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Can Public Works Infrastructure Affect Employment Outcomes? Evidence from the NREGS in India

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Bonn, November 2015 Esther Gehrke

Abstract

In this paper, I look at the effects of the infrastructure created under India's public works programme – the National Rural Employment Guarantee Scheme (NREGS) – on employment outcomes. In order to attribute observed outcomes to infrastructure creation, I address all potential causal mechanisms through which the NREGS could affect employment, namely increases in productive investments and the demand for labour among NREGS beneficiaries, an increase in wages in the implementing villages, as well as an increase in economic activity due to the infrastructure created with the NREGS. Lastly, I analyse which types of infrastructure are particularly beneficial for increasing long-term employment.

The results of this paper are as follows. I find little evidence that village employment levels are affected by increased investments of the NREGS beneficiaries or by wage changes due to the NREGS. In contrast, I find that the creation of productive infrastructure through the NREGS can indeed positively affect employment outcomes in targeted villages. Which infrastructure projects are most promising depends on the sector in which employment is to be created and on the social group that is to benefit. Effects on total employment are largest when infrastructure is targeted towards land development.

Contents

Abbreviations

ARIS	Additional Rural Incomes Survey
DIE	Deutsches Institut für Entwicklungspolitik
FY	Financial Year
INR	Indian Rupee
NREGS	National Rural Employment Guarantee Scheme
PW	Public Works
REDS	Rural Economic and Demographic Survey
SEPRI	Socio-Economic Profile of Rural Households in India

1 Introduction

Public works (PW) programmes are mostly implemented with the aim of providing employment – and therewith income – to the poor, while at the same time creating lasting public infrastructure in the target regions. PW programmes are becoming increasingly popular in developing countries because of this potential for a double dividend: poverty reduction can be achieved directly through the provision of employment and increases in the incomes of the target population, as well as indirectly through the creation of infrastructure that will then boost economic activity and increase income levels in targeted areas. In practice, however, PW programmes have focussed on the first of the two goals, whereas the quality and sustainability of the newly created public infrastructure and assets have received much less attention (both from a policy as well as an academic perspective).

However, if PW programmes are to be a cost-effective tool of poverty reduction, the simple transfer of cash to beneficiaries – with a work condition as a targeting instrument (Besley & Coate, 1992) – might not be sufficient. In a recent paper, Murgai, Ravallion and van de Walle (2015) simulate the poverty effects of the National Rural Employment Guarantee Scheme (NREGS) in one state of India and show that both an untargeted cash transfer to households as well as an imprecisely targeted cash transfers (through Below Poverty Line cards) would be more effective than the NREGS in terms of poverty reduction. Under such circumstances, an argument for PW *vis-à-vis* simple cash transfers can only be made if there are sufficiently large benefits to the local population from the newly created infrastructure and assets.

The aim of this paper is therefore to estimate the returns of the infrastructure created under PW programmes to the local population. It focusses on employment as a main dependent variable; arguably, employment levels should reflect fairly well the general economic conditions in the village and the changes in incomes of the affected population. The paper seeks to answer two questions: first, what is the effect of the infrastructure created within PW programmes on employment outcomes in the targeted villages? And second, which types of infrastructure are particularly beneficial for increasing long-term employment?

This paper uses a novel micro-data set from India to analyse the effects of the infrastructure created under India's flagship employment programme – the NREGS – on the local population. The NREGS is a good example to study such a question, because it is the largest public works programme worldwide, and because it has been operating a sufficiently long time to explore the longer-term effects of infrastructure creation in PW schemes.

A number of studies have analysed the effects of the NREGS in India on employment outcomes. Imbert and Papp (2015) look at the effect of the NREGS on private-sector employment and wages. They find that the programme led to an increase in wages for casual agricultural work and a simultaneous fall in private-sector employment levels. Similar evidence was found by Berg, Bhattacharyya, Rajasekhar, & Manjula (2014).[1]

1 In contrast, Zimmermann (2014) did not find any effects of the NREGS on employment levels or wages. However, her study suffers from low precision in estimated effects due to the empirical approach she chose.

Bhargava (2014) argues that increased wage costs due to the NREGS led to a shift towards more capital-intensive production in agriculture.

Other studies have looked at other economic outcomes of the NREGS that are directly or indirectly related to employment. Zimmermann (2014), for example, presents evidence that households with access to the NREGS are more likely to engage in entrepreneurial activities. She argues that the NREGS mainly functions as an insurance tool by helping households to cope with agricultural shocks and by encouraging them to take up risky but remunerative self-employment activities. Gehrke (2014) equally focusses on the social protection aspect of the NREGS and analyses the effects of the programme on households' agricultural production choices. She finds that households with access to the NREGS shift their production towards riskier and more profitable crops, thereby increasing agricultural productivity among participants. These productivity gains could increase employment in agriculture, as long as these changes are not associated with a shift towards more capital-intensive production.

