledderjohann, and D. Stuckler (2017). A qualitative study of factors impacting accessing of institutional delivery care in the context of india's cash incentive program. *Social Science and Medicine 178*, 55–65.

Vishnu, G. (2018). Who are the scheduled castes, scheduled tribes, obcs and ebcs? Accessed on January 25, 2022.

Watson, T. (2006). Public health investments and the infant mortality gap: Evidence from federal sanitation interventions on us indian reservations. *Journal of Public Economics 90*(8-9), 1537–1560.

Zimmermann, L. (2012). Labor market impacts of a large-scale public works program: evidence from the indian employment guarantee scheme. *Mimeo*.

Appendix

Table A.1: Regression of NREGS phase on the three backwardness measures

	NREGS phases
SC/ST population percentage (1991)	-0.024*** (0.002)
Agricultural Wage (Rs/day) in 1996/97	0.658*** (0.158)
Output per Agricultural worker	0.0017*** (0.0003)
Observations	442
Adjusted R^2	0.385

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors are in the parenthesis. Dependent variable is the number of phase in which the districts obtained the NREGS. An OLS regression was performed to see how much of the variation in NREGS phased implementation is explained by the three measures based on which the status of backwardness of the districts were calculated.

Table A.2: Mechanisms or channels for women aged 35-39 years

	1 Poisson	2 Poisson	3 LPM	4 LPM	5 LPM	6 Poisson	7 LPM	8 LPM	9 OLS
Women aged 35 to 39 years	Breastfeeding duration	ANC visits	Public/NGO delivery	Private delivery	Home delivery	Number of children born in last 3 years (by presence of children)	Want anymore children (by presence of children)	If using contraceptive (by presence of children)	Contraceptive use duration (in months) (by presence of children)
Number of observations	17,156	15,080	19,878	19,878	19,878	61,938	40,598	82,428	78,392
NREGS (ITT)	0.418 (0.573)	0.249 (0.331)	0.458*** (0.146)	-0.063 (0.079)	-0.395*** (0.12)	-0.016 (0.018)	0.029 (0.037)	0.695 (0.442)	-0.0003 (0.034)

Note: (*** p<0.01, ** p<0.05, * p<0.1). Standard errors, clustered at district level, are in parenthesis. This table analyzes if the effect of NREGS on different channels for women aged 35-39 years. All regression models include time fixed effect, district fixed effects, state-time fixed effects and district controls (agricultural wage, agricultural output, SC and ST population percentage). Additional controls include individual variables (education, number of children) and household controls (number of adults, caste and religion).

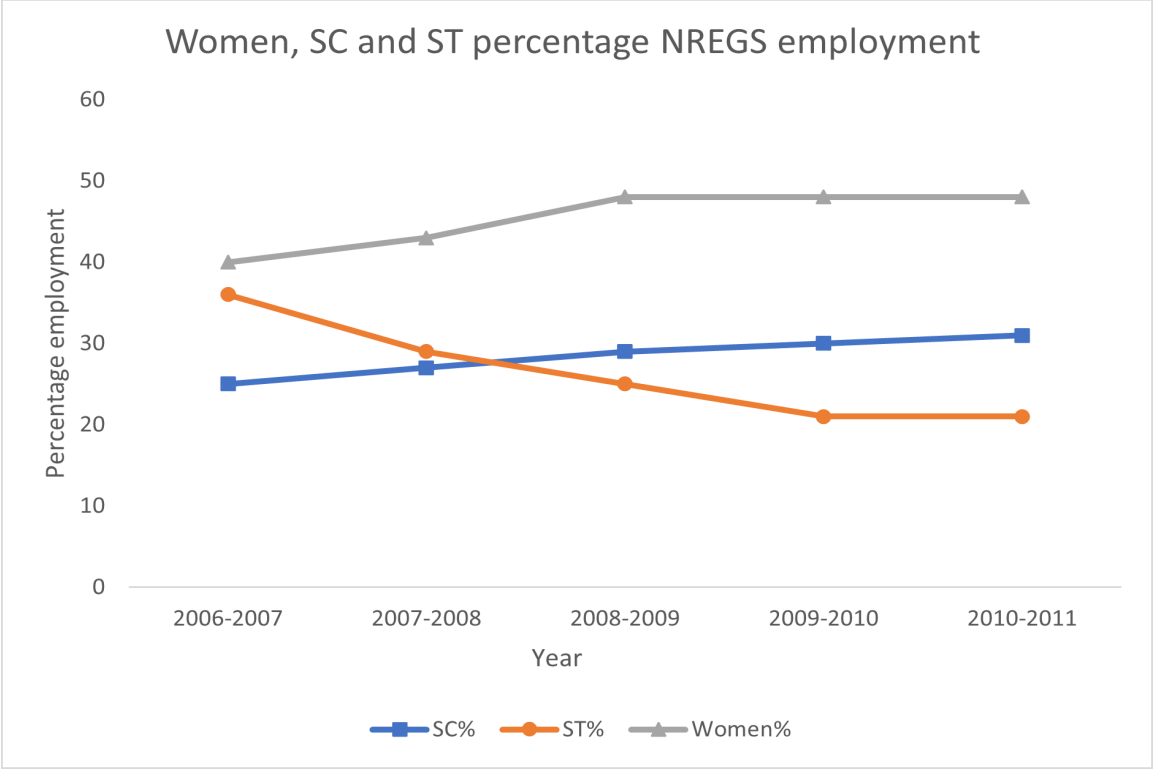

Figure A.1: Percentage of women, SC and ST employment in NREGS