ISSN No. 2454 – 1427

CDE
June 2017

The Impact of MGNREGA on Agricultural Outcomes and the Rural Labour Market: A Matched DID Approach

Deepak Varshney, Deepti Goel and J.V. Meenakshi

Department of Economics,
Delhi School of Economics,
University of Delhi

Working Paper No. 277

http://www.cdedse.org/pdf/work277.pdf

CENTRE FOR DEVELOPMENT ECONOMICS
DELHI SCHOOL OF ECONOMICS
DELHI 110007

The Impact of MGNREGA on Agricultural Outcomes and the Rural Labour Market: A Matched DID Approach

Deepak Varshney, Deepti Goel and J.V. Meenakshi

June 7, 2017

Abstract:

This paper attempts to address the impact of the MGNREGA on the rural *agricultural* sector, focusing on cropping patterns, irrigated area, crop yields, wages and rural employment. The analysis is based on two data sources: the first is a unique district-season level panel dataset that we construct using multiple sources; and the second is unit-record data from the NSS Employment Unemployment Surveys. To identify causal effects, we employ a difference-in-difference matching (DIDM) procedure, where districts are matched based on propensity scores; the use of propensity scores represents a novel aspect of this paper. We also examine pre-programme trends for each outcome variable to provide a check on the validity of our estimates. Our results indicate modest changes in cropping patterns that are state- and period-specific; however they do not indicate any improvements in crop yields that were expected given the MGNREGA's focus on investments in irrigation, although there is some evidence that irrigated area may have expanded after a lag. We also find that there is no systematic evidence of impact on wages, and therefore no evidence that public works employment in MGNREGA crowded out casual labour in agriculture.

JEL classification codes: J31, J46, J48, Q15

Keywords: MGNREGA, Public Works, Agriculture

Ackowledgements: We thank Anirban Kar, Ashwini Deshpande, K.L.Krishna and Uday Bhanu Sinha for useful comments. Any errors are ours.

The Impact of MGNREGA on Agricultural Outcomes and the Rural Labour Market: A Matched DID Approach

1. Introduction

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA or the 'Scheme'), enacted by the Indian parliament in September 2005, provides a legal guarantee of 100 days of employment to households willing to provide unskilled labour. It has, among its objectives, "the creation of durable assets and strengthening the livelihood resource base of the rural poor…" (GOI 2005). In particular, the Act has an explicit focus on water-related infrastructure: Schedule I of the Act (GOI 2005) says, "The focus of the Scheme shall be on the following works in order of their priority: (i) water conservation and water harvesting (ii) drought proofing…(iii) irrigation canals including micro and minor irrigation works …." Another notable feature of the Act is the provision of an equal minimum wage to both men and women.

Although a range of impacts of the MGNREGA have been documented in the literature,[1] this paper focuses on the extent to which the scheme has influenced *agricultural* outcomes, on which the literature is more limited. This is motivated by concerns that MGNREGA is affecting agriculture adversely by bidding up wages, and causing farmers to switch to less labour intensive crops or to quit agriculture altogether (Rangarajan, Kaul and Seema 2011).[2]

There are two major pathways by which impacts in agriculture may be seen. The first is through the infrastructure generated under MGNREGA. According to government data, more than 50 percent of the total expenditure on assets was spent on water-related works in 2010/11,[3] and

[1]These include employment and wages (Azam 2012; Berg et al. 2015; Imbert and Papp 2015; Zimmermann 2015), incomes (Jha, Gaiha, and Pandey 2009), consumption (Ravi and Engler, 2015), welfare (Deininger and Liu 2013; Imbert and Papp 2015), women's empowerment (Khera and Nayak 2009), education of children (Afridi, Mukhopadhaya, and Sahoo 2016), and child anthropometric outcomes (Uppal 2009). See also Bhatia et al. (2016) and Sukhtantar (2016) for an overview of research on MGNREGA.

[2]Rangarajan, Kaul, and Seema (2011) find that between 1999/2000 and 2004/5 about 19 million people were added to the agricultural work force, while between 2004/5 and 2009/10 about 21 million people moved out of it. They also note a greater fall in share of agricultural employment in the total work force between 2004/5 and 2009/10 as compared to 1999/2000 to 2004/05.

[3]Unless noted otherwise, these are all crop years, beginning in July and ending in June.

through 2011/12, more than 4 million such works had been created (MORD 2012).[4] Conditional on the quality of assets, it is reasonable to expect that MGNREGA may have improved the availability of water for irrigation. Improved irrigation facilities may mean that farmers are able to cultivate a second crop in areas where second season crops were not normally cultivated (CSE 2008). Additionally, even if gross area under irrigation did not increase, increased water availability may have resulted in a shift from low to high water intensive crops within the same season, or may have translated into higher yields for existing crops. A direct impact of MGNREGA on agriculture may, therefore, be assessed by examining changes in gross irrigated area, cropping patterns, and crop yields.[5]

The second pathway through which agriculture may be affected is through a change in agricultural wages. Given that at the time the scheme was introduced agricultural wages were lower than MGNREGA wage,[6] and that MGNREGA is backed by a legal guarantee, the bargaining power of hired labour may have increased after the scheme was implemented, raising their reservation wage and thereby increasing wages in agriculture. Additionally, even though the public works are meant to be carried out primarily in the off-peak agricultural season (Imbert and Papp 2015), MGNREGA may directly compete with agricultural activities in the peak season because of the inappropriate timing of the implementation of works under the scheme, and may thus have led to an increase in agricultural wages. Any resultant increase in agricultural wages[7] may have consequences for cropping patterns and productivity. For example, it may have shifted cropping patterns from high- to low-labour intensive crops, and labour saving methods, if sub-optimal, may have lowered crop yields.

Thus our primary objective is to evaluate the net effect of both these MGNREGA-induced pathways, by evaluating changes in gross irrigated area, wages in agriculture, cropping patterns and crop yields. In particular, we examine whether farmers are shifting to crops with lower

[4]Calculated from Management Information System (MIS) data, collected from MGNREGA portal, Ministry of Rural Development, Government of India. Accessed on 15th May 2012, http://164.100.129.6/Netnrega/mpr_ht/nregampr_dmu.aspx?flag=1&page1=S&month=Latest&fin_year=2010-2011

[5]It would also be useful to look at the impact on volume of water for irrigation as this may be a mechanism via which yields are affected. However, we are unable to study this as, to the best of our knowledge, data on irrigation volumes is not available.

[6]See Table 10 for figures on casual wage in agriculture. In 2004/5, before MGNREGA was instituted, these were much lower than the minimum wages guaranteed under the scheme.

[7]It is also possible that the scheme may have led to mechanization, that could potentially lower agricultural wages, as noted in Bhargava (2014).

labour and/or higher water requirements, and also whether crop yields have changed as a consequence of MGNREGA.

A second objective is to assess the scheme's impact on employment/labour use and wages, disaggregated by sector (rural agriculture and rural non-agriculture), by type of labour contract (casual, regular/salaried, and self-employed),[8] and by gender. Note that we do not undertake a disaggregated study of wages by contract type and restrict our analysis to casual wages only. This is because a priori we do not expect regular wages to be affected by the scheme as MGNREGA offers unskilled work on a voluntary basis for at most 100 days a year.

As detailed in Section 2.2, much of the literature that has considered labour market outcomes thus far has focused on the private sector as a whole, aggregating over agriculture and non-agriculture, and also across contract types. A more detailed analysis focusing on agriculture, and specifically on casual sector within agriculture, is warranted for several reasons. For instance, as noted above, to the extent that the MGNREGA has led to changes in cropping patterns, this has implications for agricultural labour demand. It is possible that by only looking at aggregate outcomes in the private sector, any change specific to agriculture may not be discerned due to counteracting exogenous changes in non-agriculture. Furthermore, unlike labour use in non-agriculture, agricultural labour use by its very nature is seasonal and more likely to benefit from the consumption smoothing opportunities offered by MGNREGA. Also, since typically non-agricultural wages are higher than both agricultural and MGNREGA wages,[9] those working in the non-agricultural sector are less likely to offer themselves for public works employment. For these reasons, it is reasonable to believe that MGNREGA might have a greater impact on labour use and wages in agriculture, and only a limited impact on these outcomes in non-agriculture. It is, therefore, important to study them separately. To the extent that crops that need more water also have higher labour requirements, the net impact of the MGNREGA on agricultural labour demand may be higher or lower, depending on whether cropping patterns have changed to toward labour-saving crops as a consequence of higher wages (if realized), or towards more water-intensive crops as a consequence of better irrigation (if realized). Therefore, the net effect on labour use and on wages in agriculture is ambiguous and depends upon the magnitude as well as the direction of change in cropping pattern.

[8]Casual wage labour are persons engaged in other farm or non-farm enterprises and getting in return wage according to the terms of the daily or periodic (but not regular) work contract (NSSO 2006).
[9]Table 10 shows that in 2004/5, before the institution of MGNREGA, wages in non-agriculture were higher than those in agriculture.

Looking at different contract types within agriculture, casual labourers and those self-employed (with petty businesses) are most likely to be impacted given the self-targeted nature of the MGNREGA. Those who are in regular/salaried jobs, or those who have a large enough asset base (for example, farmers with mid- to large-sized holdings who work on their own farms), are unlikely to offer themselves for short-term employment offered under the scheme. Hence, it is also important to distinguish between contract types.

MGNREGA is also likely to have a differentiated impact by gender. There are several reasons to expect that the scheme may disproportionately increase the labour force participation by women. First, compared to men, labour force participation rates for women are very low in India.[10] Further, the Act mandates that at least one-third of employment be accounted for by women. It also provides for crèche facilities at each worksite so that women with younger children can participate. Finally, women who are reluctant to travel outside their village in search of employment because of social taboos can now find opportunities locally. Compared to men, therefore, these features may draw in a larger proportion of women into the labour market who were engaged in domestic duties or were otherwise not in the labour force. Correspondingly, there may be a greater impact on female casual wage. We, therefore, specifically focus on female labour use and female casual wage rates.

The conceptual framework and empirical strategy employed in this paper extends that set out in Azam (2012) and Imbert and Papp (2015). Like this literature we also take advantage of phased roll out of the MGNREGA: It was initially implemented in February 2006 in the poorest 200 districts (districts are administrative subdivisions of states), termed the `Phase I' districts; was then extended to another 130 `Phase II' districts in April 2007; and in April 2008 it was introduced in the remaining `Phase III' districts as well.[11] Thus, in 2004/5, MGNREGA had not been implemented anywhere in the country, in 2007/8 it had been implemented only in the Phase I and II districts, and in 2009/10 it had been rolled out in all districts, including in Phase III districts.[12]

[10]In 2004/5, labour force participation rate for males in rural India was 545 persons per thousand persons, while the corresponding figure for females was 287 (NSSO 2006).

[11]Some district boundaries were redrawn during this period, and new districts created. In February 2006, the total number of districts in the country was 612. This increased to 633 by April 2008. Care has been taken to account for these changes in the empirical analysis (see Appendix B for more detail).

[12]Although implementation in Phase III districts was officially initiated in April 2008, as noted in Imbert and Papp (2015), effective employment creation is likely to have been weak in the initial months since implementation. Therefore, in the empirical analysis, Phase III districts are assumed to be immune to the scheme in the last three months of 2007/8.

Given this phase-wise roll out across vastly distinct geographies, we estimate two sets of impacts. The first of these, termed as the *impact on Phase I and II districts under partial implementation*, assesses the initial impact of MGNREGA on the Phase I and II districts at a time when the scheme had yet to be rolled out in the Phase III districts. Partial implementation impacts are estimated by looking at outcomes in 2004/5 and in 2007/8 for Phase I and II districts, and comparing the change over this period relative to the change over the same period in the Phase III districts. However, we go further than the existing literature to estimate a second set of impacts which assesses whether the same effects, both in magnitude and direction, are observed in the richer Phase III districts once these districts had also been covered under the scheme. This is termed as the *impact on Phase III districts under full implementation,* and is obtained by looking at outcomes in 2007/8 and in 2011/12 for Phase III districts, and comparing the change over this period relative to the change over the same period in Phase I and II districts. Phase I and II districts act as the control districts in this case, and unlike in the previous set of impacts, the control districts had the scheme in the both comparison years. Differences, if found, between the two sets of impacts, namely, Phase I and II under partial implementation and Phase III under full implementation, may be attributed either to the differences in the socio-economic conditions between Phase I and II districts and Phase III districts, or to the partial versus full roll out of the scheme.

A second aspect that distinguishes our empirical strategy is that unlike the literature, we use *matching* techniques to create appropriate counterfactuals before computing double-difference estimates of impact. We thus employ a difference-in-difference matching (DIDM) procedure to identify the causal effect of the scheme (Heckman, Ichimura, and Todd 1997). Matching makes it more likely that the underlying assumption of identical changes over time between treatment and control districts in the absence of the scheme holds good.

Thus, we extend the existing literature in two important ways. The first is our comprehensive focus on agricultural outcomes—including area under irrigation, cropping patterns, crop yields, as well as casual labour market outcomes within agriculture. Second, we estimate two different sets of matched impacts, comparisons across which show whether geography and scale of program implementation matter.

The rest of the paper is organized as follows. The second section provides a brief review of literature. The third section describes the datasets used and presents a ranking of states according to successful MGNREGA implementation. The fourth section details the empirical

strategy. The fifth section presents summary statistics followed by causal impact results for our first set of outcome variables, namely, gross irrigated area, agricultural wages, cropping patterns and crop yields, using a district level dataset. The sixth section does the same for our second set of outcomes variables, namely, ten mutually exclusive and exhaustive employment categories and casual wages, using an individual level dataset. The seventh section presents the conclusions.