Based on the existing evidence, this paper identifies three channels through which the NREGS could affect employment levels in the implementing villages. First, the NREGS might lead participants of the programme to increase their productive investments. This can happen for two reasons: on one hand, the NREGS increases incomes of participants and therewith their ability to finance investments; on the other hand, the NREGS provides employment independently of weather or other economic shocks, thereby improving the capacity of participants to cope with shocks and reducing the need of participants to hold unproductive precautionary savings. Second, the scheme might cause wages in the private sector to increase, which could lead employers to shift towards labour-saving technologies and reduce private-sector employment in the implementing villages and regions. Third, the infrastructure created within the PW programme could affect long-term employment by boosting economic activity, for example by improving market access or by increasing agricultural production and productivity.

In order to isolate the effects of infrastructure creation, I address all three potential causal mechanisms separately. The identification strategy makes use of the differential timing in the introduction of the NREGS throughout the country, and of regional differences in the number of projects conducted and amount of money disbursed at the village level. Furthermore, due to the decentralised structure of the programme, I can explore variation in terms of implementation details of the NREGS (labour-capital ratio, choice of public infrastructure to be created, design of projects, etc.). I use this variation to analyse the main obstacles to – and drivers of – successful long-term employment creation through public works programmes. The data used in this paper was collected in 102 villages in 8 states of India in the years 2006 and 2014. It provides detailed information about the implementation of the NREGS at the village level, and about different economic activities and the resulting time allocation of households.

The results of this paper are as follows. I find little evidence that village employment levels are affected by increased investments of NREGS beneficiaries, or by wage changes due to NREGS. In contrast, I find that the creation of productive infrastructure through the NREGS can indeed positively affect employment outcomes in targeted villages. Which infrastructure projects are most promising depends on the sector in which employment is

to be created, and on the social group that is to benefit. Effects on total employment are largest when infrastructure is targeted towards land development.

The remainder of this paper proceeds as follows. Section 2 provides some background information about the NREGS and the infrastructure created with the programme. Section 3 presents the conceptual framework. Sections 4 and 5 discuss the data and estimation strategy, respectively. Sections 6 and 7 present the results to the two main research questions, and Section 8 concludes.

2 The National Rural Employment Guarantee Scheme

2.1 Background

The National Rural Employment Guarantee Act was passed in 2005. The law entitles every household in rural areas of India to up to 100 days of work per year at state minimum wages. The implementation of the NREGS started in 2006 in 200 districts of India. The programme was subsequently extended to all other rural districts of the country and the implementation was completed by 2008. In financial year (FY) 2011/2012, the budgeted expenditure for the programme was 373 billion Indian rupees (INR) (US$ 7.1 billion), representing 0.4 per cent of gross domestic product and 3.8 per cent of government spending.

The most important objectives of the NREGS are to provide social protection for the most vulnerable, and to ensure livelihood security (Ministry of Rural Development [MoRD], 2012). Due to its focus on providing social protection, it is a demand-based programme, which gives participants a number of rights by law. Most importantly, employment has to be provided upon demand, within 14 days after the application for work has been made, and within a 5 km radius of the village. Additionally, all work sites have to provide drinking water and medical aid, and provisions for childcare are to be made if there are more than five children at a work site (MoRD, 2013).

The NREGS is a targeted programme, insofar as it is only available in rural areas. But otherwise it is universal: every household is entitled to an NREGS job card. In order to make sure that only the poorest households participate with the NREGS, wages are set at state minimum wages. But since these are above observed market wages in many cases, not only the poor are participating in the programme. Still, recent studies suggest that mostly the poorer segments of the population are working with the NREGS (Imbert & Papp, 2015; Murgai et al., 2015).

The quality of implementation varies substantially across states. The share of rural households working with the NREGS was 24.9 per cent in the entire country in FY 2009/2010. However, in the worst-performing states (Haryana and Punjab), only 5 per cent of rural households were registered with the NREGS, whereas 62 per cent of rural households were registered with the NREGS in Rajasthan, the best-performing state. Similarly, there is a huge disparity in the number of days worked with the NREGS per participant. Whereas the average number of days was 27 in FY 2011/2012, this value varies between 15 days per participant in Karnataka (the worst-performing state) and 76

days per participant in Mizoram (the best-performing state. Given these disparities, it is not surprising that there were reports of substantial rationing of employment under the NREGS in several states (Dutta, Murgai, Ravallion, & van de Walle, 2012).

2.2 Project selection in the NREGS

Infrastructure creation within the NREGS focusses mostly on improving transport infrastructure and on increasing agricultural production. According to administrative data: 35 per cent of total expenditure went towards rural connectivity works in FY 2011/2012; 20 per cent of spending was oriented towards water conservation, and another 20 per cent of funds to other irrigation-related works, that is, the renovation of water bodies and irrigation projects; 8 per cent of the funds were invested in land development; 6 per cent in drought-proofing; and 5 per cent in flood control. Only 5 per cent of the funds were allocated towards other activities, such as sanitation, drainage, and building and maintenance of public buildings.[2]

The focus on transport infrastructure and agriculture-related works is also reflected in the data used for this paper. However, the exact composition of works is slightly different. In FY 2011/2012, only 15 per cent of spending went towards rural connectivity works, whereas 28 per cent of NREGS funds were allocated to water conservation activities and another 8 per cent to other irrigation-related works (renovation of water bodies and irrigation). Land development activities made up for 10 per cent, drought-proofing for 8 per cent and flood control for only 0.2 per cent of the funds (see Table 1).

Table 1 also shows that the composition of spending in the villages surveyed changed considerably over time. Activities related to water conservation increased from 23 per cent of spending in FY 2006/2007 to 34 per cent in FY 2012/2013. In contrast, the allocation of funds to rural connectivity works decreased over time, from 28 per cent in FY 2007/2008 to 14 per cent of spending in FY 2012/2013. Finally, spending on land development activities increased from 10 per cent of funds in 2006/2007 to 17 per cent in 2008/2009, and decreased again to 12 per cent in FY 2012/2013.

3 Conceptual framework

The NREGS can affect employment outcomes through a number of causal links and effects. To better understand observed outcomes, each of these potential effects need to be addressed systematically.

The first effect of public works programmes on employment outcomes is an increase in productive investments of beneficiaries, which could increase demand for labour in that group. Increased productive investments might be triggered through two causal links. On the one hand, increases in the available incomes of households that participate in the programme could affect their willingness to undertake productive investments. On the other hand, since the NREGS offers employment upon demand and helps households in

2 The data is available online at http://www.nrega.nic.in.

coping with weather and economic shocks, it improves the risk-management capacity of beneficiary – or potentially beneficiary – households and individuals (Gehrke, 2014). This might allow households to reduce unproductive precautionary savings and increase their willingness to undertake productive investments (Barrett, Holden, & Clay, 2004; Binswanger-Mkhize, 2012). Investments can take part on participants' farms or in their own business. The NREGS could therefore also increase the willingness of participants to be self-employed, as described by Zimmermann (2014).

The second effect though which PW programmes can influence employment outcomes are changes in private-sector wage levels that occur if beneficiaries reallocate their labour supply from the private sector towards the PW programme.[3] PW programmes can create a reduction in labour supply to the private sector and changes in the local wage levels if PW wages are higher than market wages for low-skilled workers. Such wage changes could have two effects on overall employment. On the one hand, depending on the elasticity of labour supply, increasing wages might increase overall labour supply – by pulling more people into the labour force or by encouraging workers to increase the number of hours worked. Similarly, the NREGS might persuade individuals to remain in rural areas instead of migrating for work in agricultural lean seasons, also increasing labour supply in rural areas. On the other hand, increased wages might lead farmers and employers to use more labour-saving technologies, and hence reduce their own labour as well as private demand for labour in production. The extent to which wages change additionally depends on the labour-market structure, such as the amount of un- or underemployment in the respective regions, and the competitive or non-competitive structure of labour demand (Basu, Chau, & Kanbur, 2009). In settings with high concentrations in market power among the employers, for example, observed wages might be below equilibrium wages. In such situations, an increase in wages – due to the introduction of a PW programme – will not necessarily lead to a reduction in labour demand among employers. It might be optimal for them to continue producing with the same production technology, and merely shift part of the rents from the employers to the workers.

The third effect goes through increased economic activity. The idea is that investments in public infrastructure – or even in private productive infrastructure – will enhance economic activity, and therewith demand for labour, in the targeted regions. Productive infrastructure can range from traditional infrastructure projects, such as road construction, to private infrastructure, such as land development, and the rehabilitation of environmental services, such as reforestation, restoration of water bodies, etc. (Lal, Miller, Lieuw-Kie-Song, & Kostzer, 2010; Lieuw-Kie-Song, 2011). What all these works have in common is that they can boost economic activity in the short and in the long run. Sanitation-related infrastructure could reduce disease prevalence and improve health outcomes, and investment in school buildings could raise school attendance and increase educational levels. However, it might take a long time until these outcomes translate into a better quality of labour supply of the target population. More direct economic effects can be expected through those infrastructure projects that target agricultural production (such as water conservation works, irrigation and land development) or economic activity more

3 Obviously, participants could also reallocate their labour supply from other public employment towards the NREGS. Arguing that other public employment than public works is very limited in rural areas of India – and for the sake of clarity – I use the term "private-sector employment" instead of "other employment" throughout the paper.

generally in the village (through improved rural connectivity, for example). Such infrastructure can affect some population groups directly, for example if certain works are being conducted on their own land (such as tree planting, well-digging or land development) or indirectly through a boost in economic activity that is triggered by an increased availability of public infrastructure at the village level (such as road construction or watershed development). Such types of infrastructure would then affect production levels, income and aggregate employment at the village level. The extent to which this happens is expected to depend on the need of communities for certain infrastructure and on the quality of the infrastructure created (Alderman & Yemtsov, 2014).

4 Data

I test the hypotheses outlined above with the 2006 and 2014 round of the Rural Economic and Demographic Survey (REDS) data, which I merge with meteorological data to predict shocks faced by households.

The REDS is the follow-up survey of the Additional Rural Incomes Survey (ARIS), which was first collected in 1971 by the National Council of Applied Economic Research. The sample was designed to represent the rural population of India across 19 major states. The ARIS covers 4,527 households in 259 villages. Three follow-up rounds were collected in 1982, 1999 and 2006 to re-visit these households. The sample was increased over time by randomly sampling additional households from the same villages. The sample in 2006 consists of roughly 9,500 households in 242 villages (17 states).[4] A fourth follow-up round, called the Socio-Economic Profile of Rural Households in India (SEPRI), was collected in 8 out of the 17 REDS states in 2014. These states are Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Jharkhand, Madhya Pradesh, Tamil Nadu and Rajasthan.