2. Review of Literature

We present the literature in two sub-sections. The first covers studies related to irrigation, cropping patterns, and crop yields. Most studies in this sub-section use methods that do not result in causal estimates. The second sub-section covers studies related to the impact on employment and wages.

2.1. MGNREGA and Irrigation, Cropping Patterns and Crop Yields

Kareemulla et al. (2009) study six villages of Anantpur district in Andhra Pradesh. They find that only about 25 percent of the ponds that were taken up under MGNREGA were being utilized for irrigation, primarily because there was no provision of channeling water to the farm plots. They note, however, that the investment in ponds was recharging ground water. The Indian Institute of Forest Management (2010) studies four districts in Madhya Pradesh to find that households perceived that there was a significant improvement in the availability of irrigation water. Tiwari et al. (2011) study Chitradurga district of Karnataka and find that there was a significant improvement in ground water level in three out of the six study villages after the introduction of MGNREGA. A study by the Indian Institute of Science (2013) in 10 villages each from Andhra Pradesh, Karnataka, Madhya Pradesh and Rajasthan compared groundwater levels before and after MGNREGA and similarly found that levels had increased. Verma and Shah (2012) examine the rate of return for irrigation assets constructed under MGNREGA in Bihar, Gujarat, Rajasthan and Kerala for the year 2009/10. They use cost-benefit analysis for 140 best-performing MGNREGA related assets and find that that 80 per cent of the assets created recovered their investment in the first year itself.

Studies that consider the impact of the MGNREGA on cropping patterns and crop yields are relatively limited. Centre for Science and Environment (2008) examines the impact of MGNREGA on irrigation and cropping patterns in a single district each of Orissa and Madhya Pradesh and finds that respondents in Madhya Pradesh perceived there to be an improvement

in irrigation availability, and a change in cropping pattern as a result, but respondents in Orissa did not report any change. Aggarwal, Gupta, and Kumar (2012) study the implications of eleven wells constructed under MGNREGA in a gram panchayat of Ranchi district in Jharkhand on cultivation costs and profits. They find that there was a considerable diversification of cropping patterns, especially toward vegetables, after the construction of the wells, and that as a result farm profits in the command area of these wells increased from Rs.7,635 per year to Rs. 15,728 per year.

Nearly all the studies reviewed above are associative in nature, in that they do not account for possible biases in impact estimates resulting from endogeneity in participation. Studies that explicitly estimate causal impacts include Gehrke (2014) and Bhargava (2014). Gehrke (2014) examines the role of the MGNREGA in mitigating household's uncertainty vis-à-vis income streams and thereby affecting crop choices. Using data for Andhra Pradesh, she finds that farmers have switched to more profitable but risky crops as a result of MGNREGA. Bhargava (2014) examines the impact of MGNREGA on demand for agricultural technology. Using agricultural census data he finds that the MGNREGA caused a 20 percentage point shift away from labour-intensive technologies towards labour-saving technologies, particularly for small farmers.

Our study contributes to the literature examining agricultural outcomes by providing the first rigorous estimates for the causal impact on irrigated area at the all-India level, and for cropping patterns and crop yields for three major states.

2.2. MGNREGA and Employment and Wages

Azam (2012) was the first to exploit the phase-wise roll out of the MGNREGA and use a difference-in-difference (DID) approach to identify causal impacts of MGNREGA on employment and wages. Using Employment Unemployment Surveys (the same dataset as we use) for 2004/5 and 2007/8, he finds a positive impact on public works employment and on labour-force participation rates, largely driven by changes in women's employment. For the same period, and following largely the same methodology, Imbert and Papp (2015) examine the impact of the scheme on the *composition* of employment between public and private works, disaggregated by season. They find a 1.2 percentage points increase in the fraction of days spent in public works during the dry season (roughly corresponding to the agricultural off-peak season), and a decline of 1.3 percentage points in private work in the same season. They

interpret this as evidence to suggest that private sector employment is being substituted by employment in public works. Similarly, based on a panel survey of 3725-households conducted by the World Bank in Andhra Pradesh in 2004, 2006, and 2008, Sheahan et al. (2016) also use a difference-in-difference estimation strategy to conclude that the number of days in paid non-MGNREGA employment has declined significantly in the state of Andhra Pradesh as a consequence of the scheme. Zimmermann (2015) also uses EUS data but adopts a regression discontinuity approach using data only for the year 2007/8. In contrast to the first two papers mentioned above she finds that the MGNREGA did not impact employment in public works.

Thus, the evidence on the impact of MGNREGA on employment is mixed; this is also true of the impact on casual wages. Both Azam (2012) and Imbert and Papp (2015) find a positive impact with the latter finding a 4.7 percent increase in the dry season, and no change in the rainy season (corresponding to the agricultural peak season). Similarly, Berg et al. (2015) use a different data set—monthly data from Agricultural Wages in India (AWI) reports for the period 2000 to 2011—but employ the same identification strategy to conclude that the scheme resulted in a 4.3 percent increase in casual wages. In contrast to these papers, Mahajan (2014) and Zimmermann (2015) find no impact on casual wages. Mahajan (2014) uses the same data and the same methodology as adopted by Azam (2012) and Imbert and Papp (2015), but she includes interactions between state and time dummies to capture state-specific time trends which seem to explain away the positive results found in earlier papers.

Furthermore, the gender disaggregated impact is quite contrasting in these papers: While Azam (2012) finds the positive impact on casual wage to be driven by female workers, Imbert and Papp (2015) find it to be driven by male (and not female) workers and Berg et. al. (2015) find the impact to be gender neutral.

We contribute to the literature examining labour market outcomes in the following ways. First, as noted earlier, while studies such as the one by Imbert and Papp (2015) consider private and public employment separately, they do not further disaggregate the private sector into agriculture and non-agriculture. Also, they do not examine casual labour employment separately, as we do in this paper. Second, for identifying causal estimates we use matching before difference in differences which makes the assumption of identical time trends between control and treatment districts more plausible. Finally, in addition to partial implementation estimates, we also present full implementation estimates for the period 2007/8 to 2011/12.

3. Datasets and Ranking of States

To evaluate changes in gross irrigated area, agricultural wages, cropping patterns and crop yields, we constructed a *district-level* panel dataset for the years 2000/1 through 2009/10. The dataset, which we shall refer to as the crop-wage dataset, was collated from a large number of sources, not all of which are readily available in the public domain (see Appendix A for details).

While it is meaningful to undertake the analysis of gross irrigated area and agricultural wages at the all-India level, in order to study changes in cropping patterns and crop yields it is important to consider a geography that is characterised by homogenous agro-climatic conditions (to be able to identify competing crops), and at the same time is large enough to have sufficiently large number of treatment and control districts. We consider state-season to be such an appropriate geography and the analysis of cropping patterns and yields is confined to the top three states in terms of MGNREGA implementation.

For our second objective, which is to examine changes in employment and casual wages in rural India, we use repeated cross-sections of individual level data from Employment-Unemployment Surveys (EUS) conducted by the National Sample Survey Organization. The surveys used correspond to the years 1999/2000, 2004/5, 2007/8 and 2011/2 and are representative at the national and state levels. To maintain comparability with other papers (in particular with Imbert and Papp 2015), we consider individuals between 18 and 60 years of age, living in rural areas of the 19 major states listed in Table 1.[13] Construction and definitions of the main outcome variables for both the datasets are presented in Appendix A.

We note two things. First, we study wages using two different datasets. Data on agricultural wages from the crop-wage dataset does not distinguish between contract types; it is the average wage paid to unskilled labour employed in agriculture. On the other hand casual wage in agriculture from the EUS is restricted to wages paid to persons according to an ad hoc work contract and excludes wages paid on a regular basis. Second, we have used two different, but related, characterisations of seasons within an agricultural year. When discussing impacts on cropping patterns and crop yields, we talk about seasons as kharif and rabi. Although the exact months comprising these seasons vary by state, and by crop, in most parts of India sowing for the kharif crops begins in July and harvesting is done by October or November, while sowing

[13]These states together cover 97 percent of the country's rural population in 2004/5.

for the rabi crops begins in mid-November and harvesting is completed by April or May. When discussing impacts on employment and wages we refer to seasons as dry and rainy.[14] The dry season refers to the months from January through June, while the rainy season from July through December. The rainy season roughly corresponds to the agricultural peak season because in most states it includes the sowing and harvesting of kharif crops, and the sowing of rabi crops, all of which are highly labour intensive. On the other hand, the dry season may be considered as the agricultural off-peak season as the only labour intensive operation during this period is the harvesting of rabi crops.

3.1 Ranking of States according to MGNREGA Implementation

Dutta et al. (2012), and Liu and Barrett (2013), find substantial inter-state variation in the implementation of MGNREGA with the latter finding that the scheme achieved effective targeting in only about half of the Indian states. In the light of this, it is likely that the effects of the MGNREGA are more pronounced—and therefore more readily apparent—when we focus on only the states that have more successfully implemented the scheme. For this reason, in addition to studying the impacts at the national level, we separately study the top three states in terms of MGNREGA implementation.

Table 1 presents the ranking of all 19 states according to MGNREGA implementation. The ranking is based on an index defined as the product of the scheme's intensity and its coverage. Intensity is the average, over participating households, of the number of days of MGNREGA employment in a year. Coverage is the share of rural households that obtained (any) MGNREGA employment. The final index for a state is the product of intensity and coverage, each calculated as the average over the two years, 2008/9 and 2009/10. According to this ranking, the top three performing states are Rajasthan, Andhra Pradesh, and Madhya Pradesh, having average intensity figures of 72, 61 and 55, and average coverage rates of 79, 56 and 60 percent, respectively.[15]

4. Empirical Strategy

As stated in the introduction we exploit the phase-wise roll out of MGNREGA that facilitates the application of DID. This strategy has been used by several papers including Azam 2012; Berg et al. 2015, and Imbert and Papp 2015. However, as noted in Zimmermann (2015) and

[14]We change terminology to be consistent with other literature, in particular with Imbert and Papp 2015.
[15]Overall, our ranking compares well with that of Dutta et al. (2012).

Gupta (2006), although the scheme was meant to be implemented in poorer districts first, there was significant deviation in the final selection of districts for early implementation. Keeping this in mind, we deviate from the literature that has used DID to study the scheme's causal effects and adopt DIDM procedure instead.[16]

We implement the DIDM procedure in the following steps. First, using 2004/05 data, we match each Phase I and II district with a weighted combination of Phase III districts such that the predicted probability of receiving the scheme by 2007/08 is similar in both. We then compare the outcomes in each Phase I and II district with the weighted average of outcomes across matched Phase III districts. Implementing the matching procedure essentially involves modifying the individual level survey weights provided by the NSSO. This is explained in Appendix B.

The DIDM framework allows us to identify the impact under the maintained hypothesis that, conditional on covariates, there would have been no difference in time trends between Phase I and II and Phase III districts in the absence of the scheme. As noted earlier, even before MGNREGA was implemented, the two sets of districts differed in their socio-economic characteristics. Implementation of propensity score matching reduces the concern that the maintained hypothesis may not hold good. Appendix Table C1 confirms this: In 2004/5, without matching, compared to Phase III districts, Phase I and II districts have a larger share of SC/ST households, less educated individuals, lower consumption expenditure per household, lower agricultural wages, and lower cultivable land per household. After matching, these differences disappear. To be completely certain that we are indeed capturing the effects of MGNREGA, we also examine pre-program changes in each outcome over the period 1999/2000 to 2004/5, and give causal interpretations only when there is no difference in pre-program changes between treatment and control districts.

Next we present the regressions used to estimate the impact under partial implementation, followed by that under full implementation. We present the empirical specifications in the context of regressions run using EUS data. Similar specifications, with minor modifications, were used when using the crop-wage data.

[16]We restrict ourselves to a standard DID for the analyses of cropping pattern and crop yields as these are done at the state-season level and the number of districts is not large enough to implement matching sensibly, e.g. Andhra Pradesh has only 22 districts.

4.1. Impact on Phase I and II districts under Partial Implementation

The DIDM estimate on Phase I and II districts under partial implementation is given by the following equation:

$$Y_{idst} = \alpha_0 + \alpha_1(T07_t * Phase1\&2_d) + \sum_{k=1,\ldots,5} \alpha_{2s}(T07_t * AEZk_s) + \alpha_3 \boldsymbol{X}_{idst} + \alpha_4 Z_{dt} + \{\mu_d\} + \varepsilon_{idst} \quad (1)$$

where *i* stands for individual, *d* for district, *s* for Agro-Ecological Zone (AEZ) and *t* for year. In the specification for partial implementation, *t* is either 2004/5 or 2007/8.

When studying outcomes from the EUS, *Y* is one of the following:

(a) Time share in one of ten employment categories listed in section A2 of Appendix A. For each category, Y is a value between 0 and 1, and captures the fraction of time spent in that category during the reference week.[17]

(b) Logarithm of casual wage in agriculture (and separately in non-agriculture).

When using the crop-wage dataset, *Y* is one of the following:[18]

(a) Logarithm of share of gross irrigated area in total cropped area.

(b) Logarithm of agricultural wage.

(c) Share of crop acreage in total cropped area.[19]

(d) Logarithm of crop yield.

The right hand side variables are as follows:

(a) *T*07 is a dummy variable for the year 2007/8.

(b) *Phase*1&2 is a dummy variable for whether the district is a Phase I or a Phase II district.

(c) *{AEZk}* is a set of dummy variables, one for each of the five AEZs in India: Coastal, Arid, Hills, Irrigated, and Rain fed (Saxena, Pal, and Joshi 2001). The interaction between year and zone dummies allows for AEZ specific time trends.[20]

---

[17]For example, if in the reference week of 7 days, a person spends 4.5 days as casual labour in agriculture and 2.5 days in domestic work, then Y takes values 0.64 and 0.36 for these two categories, respectively, and it takes the value 0 for all other categories. Note that this outcome variable is not in logarithms as for a given individual many categories take the value 0.

[18]In specifications for the crop-wage dataset, the subscript *i* is not applicable as the unit of observation is a district and not an individual.

[19]Again, this variable is not in logarithms because even within a state-season strata, there are several districts which do not grow a particular major crop and therefore have 0 values for those crops.

[20]For the two outcomes analysed at the state-season level, namely, share of crop acreage in total cropped area and crop yield, AEZs are replaced by Agro-Ecological Zone Production Systems (AEZPSs). Each AEZPS is a

(d) $\boldsymbol{X}$ stands for individual covariates included to increase precision.[21] These are: age; age squared; marital status (never married, currently married, and residual other category); caste (SC, ST, Other Backward Classes (OBC), and residual other category); Muslim; and education (illiterate, primary and below, middle, secondary and above).

(e) Z stands for rainfall[22] at the district level.[23]

(f) μ is a set of district fixed effects and

(g) ε is the error term.

α_1 is the DIDM impact estimator for Phase I and II districts under partial implementation when equation (1) is run on the common support region with modified individual level matching weights. Robust standard errors, clustered at the district-year level, have been used in this and all other specifications mentioned in this section.

4.2 Impact on Phase III Districts under Full Implementation

The impact on Phase III districts under full implementation is given by the following equation:

$$Y_{idst} = \gamma_0 + \gamma_1(T11_t * Phase3_d) + \sum_{k=1,\dots,5} \gamma_{2s}(T11_t * AEZk_s)$$
$$+\gamma_3 X_{idst} + \gamma_4 Z_{dt} + \{\mu_d\} + \varphi_{idst} \qquad (2)$$

where the subscripts are as defined in equation (1). In this specification, t is either 2007/8 or 2011/2. $T11$ is a dummy variable for the year 2011/12, and *Phase3* is a dummy variable for Phase III districts. All other variables are defined similarly as in equation (1). γ_1 is the DIDM impact estimator for Phase III districts under full implementation.

Another issue is that intensity of implementation of the scheme in Phase I and II districts could itself vary in moving from 2007/8 to 2011/12. This would also confound the effect of the scheme on Phase III districts under full implementation. We find that this is not the case: for the top 3 states in Phase I and II, 1.7 percent of time was spent in public works in 2007/8 and

homogenous group of districts with similar cropping pattern that falls within a single AEZ (Saxena, Pal, and Joshi 2001).

[21]For specifications using the crop-wage dataset, the covariates are shares of: SC/STs, illiterates, currently married, Muslims and average age and age squared, all at the district level.

[22]Monthly rainfall at the district level for the period from 1999/2000 to 2007/8 was obtained from International Crop Research Institute for Semi-Arid Tropics, ICRISAT, Hyderabad, and for the remaining years from Indian Meteorological Department, Government of India.

[23]For the agricultural wage outcome in the crop-wage dataset, *Z* also includes the proportion of SC/ST population and the literacy rate, both at the district level.

1.9 percent in 2011/12. For all India, the corresponding figures are 1.0 percent in 2007/8 and 1.3 percent in 2011/12.

5. Impact on Gross Irrigated Area, Agricultural Wages, Cropping Patterns and Crop Yields using Crop-wage dataset

Before we present the impact estimates we discuss some summary statistics.

5.1. Summary Statistics

Table 2 presents the average share of gross irrigated area in total cropped area. As expected, in 2004/5, the average share of gross irrigated area in Phase I and II districts is lower than that in Phase III districts by 10 percentage points. This difference is maintained in subsequent years as well and continues to persist in 2009/10 even when the scheme was fully implemented in the country.

Turning to real agricultural wages, in Table 3 we see that agricultural wages in Phase I and II districts were lower than those in Phase III districts, in all three years: This is true for both men and women, and in both the dry and the rainy seasons: the difference ranges from 7 to 9 rupees per day for women and from 14 to 20 rupees per day for men (in 2004/5 prices).[24]

Table 4 presents the seasonal cropping patterns (crop shares in total cropped area) for each of the top three states, separately for Phase I and II and for Phase III districts. Within a state-season, we restrict ourselves to studying the set of at most five crops with the largest crop acreages that together cover at least 90 percent of total cropped area between 2000/1 and 2005/6. Crops shares in Phase I and II districts are similar to those in Phase III districts in Rajasthan, but are somewhat different in Andhra Pradesh and Madhya Pradesh. This raises some concerns about whether cropping patterns are comparable across the two sets of districts in these two states.

Table 5 presents similar summary statistics for crop yields, which indicate that, as expected, crop yields are typically lower (or statistically no different) in Phase I and II districts compared to Phase III districts.

24 Note that generating a balanced panel across all three years would have resulted in a loss of several observations and for this reason, the sample sizes are smaller for 2004/5. This means that impact estimates computed later in Table 7 for impact under partial implementation are based on a smaller sample size than those for full implementation; the estimation sample under each is however a balanced panel.

5.2. Impact on Gross Irrigated Area

Table 6 presents the DIDM impact estimates for the share of gross irrigated area in total cropped area.[25] We do not find differences in pre-program changes between 2000/1 and 2004/5 in the share of gross irrigated area between the two sets of matched districts which raises the credibility of our estimates.

At the all-India level and for the top three states, we find an adverse impact of MGNREGA on share of gross irrigated area with impact magnitudes being larger for the top three states. For the top three states under partial implementation, we find that because of the scheme the share of gross irrigated area grew at a rate that was 16 percentage points (p.p.) lower in Phase I and II (i.e. treated) districts between 2004/5 and 2007/8. Under full implementation also, we find that MGNREGA resulted in a smaller growth (lower by 17 p.p.) in the share of gross irrigated area in Phase III districts between 2007/8 and 2009/10. Thus, in spite of the scheme's focus on water works, it did not manifest as an increase in gross irrigated area. These results are contrary to expectation. A plausible explanation for the results under full implementation, is that the effect of MGNREGA on gross irrigated area appears with a lag. In other words, water works implemented under the scheme are ineffective in increasing gross irrigated area initially, but improvements to existing infrastructure make these investments effective in raising gross irrigated area subsequently. For example, Kareemulla et al. (2009) report in their study that although ponds and water reservoirs got built, the connecting channels to plots of land were only constructed later on. If this is indeed the case, then from 2007/8 to 2009/10, when MGNREGA is being implemented for the first time in Phase III districts and is continuing in Phase I and II districts, the scheme would result in higher growth in gross irrigated area in Phase I and II districts relative to Phase III districts. None of these results preclude the possibility that MGNREGA may have improved the volume of water available for irrigation.

5.3. Impact on Agricultural Wages

Table 7 presents the DIDM estimates of impact on real agricultural wages, disaggregated by gender and by season. As in the case of gross irrigated area we did not find differences in pre-program changes between the two sets of matched districts.

[25]In this discussion, we sometimes refer to share of gross irrigated area in total cropped area as simply the share of gross irrigated area.

At the all-India level, we do not find evidence that male agricultural wages were affected by the scheme. In the top three states under partial implementation in Phase I and II districts, in the dry (off-peak) season, there was no impact of the MGNREGA on male agricultural wages, and it is only in the rainy (peak) season that there is weak evidence (at the 10 percent level of significance) of an increase in agricultural wages for men. Wages for women in the rainy season under partial implementation did increase—the evidence is stronger for the top 3 states than for all-India. There does not have been any impact under full implementation in Phase III districts.

5.4. Impact on Cropping Patterns

Table 8 presents the DID impact estimates for cropping patterns in each of the top three states, separately for kharif and rabi seasons. We do not carry out the matching exercise for impacts on crop shares and crop yields as the number of districts is too small. We italicize impact estimates for outcomes with pre-program trends; these estimates cannot be interpreted to be causal.

In the following paragraphs, we discuss the impacts for each state separately, first for the kharif season and then for the rabi season. As mentioned earlier, the kharif season roughly coincides with the rainy season, while the rabi season with the dry season.

Rajasthan: Looking at the top five crops grown in the state in the kharif season, one expected a shift to lower labour intensive crops if one takes into account that for Phase I and II districts under partial implementation there was a positive impact on agricultural wages in the rainy season, but not on gross irrigated area. However, we do not find evidence for this. For Phase III districts under full implementation, MGNREGA led to a greater increase in soyabean acreage in Phase III districts compared to Phase I and II districts: there is a 2.6 p.p. greater increase in jowar cultivation between 2007/8 and 2009/10. As indicated in Appendix Table C2, jowar has lower labour and about the same water requirements relative to maize, although other competing crops have still lower labour requirements. Thus, this increase in jowar acreage is consistent with an increase in male wages in the rainy season under full implementation (this impact on males wages is significant only at the 10 percent level of significance). In the rabi season, under partial implementation, MGNREGA adversely affected wheat: Between 2004/5 and 2007/8, the scheme resulted in a 11.7 p.p. lower increase in wheat area share. As indicated in Appendix Table C2, wheat is more labour intensive than other competing crops. We

conjecture that crop acreage under wheat may have been adversely impacted in Phase I and II districts not directly by an increase in the agricultural wage rates in the dry season (as there was no positive impact on agricultural wages in the top three states in this season), but that the announcement of the MGNREGA and the subsequent increase in agricultural wages in the kharif season translated into an expectation of similar increases in the rabi season and thus altered crop choices. For Phase III districts under full implementation, MGNREGA resulted in a 7.6 p.p. increase in crop acreage of wheat in Phase III districts relative to Phase I and II districts. Since wheat has higher labour and water requirements compared to most competing crops, this result is clearly not consistent either with the increase in female wages nor with the lower rate of growth in irrigated area in these districts. It is possible that irrigated area is not a good measure of the impact of the MGNREGA, as it may have improved water availability more than irrigated area; however we do not have information on the volume of water. Further, as seen later, there was no impact on wheat yields, which should have increased with improved water availability.

Andhra Pradesh: In the kharif season, we find a positive impact on arhar acreage under partial implementation. As indicated in Appendix Table C2, arhar requires least amount of labour among other competing crops. This result may therefore be explained by an increase in agricultural wages in the rainy season. Among rabi crops, under partial implementation, we find a decline in paddy acreage (21.5 p.p.) accompanied by an increase in urad (15.6 p.p.) in Phase I and II districts.[26] Nagaraj et al. (2016) find a decline in labour use as a consequence of MGNREGA in semi-arid villages of Telangana and Maharashtra. As indicated in Appendix Table C2 that paddy is a very high labour and water intensive crop among competing crops. This result may therefore be explained through a farmer's expectation of wage rise in the dry season after they saw an increase in agricultural wages in rainy season. Under full implementation, we find an increase in acreage of gram. As indicated in Appendix Table C2, gram requires less labour and water among competing crops. Once again, we conjecture that this may have operated through an expectation of increased wages in the rabi season (because of the experience in the kharif season) that did not, in the event, materialize.

[26]Bhaskar (2012) finds a decline in paddy cultivation but he finds switch towards cotton, but here we find switch towards urad.

Madhya Pradesh: For the five kharif crops, there is no evidence of MGNREGA affecting crop shares under partial implementation. Under full implementation, we find an increase in jowar acreage in Phase III districts relative to Phase I and II districts. As seen from the Appendix Table C2, jowar is more water- and labour-intensive as compared to soyabean which is the main crop in Madhya Pradesh. Once again, this is contrary to expectations given the increased wages for men (significant at the 10 percent level) and lower increase in irrigated area in Phase III districts relative to Phase I districts under full implementation. There is no evidence of impact on rabi cropping patterns, neither under full, nor partial implementation.

Thus from a food security point of view, with the main crops, there is evidence that although the MGNREGA adversely affected wheat area in Rajasthan initially it subsequently increased under full implementation in Phase III districts. This represents a switch initially towards less labour-intensive and later to more water-intensive crops and cannot be explained fully through the two channels since the rate of increase in irrigated area in Phase III districts was lower than in Phase I and II districts. There is evidence of a switch away from paddy to urad in Andhra Pradesh, which is consistent with expectations.

5.5. Impact on Crop Yields

Table 9 presents the DID impact estimates for crop yields in each of the top three states, separately for kharif and rabi seasons. The crops considered are the same as those discussed in Table 8.

Rajasthan: During the kharif season, MGNREGA had a negative impact on the rate of growth in soyabean yields for Phase III districts relative to Phase I and II districts under full implementation. Other than this, there is no evidence that MGNREGA had any impact on yields of other major crops in either the kharif or the rabi season for both sets of districts.

Andhra Pradesh: Under partial implementation, in the kharif season, there is a positive impact on the rate of growth in groundnut yield, and a negative impact on arhar yields growth in Phase I and II districts relative to Phase III districts. There was no impact under full implementation in the kharif season. In the rabi season a negative impact is observed for groundnut yield in Phase III districts under full implementation.