Merging the 2006 REDS with the 2014 SEPRI data gives a sample of 6,260 observations (3,130 panel households). Detailed summary statistics of household characteristics, the income structure and the time allocation of these households are displayed in Table 2. Income data is deflated to May 2006 values using the state-level consumer price index for agricultural labourers. For roughly 60 per cent of these households (58.5 per cent in 2006 and 61.6 per cent in 2014), we also have detailed information about their agricultural production (summarised in Table 3). This subsample consists of all households, with complete information on agricultural production patterns in each round.

The 2014 data includes a village questionnaire that collects detailed data on the implementation history of the NREGS in each village. I use this information to compute the treatment intensity of the NREGS in these villages. This measure combines the time since the introduction of the NREGS in each village with the amount spent per village and year (relative to village size). Additionally, the survey data contains information about the allocation of funds to different infrastructure projects (as discussed in Section 2.2) and about the labour-capital ratio and completion rate of NREGS projects. Summary statistics of NREGS implementation are provided in Table 4.

4 Due to armed conflict, no data were collected in Jammu & Kashmir and in Assam in the 2006 round of interviews.

5 Empirical strategy

The main problems in estimating the effects of a large PW programme such as the NREGS on village-level outcomes are the non-random probability of introducing the NREGS as well as the non-random assignment of treatment intensities. More concretely, poorer villages might get higher amounts of funds than richer villages. Conversely, poorer villages might have lower administrative capacities, resulting in lower disbursements to these villages. It is unclear *ex ante* in which direction resulting biases might go. Similarly, NREGS participants might be very different from non-participants; NREGS participants will probably tend to be poorer that non-participants, but in states or regions with rationing in access to the NREGS, the poorest households and those belonging to minorities might be more likely to be excluded from the programme. Lastly, households that benefit from the NREGS through infrastructure projects on – or close to – their lands are not necessarily a random (and representative) subsample of the village population.

To address these concerns, I use a difference-in-difference approach, making use of the panel data structure of the data. This approach cancels out time-constant differences across districts, villages and households and uses only the differential variation in the dependent and independent variables over time across households. To further increase the robustness of my findings, all standard errors are clustered at the village level.

What this approach cannot do, however, is eliminate any potential bias emerging from non-parallel trends. For example, it might be that some villages are affected by shocks, which increases the demand for the NREGS and possibly also disbursements under the programme to those villages. Given that these shocks cannot all be observed, adequately controlling for these is very difficult.

In order to address this issue, I control for state-year trends and for deviations in current and lagged rainfall from its long-term average in all estimations. The assumption is that large shocks (price shocks) will be common to all villages in one state, whereas rainfall shocks represent the most important reason for differential trends in the demand for the NREGS.

I use two treatment variables at the village level: cumulative spending under the NREGS since programme inception and cumulative days of employment generated under the programme, both in logs. These variables are assumed to best represent the intensity of NREGS treatment at the village level by combining the time span since the introduction of the PW programme at the village level with the average amount disbursed per capita per village. The two variables measure slightly different things, however, since employment days created depend not only on the spending at the village level but also on the type of projects selected and the resulting labour ratio in NREGS works. Furthermore, I compare households that participated in the NREGS and households that did not, as well as households that benefited from NREGS infrastructure being created on – or close to – their lands versus households that did not.

Lastly, I explore differences across villages in the share of spending allocated to different NREGS projects (irrigation, land development, water conservation, etc.) to determine which of these activities are most beneficial to employment creation in the long term. Again, the identifying assumption is that village-level characteristics that determine the

selection of projects are mostly constant over time, that is, location, average precipitation levels, agricultural potential and economic structure of the village, such that the difference-in-difference estimator provides an unbiased estimate of the true effect.

6 Results

This section presents the main results of the paper. I start by showing the results of estimating the "net" effect of the NREGS on employment. I then proceed with analysing the three causal mechanisms outlined above in order to isolate the contribution of infrastructure created under the NREGS. Lastly, I assess in how far technical and governance aspects matter for the effect of infrastructure creation within the NREGS on long-term employment outcomes. The following section then addresses the extent to which different types of infrastructure projects benefit employment creation.

6.1 Net effect of the NREGS on employment

To analyse the "net" effect of the NREGS on employment, I estimate the extent to which the village-level treatment intensity – that is, cumulative spending and total employment days generated under the NREGS since the programme started – affects employment outcomes. Three different employment outcomes are considered: the number of working adults in the household, the total number of hours worked of all adult household members and the log of total hours worked. I then test if the NREGS affects employment to different sectors, using the log of total hours worked as the dependent variable.

I find no evidence that the NREGS affects total employment in the village. The treatment intensity of the NREGS at the village level seems to have no effect on labour-market participation, measured in the number of working-age adults who reported to work in the last 12 months. I can also not find any statistically significant effect of cumulative spending or cumulative employment creation at the village level on the total hours worked by all adult household members (see Table 5).