Madhya Pradesh: In the rabi season, under partial implementation, there is a positive impact on wheat yield in Phase I and II districts relative to Phase III districts.

To sum up, we find evidence of a positive impact on yield growth of groundnut (in kharif under partial implementation in Andhra Pradesh) and wheat (in rabi under partial in Madhya Pradesh). However, we find an adverse impact on yields of soyabean (in kharif under full in Rajasthan), arhar (kharif under partial in Andhra Pradesh), groundnut (in rabi under full in Andhra Pradesh). It is perhaps worth reiterating that these negative coefficients do not imply that yield growth was negative, but rather that the rate of growth in (say) Phase III districts was lower than that in Phase I and II districts. These negative estimates are not consistent with what one might have expected if there had been a substantial improvement in the availability of water for irrigation.

6. Impact on Casual Wages and Employment using EUS dataset

6.1. Summary Statistics

Table 10 shows summary statistics for real wages by gender. Wages for females are lower than that for males in all years and across sector-contract types. As might be expected, there are substantial differences in wages across sectors and contract types. In 2004/5, before MGNREGA was implemented, in Phase I and II districts, wages in public works were higher than wages in casual agriculture and casual non-agriculture for both males and females. For Phase III districts, wages in public works were higher to wages in casual agriculture for both males and females. These differences in wage rates across sectors suggests that once MGNREGA is instituted, there might be a greater incentive to shift to public works from contract types where wages are lower. Additionally, for regular workers who are on long-term contracts, the difference would need to be large enough to compensate for the short term nature of employment that MGNREGA offers. We therefore expect to see the largest impact on casual workers. By 2011/12, for males in Phase I and II, and Phase III districts, casual wages in agriculture over shot public wages. For women, the difference between wages for casual work in agriculture and public works narrowed considerably by 2011/12 in both sets of districts.

Tables 11.1 and 11.2 present the average time shares across ten mutually exclusive and exhaustive categories of labour market participation for the target population for males and females, respectively. For males, in 2004/5, the top two categories according to time shares are self-employment in agriculture (36.8 percent) and casual labour in agriculture (15.3 percent). For females, in the same year, these are domestic work (56.3 percent) and self-employment in agriculture (19.2 percent). Thus, there is a significant difference in what men and women do with their time. Public works accounts for a relatively small share of peoples' time in rural

areas. For males, the time shares in public works are 0.2 percent in 2004/5, 0.7 in 2007/8 and 1.2 in 2011/12 (for females these figures are 0.1, 0.5 and 1.0, respectively). Over the years, the increase in time spent on public works is small in absolute terms, this is still a substantial increase when viewed in light of initial shares in 2004/5, and presumably is a reflection of increasing implementation of MGNREGA. That the absolute share of time spent in public works is small limits its potential to cause major changes in time shares in other categories. This needs to be kept in mind while interpreting the ability of MGNREGA to influence labour market outcomes.

For both males and females, share of time spent as casual labour in agriculture increased during the period from 2004/5 to 2007/8, (for males, from 15.3 percent to 17.3 percent), and then decreased from 2007/8 to 2011/12 (for males, from 17.3 percent to 15.1 percent). Between 2004/5 and 2011/12 the most remarkable status shifts for the males have been for the self-employed in agriculture, and for casual labour in non-agriculture categories: over this period, the share of time spent in self-employment in agriculture decreased (from 36.8 percent to 32.7 percent) and the share of time spent in casual labour in non-agriculture went up (from 7.6 percent to 11.4 percent). For the females over this period, the most remarkable change has been an increase in share of time spent in domestic works (from 56.3 percent to 64.9 percent).

Appendix Table C3 presents evidence on the seasonality in MGNREGA implementation. It reports time shares spent by casual labour in public works, private agriculture, and private non-agriculture in 2007/8, in the dry and rainy seasons. Employment shares in public works in the dry season exceed that in the rainy season in almost all the states. For all states taken together, the average time share of casual labour in public works was 0.9 percent in the dry season, while it was 0.4 percent in the rainy season. When we look at casual labour in private agriculture, it was 11.5 and 12.5 in the dry and rainy seasons, respectively. As mentioned earlier, the rainy season corresponds loosely to the peak season, and this is therefore suggestive of counter seasonality in MGNREGA employment in most states. Based on this, one would expect there to be a greater impact of MGNREGA in the dry season relative to the rainy season.

Given differences in impact depending on whether the top three states or all-India estimates are considered, we discuss these two levels of aggregation separately. And given the focus of this paper, we mainly interpret labour market impacts on the agricultural sector, which is also

the single largest employer in rural areas (although estimated coefficients for the non-agricultural sector are also presented in the tables).

6.2. Results for the Top 3 States

6.2.1. Impact on Casual Wages

Table 12.1 presents the DIDM estimates of the effect of MGNREGA on casual wages in agriculture and casual wages in non-agriculture. In agriculture, for men, there was no impact on casual wages in any season under both partial nor full implementation. For women, MGNREGA led to an increase in casual wages in agriculture in rainy season both under partial implementation (16.1 p.p.) and under full implementation (26 p.p.). There was however no impact on female wages in agriculture in the dry season.

These estimates computed using EUS data are not consistent with the impact estimates computed for wages from Agricultural Wages in India presented in Table 7. Clearly the choice of data set matters to inferences on impact on wages.

In the non-agricultural sector there was an increase in wages of 16.1 p.p. for men in Phase I and II districts relative to Phase III districts in the rainy season under partial implementation, and there was an adverse impact on wages for men in Phase III districts in the dry season; all other impact estimates are either insignificant or were subject to significant differences in pre-program trends.

6.2.2. Impact on Employment Time Shares

Tables 12.2 and 12.3 present DIDM estimates of the effect of MGNREGA on time shares spent across the ten categories of labour market participation for the four gender-season combinations, namely, male-rainy, male-dry, female-rainy and female-dry. The average time shares in each category are also given (the rows for average shares add up to one). The impact estimates refer to difference in change in time shares between treated and control districts over the comparison years. Thus, the rows add up to zero.

Males: In the rainy season, there was no impact on the changes in time shares of employment in agriculture neither under partial nor under full implementation. There was a greater increase

in the time share in public works (by 1.5 p.p.) in Phase I and II districts under partial implementation. Note that, if the expectation that much of the increase in public works would take place in the dry season is met, the consequences for casual contract work in agriculture (and non-agriculture) would also be more pronounced in this season, at least for men, who constitute much of the rural labour force. This does seem to have happened. As noted in Table 12.2, in the dry season, under partial implementation, there is some evidence that in the agricultural sector, the change in time shares of casual labour contracts decreased by 8.4 p.p. and of regular work by 1.1 p.p.; at the same time, MGNREGA led to a significant increase in the time share spent in self-employed in agriculture (12.4 p.p.): this may have been driven by the expectation on wage increases (that in the event did not materialize over and above trends in the counterfactual districts) that caused some substitution from casual labour toward self-employment. Although the coefficient on public works time share is positive, we do not interpret it as there is evidence of differential pre-programme trends. Under full implementation, we once again see the shift toward reliance on self (or family) labour (increase by 9.9 p.p.).

Females: As indicated in Table 12.3, we are unable to comment on time shares employed in public work for women in the rainy season, either in partial or full implementation because of the presence of differences in pre-programme trends. Under partial implementation, the MGNREGA resulted in a smaller increase in casual work in agriculture (6.4 p.p.) and in not in the labour force (2.7 p.p.) categories, accompanied by a significant increase in time spent in domestic works (11.5 p.p). Under full implementation, there was a smaller increase (of 0.3 p.p.) in regular-employment in agriculture; however there is very little employment of women in regular contracts in agriculture.

Thus, in the rainy season, which roughly corresponds to the peak season, for Phase I and II districts under partial implementation and, for females, the scheme led to a decline in casual labour in agriculture accompanied by an increase in domestic works and not in labour force. In contrast, as indicated in Table 12.3, in the dry season, under partial implementation, we see the expected increase in the share of time spent in public works (by 2.8 p.p.). The increase in public works was accompanied by a decrease in time spent unemployed (4.7 p.p.) and an increase in casual labour in non-agriculture. Under full implementation there was no significant difference in change in the time share of public works between Phase III and matched Phase I and II districts, but there was an increased reliance on self-employment in agriculture (increase of 9

p.p.), which seems to have come largely at the expense of time spent in domestic work (decrease of 13.8 p.p.). These results seem to suggest that in the latter period, MGNREGA has a positive impact especially on females by reducing unemployment and increasing public works participation.

6.3. Results at the All India Level

As compared to the impact of the MGNREGA on the top three performing states, impact at the all-India level is far more muted and is difficult to interpret. First, by and large, as indicated in Table 13.1 shows that under full implementation, the only significant coefficient is that associated with women in the dry season, where the rate of growth in wages for women seems to have been lowered in the Phase III districts.

In the rainy season, as indicated in Table 13.2, male time shares in public works increased in Phase I and II districts under partial implementation, and even after expansion of the MGNREGA to Phase III districts, the increase in public works employment was greater in Phase I and II districts. Time shares of self-employment in agriculture decreased in partial implementation, compensated by an increase that of regular employment. For women, as indicated in Table 13.3, there was an increase in public works under partial (but not full) implementation.

In the dry season, as indicated in Table 13.2, for men, there is no evidence of impact on public works, but employment shares in casual work in agriculture declined both in partial and full implementation. For women, as indicated in Table 13.3, there was an increase in public works employment under partial implementation (and no difference between Phase I and II and Phase III districts under full implementation) but there was no adverse impact as a consequence on employment time shares in agriculture (the coefficients all positive).

Some of our results are in sharp contrast to those found by Imbert and Papp (2015). For instance, they find that casual wages in the dry season increased, this is unlike the case here, but they aggregate across the agriculture and non-agriculture sectors. The main differences lie in our results on employment, where they find an unambiguous negative impact on private sector employment. In addition to a somewhat different definition of employment they use (making a direct comparison difficult), an important reason why our results vary from theirs is

that they aggregate not only across sectors but also across contract types; and the specification used to estimate impact also varies. Thus a more disaggregated analysis by type of contracts yields a less clear picture.[27]

7. Conclusions

Increased wages and irrigation were the two main channels by which the MGNREGA was expected to have influenced cropping patterns and yields, estimating the magnitude of which was our first objective.

The results for the top three states, using the Crop-Wage data set, suggest an increase in wages for men in agriculture in across both the partial and full implementation periods but only in the rainy season. But this is not corroborated fully by the EUS data set for these states, which shows that there was no impact on casual wages in agriculture for men. As far as impact on gross irrigated area is concerned, the scheme seems to have had a positive impact with a lag.

Turning to cropping patterns, our estimates suggest that MGNREGA adversely affected wheat area in Rajasthan in Phase I and II districts under partial implementation but later increased in Phase III districts under full implementation. Thus, partial implementation saw cropping pattern shift mainly towards labour-saving crops, while full implementation saw a shift towards a water-intensive crop. As noted earlier, we conjecture that cropping pattern choices may have been made in anticipation of wage increases seen in the kharif season, that did not then materialize; and water availability did improve relatively in the latter period in Phase I and II districts. In Andhra Pradesh, the switch from paddy to urad is consistent with expectations; there was no discernable or meaningful impact in Madhya Pradesh.

[27] To test to what extent choice of specification matters to our results, we attempt an alternative specification. This alternative is motivated by the differential agriculture and labour market growth trends across states since 2004. Mahajan (2014) accounts for these differential trends by including the interaction of state and time dummies, and finds an insignificant impact of MGNREGA on labour market outcomes. We also follow this approach—that is, add the interaction of state and time dummies as additional controls in our specifications—and see whether our results change. The results are broadly similar to those presented earlier. Our main results on gross irrigated area and agricultural wages also don't change. Similarly, estimates of impact on casual wages and time shares are, in most cases, qualitatively the same as our main specification. Results from these exercises are available with the authors. Finally, these results are also robust to choice of other weighting methods such as nearest-neighbour matching used to match districts (results not presented for reasons of space).

Furthermore, there is no systematic evidence of improvement in crop yields in these three states, although the scheme has a positive impact on groundnut yield in Andhra Pradesh, and on wheat yields in Madhya Pradesh.

The second objective of the paper was to assess the impact of MGNREGA on employment and wages, disaggregated by sectors (agriculture and non-agriculture), and by gender. In the top three performing states, where impacts should have been more readily discernable, our results show that for men under partial and full implementation, there are no differential changes in employment shares in agriculture in the rainy season; this is consistent with the lower amounts of public works in this season. Impact is only seen in the dry season, with a negative impact on casual labour in agriculture under partial and a positive impact on self-employment under both partial and full; our conjecture once again is that this may have driven expectations of wage increase; although the rainy season EUS data do not indicate any increase. For women, a negative impact on casual labour employment is seen only in the rainy season. As far as impact on employment at the all-India level is concerned, under partial implementation, time shares in public works increased for women in both seasons. For men we find evidence of an increase only in the rainy season. There was also a decline in casual labour in agriculture for males in dry season in Phase I and II districts. Under full implementation, in the rainy season, there was a greater participation in public works only for men in Phase I and II districts; however, in the dry season, there was a greater increase in casual labour in agriculture for males. Thus, there does not seem to be any strong evidence of crowding out of employment in agriculture by public works.