I can also not find much evidence that the NREGS affects employment levels in particular sectors. When disaggregating employment by sectors, I find a statistically significant effect of the NREGS treatment intensity only on casual employment and on employment in public works (see Table 6). Village-level spending under the NREGS seems to increase the number of hours households work in casual employment, but I cannot find the same effect using the number of employment days created under the NREGS as a treatment variable. Also, the effect is very small and only statistically significant at the 10 per cent level. Not surprisingly, the NREGS seems to also increase the number of hours worked in public works: a 1 per cent increase in employment generated within the NREGS at the village level seems to increase the number of hours worked in public works at the household level by 0.23 per cent. Finally, I find no statistically significant effect of NREGS treatment intensity at the village level on time spent in own agricultural production, nor in agricultural casual work. I can also not observe any effect of village-level NREGS treatment intensity on hours worked in self-employment or permanent

employment, nor on the number of household members who temporarily migrate for work (Table 6).

The fact that I find very little evidence on overall employment effects can be due to a number of reasons. First, there might be too little variation over time in the dependent variables to capture the "true" effect of the NREGS in household fixed-effects estimation. Second, the estimation might suffer from attenuation bias: measurement error in the treatment variable causes the coefficient of interest to be biased towards zero. Third, the net zero effect might hide substantial within-village variation in effects, which could be due to different causal mechanisms, through which the NREGS affects employment outcomes, as discussed in Section 3. The following sections address this question in more detail, taking the conceptual framework as a guideline.

6.2 The effect of the NREGS on productive investments of participants

The first effect of the NREGS on employment discussed in the conceptual framework was due to an increase in productive investments among beneficiaries. In order to assess if investment behaviour changes as a function of the NREGS, I look at changes in input allocation and labour demand in agriculture, in agricultural productivity as well as in hours worked in self-employment. Because I want to know if this effect is driven by individual access to the NREGS, I compare NREGS participants and non-participants, controlling for overall village-level spending under the NREGS. The treatment variables used in this section are whether households own an NREGS job card and the number of hours a household has worked in public works in the past 12 months (in logs).

I find some evidence that access to the NREGS leads participants to increase their investments in agriculture, measured in input allocation per acre (see Table 7). This is in line with earlier work on the investment behaviour of NREGS participants (Gehrke, 2014). Surprisingly, however, this does not seem to translate into higher productivity levels: I find no effect of the NREGS on the value of agricultural output per acre. If anything, the evidence seems to indicate that an increased participation in the NREGS (measured in hours worked in public works) reduces the value of agricultural output per acre. This could be misleading though, for example if households work more for the NREGS in the presence of weather or other agricultural shocks, which also reduce agricultural productivity.

Even if households invest more in agriculture, this does not seem to translate into higher employment on their farms. The NREGS also does not seem to increase the probability of being self-employed. Participation in the NREGS seems to have no effect on hours worked in own agricultural production nor on labour demand in agriculture (Tables 7 and 8). Similarly, I can find no evidence that access to the NREGS increases households' time allocation to self-employment activities (see Table 8). This is quite surprising because earlier work found evidence for this (Zimmermann, 2014).

All in all, it seems quite unlikely that the NREGS led to an increased demand for labour (both family labour and hired labour) in this sample through increased investments of NREGS beneficiaries in their own farms or in their self-employment activities. However,

given the long time-lag in the data since the implementation of the NREGS, it might be very difficult to isolate effects at the household level.

6.3 The effect of the NREGS on wage levels

Since NREGS wages are often higher than wages paid in casual employment (particularly in the agriculture sector), the introduction of the NREGS might increase village-level wages. In Section 3, I describe two mechanisms through which an increase in wage levels can affect employment outcomes. First, if employers substitute labour for capital, one might see a long-term shift in the production technology, which could be detrimental to overall private-sector employment, whereas employment quality might improve due to the shift in technologies, leading to higher wages and a better quality of jobs. Second, higher wages in the NREGS might increase labour supply by pulling people into the labour force who were previously not working or by reducing rural-urban migration.

With regard to the first mechanism, I cannot find any evidence that the NREGS reduces total demand for labour in agriculture nor in other casual employment. As shown in Table 6, the village-level treatment intensity of the NREGS has no statistically significant effect on employment in casual work or on employment in casual agricultural work. There might be two reasons for observing a zero effect, despite a true negative effect. On the one hand, the dependent variable might be measured too imprecisely, such that the coefficient is biased towards zero, as mentioned before. On the other hand, it might be that the NREGS has opposite effects on technology choices in agricultural production depending on the farm size, which cancel each other out on average. As hypothesised before, the NREGS might lead participating farmers to increase their investment in agriculture; these would typically be owners of smaller farms. The wage effect, in contrast, is expected to be particularly relevant for large-scale farms with a high number of employees.

In order to assess what happens to labour demand in agriculture in more detail, I look at production levels, input allocation and demand for labour across different farm sizes. Results are reported in Table 9. On average, the amount of employment generated within the NREGS at the village level seems to reduce agricultural production: I find a negative effect on the value of agricultural production as well as on agricultural productivity. I also find evidence that the NREGS reduces output and productivity, especially among farms bigger than 20 acres: the coefficient of the interaction term is negative and statistically significant (columns 3 and 6). The reduction in productivity is probably due to a reduced allocation in inputs among those farms; although I find no effect of village-level spending under the NREGS on input allocation per acre on average, there seems to be a negative and statistically significant effect for bigger farms (column 9). But surprisingly, I cannot find any evidence that this is due to increased wage costs associated with the introduction of the NREGS: employment in agriculture (per acre) seems to be unaffected by the NREGS. If anything, it seems that spending under the NREGS increases labour demand among bigger farms, whereas it has no effect on labour demand in smaller farms.

With regards to the second channel, there seems to be little evidence that the NREGS affects labour force participation or migration. I can find no evidence that the NREGS increases the number of household members who are working (Table 5). I can also find no evidence that the NREGS reduces the number of household members who temporarily

migrate for work (as reported in Table 6). Given the data, I cannot assess if the NREGS affects permanent migration.

To summarise, the NREGS seems not to influence employment outcomes through its effects on wages. The evidence presented here does not support the idea that employers reduce their demand for agricultural or other casual labour or that they shift production technologies towards higher capital intensity. I can also not find any evidence that the NREGS increases labour force participation or reduces rural-to-urban migration.

6.4 The effect of the NREGS on the creation of productive infrastructure

Beyond the two mechanisms described above, the NREGS can affect employment outcomes through the creation of productive infrastructure that boosts economic activity and demand for labour in different sectors. I test if the NREGS infrastructure has a positive effect on employment in agriculture by comparing farmers who had any NREGS activities carried out on their own lands or close to their lands to farmers who did not. Results are reported in Table 10.

I find that households which benefited from created infrastructure on their own lands or close to their lands cultivate more land; produce more agricultural output and have a higher use of agricultural inputs; and allocate more time to their own agricultural production. I cannot find any effect on the demand for labour in agriculture though, thus the observed employment effect seems to be restricted to family labour. Also, this effect seems to be restricted to a very small group of households, since the same effect cannot be observed when looking at village averages using the NREGS treatment intensity as the treatment variable (as reported in Table 6).

In this section, I assess to what extent employment outcomes from the NREGS are influenced by technical and governance aspects in implementation. In order to do so, I interact village-level spending per capita (in logs) with different variables relating to technical or governance aspects.

In terms of technical aspects, the data does not provide many insights as to how NREGS projects should be implemented. I cannot find any effect of the capital ratio in NREGS projects – neither in levels nor in squares – on total employment in the village (see Table 11). Likewise, the year in which NREGS works started, hence the time since programme inception, does not seem to matter. Only the number of projects that were taken up seems to matter. I find that the number of projects has a negative effect on employment creation, suggesting that a smaller number of larger projects are more beneficial to creating long-term impacts.

Also I cannot find any governance aspects in NREGS implementation to affect employment outcomes. The data used for this analysis come from the village questionnaire, in which village leaders were asked a range of questions relating to the implementation of the NREGS. These questions closely follow the rules set up in the operational guidelines of the NREGS and ask leaders whether each of the rules was followed or not. Arguably, this is not a perfect measure of the implementation quality in the NREGS, but in the absence of better data, I use this information to understand to what

extent implementation quality seems to matter. With these caveats in mind, Table 12 summarises the results of the analysis. As can be seen, none of the governance aspects in implementation seem to matter.

7 What type of productive infrastructure creates long-term employment?

In this section, I assess which types of NREGS infrastructure projects are particularly beneficial in creating long-term employment. The idea is that different projects might have different effects on total employment, but also on employment in different sectors. In order to test this, I interact village-level spending with the share of spending allocated to different activities. In all estimations I control for the capital ratio in NREGS projects.

In terms total employment creation at the village level, I find that activities related to land development are the most effective in creating long-term employment (Table 13). In contrast, activities related to drainage works and building and maintenance of public buildings seem to be detrimental to employment creation. Since I am looking at shares in spending allocated to different activities, the negative coefficients need to be interpreted relative to all other activities, that is, all other infrastructure projects seem to have a higher employment effect than drainage works as well as building and maintenance.

In terms of increasing employment on own farms, I find a positive and statistically significant effect of increasing the share of funds allocated to water conservation. In contrast, I find a negative effect of increasing the share of funds allocated to drought-proofing, as well as to building and maintenance (see Table 14). In terms of employment in agricultural casual work, however, infrastructure related to flood control has a positive and statistically significant interaction term, whereas investing in irrigation facilities seems to decrease casual agricultural employment (Table 15). The negative effect of irrigation could be due to a substitution effect on the farms: with greater availability of mechanised irrigation, farmers can reduce the amount of manual irrigation. All in all, it can be concluded that activities that benefit landowners and increase their time allocated to own agricultural production do not necessarily also increase overall employment in agriculture (such as through agricultural casual work). For benefits to the landless population, improving rural connectivity (via flood control) seems to be much more important than agriculture-related infrastructure.

Obviously, NREGS infrastructure can also benefit sectors other than agriculture through a general increase in economic activity. I consider specifically casual employment, self-employment and permanent employment. In creating casual employment, I cannot find any evidence about which activities would be most beneficial (Table 16). The same holds for self-employment: most effects are not statistically significant; only funding allocated to building and maintenance seems to be significantly less beneficial to self-employment than other activities (Table 17). In terms of permanent employment creation, only flood control seems to have a statistically significant effect. Again the coefficient is negative, indicating that flood control benefits permanent employment significantly less than other activities (Table 18).