The top three states also saw an increase in male wages in the rainy according to the AWI data (but not in the EUS data) under partial implementation. The all-India evidence also does not suggest any positive impact of the MGNREGA on agricultural wages for both genders, and for both seasons, under partial implementation. This is contrary to the findings by Azam (2012) and Imbert and Papp (2015), but consistent with Zimmermann (2015); we try and provide some explanations for why our results are different above. Under full implementation, however there was a greater increase in agricultural wages for females in Phase I and II districts, indicating that the program's impact could be seen only when it became more widespread.

Thus there are differences in impacts by season, phase of implementation and gender. We believe that given the segmented nature of the rural labour market, a more disaggregated

analysis, such as the one presented here, is most appropriate for analysing the impact of the MGNREGA. Overall, our results suggest that fears that the MGNREGA may have adverse impacts on the costs of agricultural labour are not well-founded; however, the expected benefits in terms of an increase in irrigated area and yields as a consequence of the investments made in water systems are yet to materialize in a substantial way.

References

Afridi, F., A. Mukhopadhaya., and S. Sahoo. 2016. "Female Labor Force Participation and Child Education in India: Evidence from the National Rural Employment Guarantee Scheme." *IZA Journal of Labour & Development* (2016) 5:7.

Aggarawal, A., A. Gupta, and G. Kumar. 2012. "Evaluation of NREGA Wells in Jharkhand." *Economic and Political Weekly* 47(35): 24-27.

Azam, M. 2012. *The Impact of Indian Job Guarantee Scheme on Labor Market Outcomes: Evidence from a Natural Experiment*. IZA Discussion Paper 6548. Bonn, Germany: Institute for the Study of Labor.

Basu, Arnab K., Nancy H. Chau, and Ravi Kanbur. 2010. "Turning a Blind Eye: Costly Enforcement, Credible Commitment and Minimum Wage Laws." *The Economic Journal* 120, no. 543 (2010): 244-269.

Berg, E., S. Bhattacharyya, R. Durgam, and M. Ramachandra. 2015. *Can Public Works Increase Equilibrium Wages? Evidence from India's National Rural Employment Guarantee.* Working Paper 2015. Bristol, UK: University of Bristol.

Bhargava, A. 2014. *The Impact of India's Rural Employment Guarantee on Demand for Agricultural Technology.* Working Paper. Davis, USA: University of California.

Bhaskar, B. 2012. "Farmers switching from paddy to cotton." *The Hindu*, June 23.

Bhatia, Raag, Shonar L. Chinoy, Bharat Kaushish, Jyotsna Puri, Vijit S. Chahar and Hugh Waddington. 2016. *Examining the evidence on the effectiveness of India's rural employment guarantee act.* Working Paper 27. International Initiative for Impact Evaluation.

CSE (Centre for Science and Environment). 2008. *An Assessment of the Performance the National Rural Employment guarantee in terms of its potential for creation of Natural wealth in villages*. New Delhi.

Deininger, K., and Y. Liu. 2013. *Welfare and Poverty Impacts of India's National Rural Employment Guarantee Scheme: Evidence from Andhra Pradesh.* IFPRI Discussion Paper 01289. Washington, DC: International Food Policy Research Institute.

Dutta, P., R. Murgai, M. Ravallion, and D.V.D. Walle. 2012. "Does India's Employment Guarantee Scheme Guarantee Employment." *Economic and Political Weekly* 47(16): 55-64.

Gehrke, E. 2014. *An employment guarantee at risk insurance? Assessing the effects of the NREGS on agricultural production decisions.* BGPE Discussion Paper No. 152. Germany, Nuremberg: Bavarian Graduate Program in Economics.

GOI (Government of India). 2005. *The National Rural Employment Guarantee Act: The Gazette of India, Extraordinary.* New Delhi: Government of India.

Gupta, S. 2006. "Were District Choices for NFFWP Appropriate?" *Journal of Indian School of Political of Political Economy* 18(4): 641-648.

Heckman, J., H. Ichimura, and P. E. Todd. 1997. "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme." *The Review of Economic Studies* 64(4) : 604-654

Imbert, C., and J. Papp. 2015. "Labor Market Effects of Social Programs: Evidence from India's Employment Guarantee." *American Economic Journal: Applied Economics* 2015, 7(2): 233–263.

IIFM (Indian Institute of Forest Management). 2010. *Impact assessment of NREGA activities for Ecological and Economic Security*. Bhopal.

IISc (Indian Institute of Science). 2013. *Environmental Benefits and Vulnerability Reduction through Mahatma Gandhi National Rural Employment Guarantee Scheme.* Bangalore.

Jha, R., R. Gaiha, and M. Pandey. 2009. "Net Transfer Benefits under India's National Rural Employment Guarantee Scheme." *Journal of Policy Modelling* 34: 296-311.

Kareemulla, K., K. S. Reddy, C. A. R. Rao, S. Kumar, B. Venkateswarlu. 2009. "Soil and Water Conservation Works through National Rural Employment Guarantee Scheme in Andhra Pradesh-Analysis of Livelihood Impact." *Agricultural Economics Research Review* 22: 443-50.

Khera, R., and N. Nayak. 2009. "Women Workers and perceptions of the National rural employment Guarantee act." *Economic and Political Weekly* 44(43): 49-57.

Liu, U., and C.B. Barrett. 2013. "Heterogenous Pro-Poor Targeting in the National Rural Employment Guarantee Scheme." *Economic and Political Weekly* 48(10): 46-53.

Mahajan, K. 2014. "Farm wages and public works: How robust are the impacts of national rural employment guarantee scheme?" *Indian Growth and Development Review* Vol. 8 No. 1, 2015 pp. 19-72

MORD (Ministry of Rural Development). 2012. *MGNREGA Sameeksha: An Anthology of Research Studies on the Mahatma Gandhi National Rural Employment Guarantee Act, 2005, 2006–2012*. Government of India. New Delhi.

Nagaraj, N and Bantilan, C and Pandey, L and Roy, N S. 2016. "*Impact of MGNREGA on Rural Agricultural Wages, Farm Productivity and Net Returns: An Economic Analysis Across SAT Villages." Indian Journal of Agricultural Economics* Vol. 71 (02), pp. 176-190.

NSSO (National Sample of Survey Organization) 2006. *Employment and Unemployment Situation in India, 2004-05 (Part-I)*. Technical Report. Ministry of Statistics and Programme Implementation, Government of India. New Delhi.

Rangarajan, C., P.I. Kaul, and Seema. 2011. “Where is the missing labour force?” *Economic and Political Weekly* 46 (39): 68-72.

Ravi, S., and M. Engler. 2015. “Workfare as an Effective Way to Fight Poverty: The Case of India’s NREGS.” *World Development* Vol. 67, pp. 57–71.

Rani, Uma, and Patrick Belser. 2012 "The effectiveness of minimum wages in developing countries: The case of India." *International Journal of Labour Research* 4, no. 1 (2012): 45-66.

Rosenzweig, Mark R. 1978. "Rural wages, labor supply, and land reform: A theoretical and empirical analysis." *The American Economic Review* (1978): 847-861.

Saxena, R., S. Pal, and P.K. Joshi. 2001. *Delineation and Characterisation of Agro-Eco Region.* Task Force on Prioritization, Monitoring and Evaluation 6. New Delhi: Indian Council of Agricultural Research

Sheahan, M., Liu, Y., Narayanan, S., and Barrett, C. B. 2016. *Disaggregated labor supply implications of guaranteed employment in India.* Boston, Massachusetts (No. 237345): Agricultural and Applied Economics Association.

Singh, J., and J.V. Meenakshi. 2004. “Understanding the Feminisation of Agricultural Labour.” *Indian Journal of Agricultural Economics* 59(1): 1-17.

Shah, V. 2012. *Managing Productivity Risk through Employment Guarantees: Evidence from India.* Working Paper. Hyderabad: Indian School of Business.

Sukhtantar, S. 2016. India's National Rural Employment Guarantee Scheme: What Do We Really Know about the World's Largest Workfare Program? Working Paper.

Tiwari, R., H.I. Somashekhar, V.R. Ramakrishna Parama, I.K. Murthy, M.S. Mohan Kumar, B.K.Mohan Kumar, H. Parate, M. Varma, S. Malaviya, A.S. Rao, A. Sengupta, R. Kattumuri, N.H. Ravindranath. 2011. “MGNREGA for environmental service enhancement and vulnerability reduction: Rapid appraisal in Chitradurga district.” *Economic and Political Weekly* 46(20): 39-47.

Uppal, V. 2009. “Is the NREGS a Safety Net for Children? Studying the access to the National Rural Employment Guarantee Scheme for Young Lives families, and its impact on child outcomes in Andhra Pradesh.” Master of Science (M.Sc) Thesis, Economics for Development, University of Oxford, United Kingdom.

Verma, S., and T. Shah. 2012. “Beyond Digging and Filling Holes: Lessons from Case Studies of Best-performing MGNREGA water assets.” Water Policy Research Highlight: International Water Management Institute (IWMI) - TATA Water Policy Program.

Zimmermann, L. 2015. *Why Guarantee Employment? Evidence from a Large Indian Public-Works Program.* Working Paper. Georgia, USA: University of Georgia

Table 1: Ranking of States according to MGNREGA Implementation in 2008/9 and 2009/10

State	Intensity	Coverage	Index	Rank
Rajasthan	72.4	0.79	57.2	1
Andhra Pradesh	61.1	0.56	34.2	2
Madhya Pradesh	55.2	0.60	33.1	3
Karnataka	52.1	0.52	27.1	4
Chhattisgarh	49.7	0.51	25.3	5
Jharkhand	44.8	0.51	22.8	6
Tamil Nadu	50.4	0.43	21.7	7
Himachal Pradesh	46.6	0.39	18.2	8
Assam	43.4	0.35	15.2	9
Uttar Pradesh	49.9	0.23	11.5	10
Uttaranchal	30.4	0.33	10.0	11
West Bengal	35.3	0.28	9.9	12
Gujarat	36.4	0.21	7.6	13
Kerala	33.8	0.19	6.4	14
Bihar	43.0	0.13	5.6	15
Orissa	24.9	0.22	5.5	16
Punjab	26.7	0.12	3.2	17
Haryana	40.1	0.06	2.4	18
Maharashtra	39.0	0.05	2.0	19
All India	50.4	0.33	16.6	

Notes: Intensity is defined as the average number of person-days of employment provided to each participating household in a year. Coverage is defined the ratio of number of households that received employment through MGNREGA in a year and the total number of rural households. Ranking of states is according to the composite index.
Source: Delivery Monitoring Unit (DMU) reports of MGNREGA (accessed on 15th May 2012)
http://164.100.129.6/Netnrega/mpr_ht/nregampr_dmu.aspx?flag=1&page1=S&month=Latest&fin_year=2008-2009

Table 2: Summary statistics on average share of gross irrigated area in total cropped area

	Average share
2004/5 All India (19 major states)	47
Phase I and II districts (a)	43
Phase III districts (b)	53
Difference (a)-(b)	-10***
2007/8 All India (19 major states)	49
Phase I and II districts (c)	45
Phase III districts (d)	55
Difference (c)-(d)	-10***
2009/10 All India (19 major states)	49
Phase I and II districts (e)	46
Phase III districts (f)	55
Difference (e)-(f)	-9***

Notes: The sample size for Phase I and II districts is 190, while that for Phase III districts is 131.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: Crop-Wage dataset.

Table 3. Summary statistics on average agricultural wages (INR per day in 2004/5 prices)

	Male		Female	
	Rainy season	Dry season	Rainy season	Dry season
2004/5 All India (19 major states)	63	65	44	46
Phase I and II districts (a)	54	56	41	43
Phase III districts (b)	74	76	48	51
Difference (a)-(b)	-20***	-20***	-7***	-8***
2007/8 All India (19 major states)	64	71	48	48
Phase I and II districts (c)	56	65	44	46
Phase III districts (d)	74	79	52	54
Difference (c)-(d)	-18***	-14***	-8***	-8***
2009/10 All India (19 major states)	72	74	53	56
Phase I and II districts (e)	64	66	50	53
Phase III districts (f)	84	86	58	62
Difference (e)-(f)	-20***	-20***	-7***	-9***

Notes: The sample size for Phase I and II districts is 103, while that for Phase III districts is 80; for 2004/5 however, the sample sizes are lower, at 59 and 51 districts, respectively.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: Crop-Wage dataset.

Table 4: Summary statistics on cropping patterns in top 3 states, average share of crop acreage in total cropped area (in percent), 2000/1 to 2005/6

	Kharif season					Rabi season					No. of districts
Rajasthan	Bajra	Maize	Soyabean	Jowar	Moth	Wheat	Mustard	Gram	Barley		
Phase I and II districts (a)	48	13	8	6	3	45	43	11	1		9
Phase III districts (b)	44	11	9	8	8	41	37	16	5		20
Difference (a)-(b)	5	2	-1	-3	-6**	4	5	-5*	-4***		
Andhra Pradesh	Paddy	Groundnut	Cotton	Arhar	Maize	Paddy	Jowar	Urad	Gram	Groundnut	
Phase I and II districts (c)	35	18	15	8	7	35	17	11	13	13	19
Phase III districts (d)	76	2	5	2	2	44	0	29	0	4	3
Difference (c)-(d)	-41***	16*	10**	6**	5*	-9	16***	-18***	13**	9**	
Madhya Pradesh	Soyabean	Paddy	Maize	Jowar	Bajra	Wheat	Gram	Mustard			
Phase I and II districts (e)	30	34	10	9	2	60	27	7			28
Phase III districts (f)	64	10	6	4	9	50	38	11			17
Difference (e)-(f)	-33***	24***	3**	5***	-7***	10***	-10***	-4*			

Notes: These crops together covered at least 90 percent of the total cropped area between 2000/1 and 2005/6, or were the top 5 in acreage, in the state and season.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: Crop-Wage dataset.

Table 5: Summary statistics on crop yields in top 3 states, tonnes per hectare, 2000/1 to 2005/6

	Kharif season					Rabi season					No. of districts
Rajasthan	Bajra	Maize	Soybean	Jowar	Moth	Wheat	Mustard	Gram	Barley		
Phase I and II districts (a)	0.69	1.17	1.04	0.48	.24	2.26	1.00	0.78	2.16		9
Phase III districts (b)	0.75	1.18	1.05	0.50	.20	2.66	1.02	0.76	2.14		20
Difference (a)-(b)	0.06	-0.01	-0.01	-0.04	-0.06	-0.39***	-0.02	0.02	0.02		
Andhra Pradesh	Paddy	Groundnut	Cotton	Arhar	Maize	Paddy	Jowar	Urad	Gram	Groundnut	
Phase I and II districts (c)	2.60	0.85	1.68	0.45	2.77	2.79	1.10	0.49	1.25	1.65	19
Phase III districts (d)	2.44	1.23	2.46	0.48	2.32	3.23	1.61	0.68	1.97	2.16	3
Difference (c)-(d)	0.16	-0.38***	-0.78***	-0.03	0.46	-0.44*	-0.51*	-0.19***	-0.72***	-0.52***	
Madhya Pradesh	Soybean	Paddy	Maize	Jowar	Bajra	Wheat	Gram	Mustard			
Phase I and II districts (e)	0.74	0.74	1.51	0.90	0.75	1.40	0.80	0.53			28
Phase III districts (f)	1.00	0.89	1.84	1.23	1.11	2.05	0.93	0.84			17
Difference (e)-(f)	-0.26***	-0.15*	-0.33***	-0.33***	-0.36***	-0.65***	-0.13***	-0.30***			

Notes: These crops together covered at least 90 percent of the total cropped area between 2000/1 and 2005/6, or were the top 5 in acreage, in the state and season.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: Crop-Wage dataset.

Table 6: Difference in rates of growth in share of gross irrigated area in total cropped area between treatment and control districts

	All India		Top 3 states	
	Difference in rates of growth (in percentage points over time)	No. of districts in common support	Difference in rates of growth (in percentage points over time)	No. of districts in common support
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.06** (0.02)	288	-0.16** (0.06)	56
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.08** (0.03)	288	-0.17** (0.08)	56

Notes: The top 3 states are Rajasthan, Andhra Pradesh and Madhya Pradesh.
The dependent variable is the logarithm of the share of gross irrigated area in total cropped area.
Figures in bold and italics (if any) are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Robust standard errors in parentheses.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: Computed from the Crop-Wage data set.

Table 7: Difference (in percentage points over time) in rates of growth in real agricultural wage between treatment and control districts

	Male		Female	
	Rainy season	Dry season	Rainy season	Dry season
All India				
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.01 (0.04)	0.02 (0.04)	0.03 (0.05)	0.01 (0.05)
No. of districts in common support	67	58	52	54
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.03 (0.04)	0.03 (0.03)	0.05* (0.03)	0.01 (0.02)
No. of districts in common support	168	114	116	90
Top 3 states				
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.21* (0.12)	0.08 (0.08)	0.57*** (0.14)	na
No. of districts in common support	33	16	18	
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.01 (0.03)	-0.03 (0.03)	0.02 -0.06	-0.07 -0.06
No. of districts in common support	51	33	29	31

Notes: Top 3 states are Rajasthan, Andhra Pradesh and Madhya Pradesh.
The dependent variable is the logarithm of real agricultural wage.
Figures in bold and italics (if any) are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Robust standard errors in parentheses.
*significant at 10%; ** significant at 5%; ***significant at 1%.
Sample districts vary by gender and season.

Source: Computed from the Crop-Wage data set.

Table 8: Difference (in percentage points) in change in crop shares between treatment and control districts for top 3 states

Rajasthan					
Kharif season	Bajra	Maize	Soyabean	Jowar	Moth
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.009*** ***(0.020)***	0.006 (.029)	-0.007 (.018)	0.025 (.018)	0.001 (0.013)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***0.003*** ***(0.019)***	-0.016 (0.017)	-0.016 (0.012)	0.026*** (0.006)	0.003 (0.006)
Rabi season	Wheat	Mustard	Gram	Barley	
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.117** (0.038)	0.064 (0.047)	***0.087**** ***(0.032)***	***-0.029**** ***(0.009)***	
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.076** (0.023)	-0.042 (0.032)	***-0.063**** ***(0.020)***	***0.025**** ***(0.013)***	
Andhra Pradesh					
Kharif season	Paddy	Groundnut	Cotton	Arhar	Maize
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.016*** ***(0.031)***	-0.012 (0.016)	-0.034 (0.035)	0.019** (0.009)	0.017 (0.017)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***-0.018*** ***(0.057)***	-0.024 (0.019)	-0.029 (0.040)	0.003 (0.013)	-0.012 (0.017)
Rabi season	Paddy	Jowar	Urad	Gram	Groundnut
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.215** (0.062)	0.002 (0.054)	0.156** (0.057)	-0.006 (0.030)	0.004 (0.051)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.129 (0.083)	-0.037 (0.024)	0.092 (0.060)	0.059** (0.023)	-0.003 (0.021)
Madhya Pradesh					
Kharif season	Soyabean	Paddy	Maize	Jowar	Bajra
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.028 (0.038)	-0.023 (0.017)	0.011* (0.006)	0.008 (0.011)	0.013 (0.010)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.024 (0.025)	0.017 (0.026)	-0.004 (0.004)	0.016** (0.006)	0.009 (0.006)
Rabi season	Wheat	Gram	Mustard		
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.035**** ***(0.019)***	-0.007 (0.014)	***0.038**** ***(0.021)***		
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***-0.005*** ***(0.021)***	0.011 (0.021)	***-0.008*** ***(0.007)***		

Notes: These crops together covered at least 90 percent of the total cropped area between 2000/1 and 2005/6, or were the top 5 in acreage, in the state and season.

The dependent variable is the share of crop acreage in the total cropped area.

Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.

There are 29 districts in the state of Rajasthan: 20 districts are Phase I and II and 9 districts are Phase III districts. There are 22 districts in the state of Andhra Pradesh: 19 districts are Phase I and II and 3 districts are Phase III districts. There are 45 districts in the state of Madhya Pradesh: 28 districts are Phase I and II and 17 districts are Phase III districts.

Robust standard errors in parentheses.

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

Source: Computed from the Crop-Wage dataset.

Table 9: Difference (in percentage points over time) in rates of growth in crop yields between treatment and control districts

Rajasthan					
Kharif season	Bajra	Maize	Soyabean	Jowar	Moth
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.33**** ***(0.12)***	-0.08 (0.11)	0.12 (0.12)	-0.54* (0.28)	***1.05**** ***(0.39)***
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***-0.46*** ***(0.59)***	-0.46 (0.30)	-0.22** (0.10)	-0.38 (0.92)	***0.18*** ***(0.58)***
Rabi season	Wheat	Mustard	Gram	Barley	
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.00 (0.10)	0.23 (0.14)	-0.02 (0.16)	0.03 (0.08)	
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.04 (0.07)	0.13 (0.20)	0.17 (0.18)	0.07 (0.12)	
Andhra Pradesh					
Kharif season	Paddy	Groundnut	Cotton	Arhar	Maize
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.02 (0.08)	0.84*** (0.01)	-0.07 (0.34)	-0.65** (0.27)	0.05 (0.27)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.04 (0.12)	-0.19 (0.50)	-0.24 (0.30)	-0.18 (0.30)	-0.16 (0.37)
Rabi season	Paddy	Jowar	Urad	Gram	Groundnut
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.12 (0.09)	na	***-0.49**** ***(0.17)***	na	0.21* (0.11)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.14 (0.09)	na	***-0.27*** ***(0.32)***	na	-0.19** (0.09)
Madhya Pradesh					
Kharif season	Soyabean	Paddy	Maize	Jowar	Bajra
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.10 (0.12)	-0.05 (0.14)	0.12 (0.08)	***0.09*** ***(0.07)***	***-0.13*** ***(0.10)***
Impact (γ_1 in equation 2) on Phase III districts under full implementation	-0.10 (0.09)	0.14 (0.30)	-0.01 (0.06)	***0.03*** ***(0.09)***	***0.46*** ***(0.46)***
Rabi season	Wheat	Gram	Mustard		
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.21** (0.07)	0.06 (0.07)	0.14* (0.08)		
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.07 (0.07)	0.06 (0.07)	-0.06 (0.06)		

Notes: These crops together covered at least 90 percent of the total cropped area between 2000/1 and 2005/6, or were the top 5 in acreage, in the state and season.
The dependent variable is the logarithm of crop yield.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
There are 29 districts in the state of Rajasthan: 20 districts are Phase I and II and 9 districts are Phase III districts. There are 22 districts in the state of Andhra Pradesh: 19 districts are Phase I and II and 3 districts are Phase III districts. There are 45 districts in the state of Madhya Pradesh: 28 districts are Phase I and II and 17 districts are Phase III districts.
"na" means not applicable (as the sample is too small)
Robust standard errors in parentheses.
*significant at 10%; ** significant at 5%; ***significant at 1%

Source: Computed from the Crop-Wage dataset.

Table 10: Summary statistics on real wages (in INR per day in 2004/5 prices)

	Casual agriculture		Casual non-agriculture		Regular agriculture		Regular non-agriculture		Public works	
	Mean	No. of individuals	Mean	No. of individuals	Mean	No. of individuals	Mean	No. of individuals	Mean	No. of individuals
Males										
2004/5 All India (19 States)	49	10748	71	7754	73	818	149	9459	84	177
Phase I and II districts (a)	45	6570	61	4259	78	400	155	4969	98	108
Phase III districts (b)	56	4178	84	3495	68	418	143	4490	61	69
Difference (a)-(b)	-10***		-23***		10**		12***		37	
2007/8 All India (19 States)	55	16721	78	8806	76	691	151	7083	64	739
Phase I and II districts (c)	52	11259	69	5616	68	407	149	3568	63	621
Phase III districts (d)	62	5462	91	3190	86	284	153	3515	68	118
Difference (c)-(d)	-10***		-22***		-17**		-3		-5**	
2011/12 All India (19 States)	74	5168	98	8756	88	273	179	8785	68	755
Phase I and II districts (e)	70	3304	87	5037	88	131	183	4500	68	555
Phase III districts (f)	81	1864	114	3719	89	142	174	4285	66	200
Difference (e)-(f)	-10***		-27***		-1		9**		2	
Females										
2004/5 All India (19 States)	34	7287	45	1331	55	208	89	2146	49	87
Phase I and II districts (a)	32	4589	41	756	58	100	82	1098	48	55
Phase III districts (b)	37	2698	50	575	51	108	96	1048	51	32
Difference (a)-(b)	-4***		-9***		7		-14**		-3	
2007/8 All India (19 States)	40	9752	53	1414	51	141	93	1689	61	434
Phase I and II districts (c)	39	6521	50	931	46	79	92	825	60	360
Phase III districts (d)	42	3231	59	483	59	62	94	864	67	74
Difference (c)-(d)	-3***		-9***		-13		-1		-7***	
2011/12 All India (19 States)	54	3378	65	1037	56	110	113	2046	59	802
Phase I and II districts (e)	53	2080	61	574	63	41	113	1053	58	438
Phase III districts (f)	56	1298	71	463	49	69	113	993	59	364
Difference (e)-(f)	-3***		-10***		14**		0		-1	

Notes: The sample comprises of 484 districts: 277-Phase I and II district and 207-Phase III district.
Wages calculated using current daily activity (CDS) status, expressed in 2004/5 prices
*significant at 10%; ** significant at 5%; ***significant at 1%.
Source: NSS-EUS dataset.

Table 11.1: Summary statistics on time shares (in fractions of unit time) for males

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force	No. of Individuals
	Self	Regular	Casual	Self	Regular	Casual					
2004/5 All India (19 States)	0.368	0.009	0.153	0.145	0.079	0.076	0.002	0.013	0.073	0.081	
Phase I and II districts (a)	0.38	0.008	0.165	0.145	0.064	0.071	0.002	0.016	0.069	0.08	51180
Phase III districts (b)	0.35	0.01	0.135	0.146	0.103	0.083	0.002	0.01	0.078	0.084	36491
Difference (a)-(b)	0.031***	-0.002***	0.030***	-0.001	-0.040***	-0.012***	0	0.006***	-0.009***	-0.004**	
2007/8 All India (19 States)	0.345	0.008	0.173	0.133	0.08	0.084	0.007	0.012	0.074	0.084	
Phase I and II districts (c)	0.351	0.008	0.186	0.132	0.063	0.084	0.01	0.013	0.078	0.075	52532
Phase III districts (d)	0.335	0.009	0.153	0.134	0.106	0.085	0.003	0.011	0.069	0.097	31300
Difference (c)-(d)	0.016***	-0.002**	0.033***	-0.002	-0.042***	-0.001	0.007***	0.003***	0.009***	-0.021***	
2011/12 All India (19 States)	0.327	0.004	0.151	0.138	0.088	0.114	0.012	0.01	0.047	0.109	
Phase I and II districts (e)	0.33	0.004	0.173	0.139	0.07	0.11	0.016	0.01	0.045	0.103	37680
Phase III districts (f)	0.323	0.006	0.117	0.135	0.117	0.119	0.006	0.008	0.051	0.118	26902
Difference (e)-(f)	0.007*	-0.002***	0.056***	0.004	-0.046***	-0.009***	0.010***	0.002**	-0.006***	-0.015***	

Notes: The sample comprises of 484 districts: 277 Phase I and II, and 207 Phase III districts. Time shares have been estimated using current daily activity (CDS) status.
*significant at 10%; ** significant at 5%; ***significant at 1%.