8 Conclusions

In this paper, I look at the effects of the NREGS on employment outcomes and try to isolate the causal mechanism driving observed outcomes. I distinguish three channels that could affect employment outcomes: increased investments among NREGS participants, increased wage levels in the implementing villages and increased economic activity due to the infrastructure created with the NREGS.

I find little evidence that village employment levels are affected by increased investments in agricultural production or in self-employment activities of NREGS beneficiaries, nor by wage changes due to the village-level amount of NREGS-employment created. In contrast, I find that the creation of productive infrastructure through the NREGS can indeed positively affect employment outcomes in targeted villages.

As to which infrastructure projects are most promising depends on the sector in which employment is to be created and on the social group that is to benefit. Effects on total employment are largest when infrastructure is targeted towards land development. Landowners seem to increase their time allocation to own agricultural production if NREGS activities concentrate on water conservation. Employment in agricultural casual work, however, seems to benefit mostly from the creation of connectivity-related infrastructure. Since mostly landless households can be found in this category, such infrastructure has a higher pro-poor focus than agriculture-related infrastructure. When looking at other casual work, self-employment activities or permanent employment, no particularly beneficial projects could be identified.

The results of this paper suggest that the selection of infrastructure projects influences which social group benefits the most from PW projects. Policy-makers need to be aware that projects which benefit the poorest and most vulnerable do not necessarily have to be of interest to the village majority. In line with this, I do not find that aggregate employment effects are necessarily larger when projects were selected in a participatory manner.

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Annex

Table 1: NREGS projects

Share of spending	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Water conservation	23.0%	29.0%	25.0%	27.0%	35.0%	28.0%	34.0%
Drought-proofing	0.3%	1.2%	9.0%	6.6%	6.6%	7.6%	17.0%
Irrigation facilities	1.9%	4.6%	3.8%	2.3%	2.2%	4.2%	3.9%
Renovation of water bodies	1.6%	2.0%	3.4%	2.9%	3.3%	3.7%	2.3%
Land development	10.0%	16.0%	17.0%	9.5%	10.0%	10.0%	12.0%
Flood control	0.0%	0.0%	0.3%	0.0%	0.0%	0.2%	0.0%
Rural connectivity	20.0%	28.0%	27.0%	23.0%	16.0%	15.0%	14.0%
Drainage works	1.1%	3.6%	2.2%	3.1%	2.3%	3.7%	2.2%
Building/maintenance	0.0%	0.0%	0.2%	0.9%	12.0%	1.6%	0.0%
School buildings	1.8%	0.2%	0.8%	5.5%	2.1%	0.3%	0.0%
Other projects	2.9%	10.0%	3.5%	12.0%	3.6%	5.2%	1.0%
Observations	56	56	91	91	91	91	60

Notes: Author's own calculation based on SEPRI data.

Table 2: Household summary statistics

	2006			2014		
	N	Mean	SD	N	Mean	SD
Household size	3130	5.27	(2.62)	3130	5.78	(3.55)
No. of children in household	3130	1.81	(1.66)	3130	1.72	(1.92)
Age (hh head)	3130	49.2	(13.0)	3130	53.9	(12.9)
Hh head male	3130	0.92	(0.27)	3130	0.88	(0.33)
Hh head is married	3130	0.89	(0.31)	3130	0.82	(0.39)
Highest school level completed (hh head)	3130	1.02	(1.05)	3130	0.73	(0.95)
Number of working adult household members	3130	2.2	(1.26)	3130	2.94	(1.99)
Number of working age household members	3130	3.3	(1.71)	3130	3.76	(2.27)
Hrs./year: own agr. production	3130	572.3	(821.7)	3130	856.4	(1145.2)
Hrs./year: self-employed	3130	227	(714.4)	3130	321.5	(1003.2)
Hrs./year: agr. casual labour	3130	458.8	(922)	3130	447.4	(850.5)
Hrs./year: non-agr. casual labour	3130	757.4	(1286.8)	3130	1468.6	(1816.9)
Hrs./year: public works	3130	45.3	(191.9)	3130	84.6	(254.2)
Hrs./year: permanent employment	3130	258.7	(837.8)	3130	612.6	(1434.9)
Annual labour supply (hrs.)	3130	2317.8	(1536.8)	3130	3791	(2733.4)
Annual labour supply, women (hrs.)	3130	393.7	(582.1)	3130	874.1	(1078.8)
Annual labour supply, men (hrs.)	3130	1924.1	(1428.7)	3130	2916.9	(2226.6)
Annual income: agr. casual labour	3130	3059	(7002.2)	3130	5921	(14809.3)
Annual income: non-agr. casual labour	3130	7268.7	(13867.9)	3130	25424.5	(35121.4)
Annual income: permanent employment	3130	6445.9	(24420.6)	3130	18149.2	(54216)
Annual income: public works	3130	312.2	(1351.3)	3130	590.6	(1762.7)
Annual income: livestock production	3130	7549.8	(14785.5)	3130	2413.8	(4585.2)
Annual income: self-employment	3130	7751	(31855.8)	3130	4358.1	(14848.4)
Total annual income: non-labour	3130	2971.9	(7836.4)	3130	26852.5	(29549.8)
Deviation annual rainfall	3130	-0.091	(0.26)	3130	0.23	(0.27)
Deviation annual rainfall (lag)	3130	-0.0054	(0.2)	3130	0.019	(0.21)
NREGS job card	3130	0	(0.00)	3130	0.35	(0.48)

Notes: All values in constant INR (May 2006). One US$ is equivalent to INR 46.38.