Table 11.2: Summary statistics on time shares (in fractions of unit time) for females

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force	Individuals
	Self	Regular	Casual	Self	Regular	Casual					
2004/5 All India (19 States)	0.192	0.002	0.088	0.04	0.018	0.013	0.001	0.563	0.035	0.047	
Phase I and II districts (a)	0.182	0.002	0.092	0.041	0.015	0.012	0.001	0.576	0.032	0.047	52194
Phase III districts (b)	0.209	0.003	0.082	0.038	0.024	0.014	0.001	0.541	0.04	0.048	36615
Difference (a)-(b)	-0.027***	-0.001	0.011***	0.002*	-0.009***	-0.002**	0	0.035***	-0.008***	-0.001	
2007/8 All India (19 States)	0.149	0.002	0.09	0.029	0.019	0.013	0.005	0.623	0.027	0.044	
Phase I and II districts (c)	0.144	0.002	0.094	0.029	0.014	0.014	0.006	0.629	0.027	0.041	54446
Phase III districts (d)	0.159	0.002	0.082	0.03	0.025	0.013	0.002	0.614	0.026	0.048	32946
Difference (c)-(d)	-0.015***	0	0.013***	-0.001	-0.011***	0.001	0.005***	0.015***	0.001	-0.007***	
2011/12 All India (19 States)	0.125	0.002	0.067	0.032	0.021	0.014	0.01	0.649	0.017	0.063	
Phase I and II districts (e)	0.115	0.001	0.071	0.034	0.016	0.013	0.01	0.666	0.014	0.059	38033
Phase III districts (f)	0.142	0.002	0.06	0.03	0.029	0.016	0.01	0.621	0.021	0.07	27420
Difference (e)-(f)	-0.026***	-0.001**	0.011***	0.004**	-0.013***	-0.003**	0	0.046***	-0.007***	-0.011***	

Notes: The sample comprises of 484 districts: 277-Phase I and II districts and 207-Phase III districts Time shares have been estimated using current daily activity (CDS) status.
*significant at 10%; ** significant at 5%; ***significant at 1%.

Source for both tables: Computed from the NSS-EUS dataset.

Table 12.1: Difference (in percentage points over time) in rates of growth in real casual wages between treatment and control districts, top 3 states (Rajasthan, Andhra Pradesh and Madhya Pradesh)

	Male				Female			
	Rainy season	No. of individuals	Dry Season	No. of individuals	Rainy season	No. of individuals	Dry season	No. of individuals
Average casual wages in agriculture sector (INR per day in 2004/5 prices)								
Phase I and II districts in 2004/5	43	673	43	645	30	805	31	656
Phase III districts in 2004/5	41	237	37	211	33	153	28	121
Impact on real casual wages in agriculture sector								
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.040 (0.030)	2451	0.058 (0.052)	2194	0.161** (0.055)	2321	-0.043 (0.069)	1910
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.038 (0.067)	1935	0.018 (0.060)	1683	0.260** (0.090)	1845	-0.066 (0.077)	1543
Average casual wages in non-agriculture sector (INR per day in 2004/5 prices)								
Phase I and II districts in 2004/5	58	444	57	510	44	101	43	117
Phase III districts in 2004/5	57	108	59	171	35	12	39	42
Impact on real casual wages in non-agriculture sector								
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.161*** (0.046)	1151	-0.021 (0.051)	1523	***-1.044**** ***(0.390)***	241	0.018 (0.261)	401
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.029 (0.051)	1181	-0.132** (0.064)	1556	***-0.179*** ***(0.176)***	234	-0.071 (0.099)	395

Notes: The dependent variable is logarithm of casual wage in agriculture.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 81 districts out of 97 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Table 12.2: Impact on time shares for males, top 3 states (Rajasthan, Andhra Pradesh and Madhya Pradesh)

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force
	Self	Regular	Casual	Self	Regular	Casual				
Average time shares in rainy season (fraction of unit time)										
Phase I and II districts in 2004/5	0.417	0.009	0.154	0.130	0.067	0.076	0.001	0.006	0.060	0.080
Phase III districts in 2004/5	0.407	0.009	0.164	0.090	0.102	0.060	0.011	0.027	0.069	0.062
Rainy season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.031 (0.020)	0.005 (0.004)	-0.001 (0.016)	-0.011 (0.009)	***0.052**** ***(0.014)***	0.010 (0.008)	0.015** (0.005)	0.004 (0.004)	-0.023 (0.025)	***-0.020**** ***(0.008)***
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.047 (0.033)	-0.004 (0.005)	-0.032 (0.025)	0.037** (0.015)	***-0.023**** ***(0.012)***	0.002 (0.021)	0.001 (0.005)	0.009 (0.007)	0.001 (0.012)	***-0.038***** ***(0.011)***
Average time shares in dry season (fraction of unit time)										
Phase I and II districts in 2004/5	0.376	0.014	0.161	0.126	0.076	0.089	0.007	0.007	0.072	0.071
Phase III districts in 2004/5	0.415	0.004	0.176	0.118	0.061	0.055	0.002	0.019	0.082	0.067
Dry season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.124*** (0.027)	-0.011** (0.003)	-0.084** (0.026)	0.016 (0.011)	-0.025** (0.012)	-0.033** (0.015)	***0.016**** ***(0.008)***	-0.003 (0.005)	-0.014 (0.014)	***0.013*** ***(0.008)***
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.099** (0.035)	-0.001 (0.003)	0.028 (0.024)	-0.049** (0.019)	-0.031 (0.021)	-0.032 (0.021)	***0.008*** ***(0.012)***	-0.009* (0.005)	-0.029* (0.015)	***0.015*** ***(0.015)***

Notes: The dependent variable is the fraction of unit time spent in a particular activity.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 81 districts out of 97 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Table 12.3: Impact on time shares for females, top 3 states (Rajasthan, Andhra Pradesh and Madhya Pradesh)

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force
	Self	Regular	Casual	Self	Regular	Casual				
Average time shares in rainy season (fraction of unit time)										
Phase I and II districts in 2004/5	0.279	0.001	0.148	0.056	0.025	0.017	0.001	0.375	0.040	0.057
Phase III districts in 2004/5	0.234	0.000	0.082	0.031	0.015	0.009	0.000	0.591	0.019	0.020
Rainy season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.013 (0.015)	-0.001 (0.001)	-0.064** (0.024)	***0.011*** ***(0.008)***	0.000 (0.007)	0.003 (0.005)	***0.004**** ***(0.002)***	0.115** (0.050)	-0.027* (0.015)	-0.027*** (0.008)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.006 (0.033)	-0.003** (0.001)	-0.015 (0.017)	***0.025**** ***(0.010)***	0.014** (0.005)	0.011* (0.005)	***0.008**** ***(0.004)***	-0.034 (0.045)	-0.013* (0.007)	0.002 (0.011)
Average time shares in dry season (fraction of unit time)										
Phase I and II districts in 2004/5	0.253	0.001	0.127	0.072	0.017	0.019	0.007	0.405	0.054	0.045
Phase III districts in 2004/5	0.172	0.001	0.095	0.049	0.013	0.015	0.004	0.597	0.031	0.025
Dry season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	0.027 (0.025)	0.000 (0.001)	***-0.041**** ***(0.014)***	0.002 (0.007)	-0.010 (0.010)	0.011** (0.005)	0.028*** (0.007)	0.015 (0.040)	-0.047*** (0.014)	0.014* (0.009)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.090*** (0.026)	-0.001 (0.002)	***0.015*** ***(0.019)***	-0.004 (0.007)	0.005 (0.006)	0.010 (0.008)	0.006 (0.011)	-0.138*** (0.033)	-0.007 (0.008)	0.024* (0.013)

Notes: The dependent variable is the fraction of unit time spent in a particular activity.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 81 districts out of 97 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences across treatment and control districts. I Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Table 13.1: Difference (in percentage points over time) in rates of growth in real casual wages between treatment and control districts, all-India

	Male				Female			
	Rainy season	No. of individuals	Dry season	No. of individuals	Rainy season	No. of individuals	Dry season	No. of individuals
Average casual wages in agriculture sector (INR per day in 2004/5 prices)								
Phase I and II districts in 2004/5	46	2233	47	2007	31	2113	32	1638
Phase III districts in 2004/5	46	2056	47	1901	32	1396	34	1233
Impact on real casual wages in agriculture sector								
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.015 (0.022)***	10412	0.002 (0.032)	9653	***0.020 (0.026)***	7886	-0.006 (0.038)	6699
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***0.035 (0.029)***	8246	-0.045 (0.031)	7611	***0.020 (0.038)***	6122	-0.130** (0.043)	5192
Average casual wages in non-agriculture sector (INR per day in 2004/5 prices)								
Phase I and II districts in 2004/5	43	292	61	1675	41	245	65	1318
Phase III districts in 2004/5	41	304	67	1670	45	239	64	1534
Impact on real casual wages in non-agriculture sector								
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***-0.040 (0.035)***	5808	0.008 (0.027)	6958	-0.220* (0.122)	928	-0.010 (0.148)	1316
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***-0.002 (0.033)***	6218	0.014 (0.028)	7258	0.227* (0.119)	897	-0.065 (0.073)	1169

Notes: The dependent variable is logarithm of casual wage in agriculture.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 391 districts out of 484 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Table 13.2: Impact on time shares for males, all-India

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force
	Self	Regular	Casual	Self	Regular	Casual				
Average time shares in rainy season (fraction of unit time)										
Phase I and II districts in 2004/5	0.414	0.008	0.153	0.128	0.072	0.064	0.001	0.013	0.067	0.079
Phase III districts in 2004/5	0.365	0.013	0.163	0.147	0.105	0.056	0.001	0.011	0.071	0.064
Rainy season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.026** (0.012)	0.004** (0.002)	***-0.002*** ***(0.009)***	0.016 (0.010)	0.014* (0.008)	***0.002*** ***(0.007)***	0.003** (0.001)	-0.003 (0.002)	0.006 (0.007)	***-0.014**** ***(0.006)***
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.023 (0.015)	0.004* (0.002)	***-0.027**** ***(0.011)***	0.002 (0.009)	0.012 (0.008)	***0.015*** ***(0.010)***	-0.009** (0.004)	0.002 (0.002)	0.011 (0.007)	***-0.034***** ***(0.008)***
Average time shares in dry season (fraction of unit time)										
Phase I and II districts in 2004/5	0.383	0.008	0.144	0.137	0.074	0.082	0.003	0.014	0.071	0.084
Phase III districts in 2004/5	0.349	0.011	0.154	0.146	0.097	0.077	0.001	0.012	0.073	0.080
Dry season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	***0.016*** ***(0.017)***	0.002 (0.003)	-0.038** (0.014)	0.002 (0.007)	0.009 (0.007)	***-0.008*** ***(0.008)***	***0.011***** ***(0.003)***	-0.007** (0.003)	0.014** (0.007)	-0.002 (0.006)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	***0.031**** ***(0.016)***	0.005 (0.003)	-0.038** (0.013)	-0.010 (0.010)	-0.001 (0.009)	***-0.003*** ***(0.010)***	***0.008**** ***(0.003)***	0.001 (0.003)	0.009 (0.007)	-0.001 (0.007)

Notes: The dependent variable is the fraction of unit time spent in a particular activity.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 391 districts out of 484 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Table 13.3: Impact on time shares for females, all-India

	Agriculture			Non-agriculture			Public works	Domestic work	Unemployment	Not in labour force
	Self	Regular	Casual	Self	Regular	Casual				
Average time shares in rainy season (fraction of unit time)										
Phase I and II districts in 2004/5	0.239	0.001	0.121	0.038	0.019	0.012	0.001	0.483	0.035	0.051
Phase III districts in 2004/5	0.206	0.003	0.109	0.037	0.017	0.009	0.000	0.549	0.027	0.042
Rainy season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.013 (0.010)	-0.002 (0.002)	***-0.005 (0.009)***	0.006 (0.005)	-0.005 (0.003)	0.003* (0.002)	0.001** (0.001)	0.023 (0.014)	***-0.006 (0.004)***	-0.003 (0.004)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.006 (0.012)	0.005** (0.002)	***0.016**** ***(0.007)***	-0.001 (0.004)	-0.002 (0.005)	0.004 (0.003)	-0.002 (0.002)	-0.036** (0.016)	***0.015**** ***(0.005)***	-0.006 (0.006)
Average time shares in dry season (fraction of unit time)										
Phase I and II districts in 2004/5	0.208	0.001	0.095	0.045	0.016	0.015	0.002	0.521	0.045	0.051
Phase III districts in 2004/5	0.181	0.005	0.085	0.045	0.024	0.019	0.004	0.560	0.039	0.039
Dry season impact estimates: Difference in change in time shares between treatment and control districts										
Impact (α_1 in equation 1) on Phase I and II districts under partial implementation	-0.001 (0.013)	0.004** (0.002)	-0.013 (0.009)	-0.002 (0.006)	0.004 (0.004)	0.008** (0.003)	0.013*** (0.003)	0.001 (0.021)	-0.008 (0.008)	-0.007 (0.005)
Impact (γ_1 in equation 2) on Phase III districts under full implementation	0.038*** (0.011)	0.001* (0.001)	-0.011 (0.007)	-0.004 (0.007)	0.005 (0.003)	0.004 (0.003)	0.006 (0.005)	-0.046** (0.017)	0.010** (0.005)	-0.003 (0.006)

Notes: The dependent variable is the fraction of unit time spent in a particular activity.
All the regressions have been performed using modified individual level weights derived from district level matching weights, in the common support region.
The common support region comprises of 391 districts out of 484 districts.
Figures in bold and italics are presented for those outcomes which have pre-program differences in trends across treatment and control districts.
Standard errors clustered at the district-year level in parentheses. *significant at 10%; ** significant at 5%; ***significant at 1%.

Source: Computed from the NSS-EUS dataset.

Appendix A: Construction and definitions of Outcome Variables

A1. Crop-wage Dataset

All variables are at the district level. Data was collected for each year from 2000/01 to 2009/10 to create a district level panel.

Share of Gross Irrigated Area in Total Cropped Area: Annual data on gross irrigated area (in hectares) at the district level for each year was taken from the *Land Use Statistics*, brought out by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. Gross irrigated area refers to the total area under irrigation in a given year, wherein the same plot of land may be counted multiple times depending on the number of times it was cultivated in that year. Corresponding data on total cropped area (also in hectares) was taken from the same source. The share of gross irrigated area in total cropped area is the ratio of these two variables.

Real Agricultural Wage (in INR per day, 2004/5 prices): Monthly data at the district level on nominal agricultural wage was compiled from the report on *Agriculture Wages in India*, published by the Directorate of Economics and Statistics, Ministry of Agriculture, Government of India. The reports contain two categories of wages: 'field labour wages'[28] and 'other agricultural labour wages'. To arrive at a single figure for nominal agricultural wage, these two wages are aggregated using shares of employment as weights.[29] Using this monthly series, nominal agricultural wage by season (dry and rainy), is calculated as the arithmetic mean of monthly figures corresponding to each season. This entire exercise is conducted separately for males and females. The nominal agricultural wages thus obtained are deflated to 2004/5 prices using the state level Consumer Price Index for Agricultural Labour, CPI-AL, constructed by the Labour Bureau of India.

Crop Shares in Total Cropped Area for Major Crops: Since it is not possible to study all crops grown within a state-season strata, we restrict ourselves to studying the set of crops with the largest crop shares that together cover at least 90 percent of total cropped area within the state-season strata during the pre-program years (2000/1 to 2004/5). If the set of such crops is greater than five in number, then we restrict ourselves to top five crops. For each state-season strata,

[28]Most states present field labour wages separately for each agricultural operation. Operations include ploughing, sowing, weeding, transplanting, and harvesting. For these states, composite field labour wages are computed by aggregating across operations using as weights the shares of employment in each operation.

[29]Shares of employment were calculated using EUS for 2004/05, and the same shares were applied for all the years assuming that these did not vary much over the study period.

crop specific acreages (in hectares) at the district level have been taken from the *Area Production and Yield*, APY, reports of the Ministry of Agriculture, New Delhi. Corresponding figures for total cropped area (in hectares), are calculated by summing over all reported crop acreages. Crop shares are then calculated by taking the ratio of crop specific acreage to total cropped area.

Crop Yield (in tonnes per hectare): For each state-season, crop yields are studied for the same set of crops used to study cropping patterns. Within each state-season, district level data for crop yields are directly reported in the APY reports.

A2. EUS Dataset

For the main analysis, we use EUS rounds for the years 2004/5, 2007/8 and 2011/12. We created a panel of districts that took into account changes in district boundaries and formation of new districts. In doing so we dropped districts which split into newer ones that had different MGNREGA phase designations, and also combined districts from later rounds when they had the same designation. The basic idea was to drop the least number of observations while maintaining a clear distinction between early and late phase districts. The exact district concordance can be obtained on request from the authors. We end up with a panel of 484 districts.

We analyse impacts on employment shares and casual wages. We explain these two outcomes below.

Employment Shares (in fraction of time spent in each category): For each individual the EUS collects information on time spent in various activities during the week immediately preceding the date of the survey. We use this information to calculate the fraction of time spent in the reference week across ten mutually exclusive and exhaustive employment categories. These are as follows:

1. Self-employment in agriculture
2. Regular wage employment in agriculture
3. Casual wage employment in agriculture
4. Self-employment in non-agriculture
5. Regular wage employment in non-agriculture
6. Casual wage employment in non-agriculture
7. Wage employment in public works (including MGNREGA)

8. Domestic work (free collection of goods, sewing and so on)
9. Unemployment
10. Not in labour force

Note that categories 1 through 6 taken together constitute fraction of time spent in private sector employment. Categories 8 and 10 when combined constitute fraction of time spent outside the labour force, defined more broadly to include domestic work.

Causal Wage (in INR per day, 2004/5 prices): In order to separately calculate casual wage in agriculture and in non-agriculture, we first classify casual work into these two categories using the National Industrial Classification 1998 (five digit). Using this classification, nominal wages in each sector is accordingly calculated using information on wage earnings earned and total days spent in wage employment during the reference week. Wages are then expressed in 2004/5 prices using state level Consumer Price Index for Rural Labour, CPI-RL, constructed by the Labour Bureau of India.

Appendix B: Construction of Weights to Implement Matching

This appendix describes how to modify individual level weights provided by the NSSO to implement the matching procedure. We describe the procedure to study the effect on Phase I and II districts using data from 2004/5 and 2007/8. Modified weights for Phase III districts can be created similarly. The procedure involves two steps.

Step 1: Derivation of District Level Weights using Kernel Matching

Using 2004/5 data, we first run a district level logistic regression to estimate the probability of receiving the scheme (propensity score) in the early phases, i.e. by 2007/8. The dependent variable is whether a district is observed to be Phase I / Phase II or not (the variable takes value 1 if it is so, and 0 if it is not). The explanatory variables are all at the district level: these are share of SC/ST households, average casual wage (2004/5 prices), literacy rate, average land holding size, average monthly per capita consumption expenditure (2004/5 prices) and state dummies. The propensity scores of the treatment group (Phase I and II) lie within the interval [0.050; 0.999], whereas for the control group (Phase III) they lie within [0.001; 0.966]. Therefore, the common support *S*, is given by all districts whose propensity score lie within [0.050; 0.966].[30] For the rest of the analysis only districts in the common support are considered.

Suppose there are *J* Phase I and II treatment districts, *t1, t2, …, tJ*, and *K* Phase III control districts, *c1, c2, …,* and *cK*. For each treatment district tj, we use kernel matching to derive the set of matching weights $\{M(tj, ck)\ k = 1, \dots, K\}$, over the *K* control districts. Each $M(tj, ck)$ depends on the distance between P_{tj} and P_{ck} where P is the propensity score, and is defined as follows:

$$M(tj, ck) = \frac{G(\frac{P_{ck} - P_{tj}}{h})}{\sum_{k=1}^{K} G(\frac{P_{ck} - P_{tj}}{h})}$$

where $\mathrm{G(u)} = \frac{3}{4}(1 - \mathrm{u}^2)$ is the Epanechnikov kernel function, and h is the bandwidth parameter.

[30]Out of 484 (277 Phase I and II, and 207 Phase III) districts considered, 391 districts (81 percent) form the common support, of which 196 are Phase I and II, and 195 are Phase III.

Step 2: Combining Individual level NSSO Weights with District level Matching Weights

First, the individual level weights provided by the NSSO for 2007/8 are adjusted such that the sum of all individual level weights within each district is equal to the corresponding value in 2004/5. Denote the adjusted weight of individual *i* in district *d* as, $w_{i,d}$, where $d \in \{t1, t2, \dots, tJ; c1, c2, \dots, cK\}$.

For an individual *i* living in treatment district *tj*, the modified weight is given by:

$$\frac{w_{i,tj}}{\sum_{d=t1}^{tJ} \sum_{i \in d} w_{i,d}}$$

For an individual *i* living in control district *ck*, the modified weight is given by:

$$\frac{w_{i,ck}}{\sum_{i \in ck} w_{i,ck}} * \left(\sum_{u=t1}^{tJ} \frac{\sum_{i \in u} w_{i,u}}{\sum_{d=t1}^{tJ} \sum_{i \in d} w_{i,d}} * M(u, ck) \right)$$

Appendix C

Table C1: Select Characteristics in 2004/5 across Matched and Unmatched Districts

	Phase I and II districts	Phase III districts	Difference
	(a)	(b)	(a-b)
	Unmatched		
Share of SC/ST households	0.38	0.28	0.10***
Share of literate persons	0.47	0.56	-0.09***
Consumer expenditure (INR per month per household)	2412	3030	-618***
Casual wage in agriculture sector (INR per day, 2004/5 prices)	46	61	-15***
Cultivable land (hectares per household)	1.23	1.48	-0.25**
Number of Districts	277	207	
	Matched		
Share of SC/ST households	0.36	0.37	-0.01
Share of literate persons	0.49	0.5	-0.01
Consumer expenditure (INR per month per household)	2533	2593	-60
Casual wage in agriculture sector (INR per day, 2004/5 prices)	47	49	-2
Cultivable land (hectares per household)	1.42	1.34	0.08
Number of Districts (in common support)	196	195	

Notes: Out of 484 districts, the common support region comprises of 391 districts: 196 Phase I and II and 195 Phase III districts. The propensity scores of the treatment group (Phase I and II) lie within the interval [0.050; 0.999], whereas they lie within [0.001; 0.966] for the control group (Phase III). The common support is given by all districts whose propensity score lie within [0.050; 0.966].

Table C2: Labour and water requirement of selected crops

Panel A : Labour requirement (in hours per hectare)					
Rajasthan					
Rabi crops	Wheat	Mustard	Gram	Barley	
	481	280	229	483	
Kharif crops	Bajra	Maize	Soyabean	Jowar	Moth
	290	583	357	250	na
Andhra Pradesh					
Rabi crops	Paddy	Jowar	Urad	Gram	Groundnut
	835	424	272	323	642
Kharif crops	Paddy	Groundnut	Cotton	Arhar	Maize
	835	642	824	465	616
Madhya Pradesh					
Rabi crops	Wheat	Gram	Mustard		
	352	238	285		
Kharif crops	Soyabean	Paddy	Maize	Jowar	Bajra
	329	540	436	385	na
Panel B: Water requirement (in INR per hectare)					
Rajasthan					
Rabi crops	Wheat	Mustard	Gram	Barley	
	2936	1651	1383	2706	
Kharif crops	Bajra	Maize	Soyabean	Jowar	Moth
	63	43	49	75	na
Andhra Pradesh					
Rabi crops	Paddy	Jowar	Urad	Gram	Groundnut
	611	106	0	1	446
Kharif crops	Paddy	Groundnut	Cotton	Arhar	Maize
	611	446	168	0	45
Madhya Pradesh					
Rabi crops	Wheat	Gram	Mustard		
	1879	534	1206		
Kharif crops	Soyabean	Paddy	Maize	Jowar	Bajra
	7	210	0	0	na

Source: Estimates of cost of cultivation for 2006/7, Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
Notes: ‘na’ means not available.

Table C3: Season wise distribution of time shares for casual labour employment in 2007/8

States	Public works		Agriculture		Non-agriculture	
	Rainy season	Dry season	Rainy season	Dry season	Rainy season	Dry season
Rajasthan	0.004	0.024	0.034	0.022	0.06	0.101
Andhra Pradesh	0.005	0.025	0.215	0.183	0.046	0.055
Madhya Pradesh	0.003	0.018	0.135	0.137	0.04	0.052
Karnataka	na	na	0.211	0.215	0.037	0.035
Chhattisgarh	0.002	0.031	0.181	0.127	0.029	0.051
Jharkhand	0.004	0.005	0.052	0.031	0.079	0.118
Tamil Nadu	0.013	0.019	0.17	0.166	0.077	0.072
Himachal Pradesh	0.014	0.016	0.011	0.007	0.06	0.063
Assam	0.001	0.004	0.06	0.055	0.032	0.044
Uttar Pradesh	0.005	0.002	0.05	0.052	0.049	0.056
Uttaranchal	0.003	0.007	0.029	0.016	0.04	0.053
West Bengal	0.003	0.008	0.137	0.121	0.052	0.056
Gujarat	na	na	0.158	0.165	0.042	0.052
Kerala	0.004	0.005	0.05	0.053	0.091	0.101
Orissa	0.003	0.005	0.13	0.08	0.041	0.062
Bihar	0.004	0.005	0.151	0.149	0.028	0.034
Punjab	na	na	0.067	0.071	0.063	0.061
Haryana	0.002	0.001	0.05	0.057	0.054	0.07
Maharashtra	0.001	0.001	0.199	0.182	0.026	0.041
All states	0.004	0.009	0.125	0.115	0.047	0.058

Source: Employment and Unemployment Survey, National Sample Survey (NSS), 2007/8
Note: Target population consists of individuals residing in rural areas, between 18 and 60 years of age, for 19 major states. 'na' means not available. The states have been arranged according to the ranking of successful MGNREGA implementation given in Table 1.