Table 3: Agricultural production summary statistics

	N	Mean	SD	N	Mean	SD
Cultivated area (acres)	1831	7.69	(9.36)	1928	6.25	(9.12)
Value of agricultural production	1831	57894.7	(65794.4)	1928	53045.5	(64065.3)
Value of purchased manure	1831	101.2	(668.7)	1907	403.9	(1912.9)
Value of purchased fertilizer	1831	4137.7	(6280.1)	1907	8869.5	(156532.3)
Value of purchased seeds and seedlings	1831	1744.5	(3993.9)	1907	12441	(247839.3)
Quantity of applied seeds and seedlings (kg)	1831	282.8	(1074.0)	1907	270.6	(991.8)
Quantity of applied fertilizer (kg)	1831	710.6	(1165.0)	1907	582.5	(1010.5)
Quantity of applied manure (kg)	1831	1742.2	(4335.0)	1907	585	(2097.3)
No. of days used bullocks	1831	5.2	(10.2)	1907	1.12	(4.82)
No. of days used tractor and other machinery	1831	6.99	(11.6)	1907	3.68	(3.60)
Value of used tractor and other machinery	1831	2846.3	(5567.6)	1907	2573.4	(5499.2)
Total cost of irrigation	1831	445.3	(1100.8)	1907	1624.6	(4540.9)
Total other input costs	1831	1761.2	(3843.1)	1907	576.3	(1852.6)
Total input costs	1831	11036.2	(15669.1)	1907	10637.6	(10514.8)
Family labour (male) used at planting	1831	452.3	(786.9)	1928	238.9	(429.7)
Family labour (female) used at planting	1831	113.3	(212.1)	1928	107.6	(260.2)
Hired labour (male) used at planting	1831	268.2	(1038.5)	1928	177.3	(1080.7)
Hired labour (female) used at planting	1831	142.7	(346.7)	1928	261.4	(1659.7)
Family labour (male) used for harvesting	1831	187.3	(240.0)	1928	62	(113.6)
Family labour (female) used for harvesting	1831	100.9	(139.1)	1928	46.8	(86.8)
Hired labour (male) used for harvesting	1831	180.6	(384.4)	1928	149.6	(509.5)
Hired labour (female) used for harvesting	1831	155.7	(332.9)	1928	133.3	(489.9)
Family labour (male) used for supervision	1831	135.4	(457.5)	1928	46.3	(159.0)
Family labour (female) used for supervision	1831	14.3	(90.0)	1928	31.5	(101.9)
Total hired labour employed in agriculture	1831	747.2	(1596.5)	1928	721.7	(2793.1)
Total family labour employed in agriculture	1831	1003.5	(1321.5)	1928	533	(820.3)
Total labour employed in agriculture	1831	1750.7	(2616.9)	1928	1254.7	(2924.8)
NREGS activities on own or nearby plots	3130	0	(0)	2969	0.046	(0.21)

Notes: All values in constant INR (May 2006). One US$ is equivalent to INR 46.38.

Table 4: NREGS summary statistics

	N	Mean	SD
Total employment generated per capita, NREGS	3130	8.16	(9.50)
Total employment generated per capita, NREGS (log)	3130	1.4	(1.30)
Total spending per capita, NREGS (INR millions)	3130	198.4	(307.7)
Total spending per capita, NREGS (log)	3130	17.6	(4.12)
Share of spending on water conservation, NREGS	3130	0.3	(0.25)
Share of spending on drought-proofing, NREGS	3130	0.075	(0.13)
Share of spending on irrigation facilities, NREGS	3130	0.027	(0.085)
Share of spending on renovation of water bodies, NREGS	3130	0.019	(0.068)
Share of spending on land development, NREGS	3130	0.11	(0.13)
Share of spending on flood control, NREGS	3130	0.00086	(0.0076)
Share of spending on rural connectivity, NREGS	3130	0.27	(0.23)
Share of spending on drainage works, NREGS	3130	0.02	(0.051)
Share of spending on building/maintenance, NREGS	3130	0.076	(0.19)
Share of spending on school buildings, NREGS	3130	0.037	(0.11)
Share of spending on other projects, NREGS	3130	0.057	(0.11)
Wage spending to total spending, NREGS	3130	0.69	(0.19)
Material spending to total spending, NREGS	3130	0.31	(0.19)
Completion rate, NREGS works	3015	0.97	(0.14)

Notes: Author's own calculation based on SEPRI data.

Table 5: Effects of the NREGS on labour supply

	Working hh members				Hours (log)	
	(1)	(2)	(3)	(4)	(5)	(6)
Total employment generated per capita, NREGS (log)	-0.039		48.696		0.009	
	(0.043)		(81.064)		(0.056)	
Total spending per capita, NREGS (log)		0.012		14.294		0.011
		(0.009)		(18.394)		(0.010)
No. of working age hh members	0.420***	0.419***				
	(0.024)	(0.024)				
Age (hh head)	0.010***	0.010***	-1.601	-1.460	-0.018***	-0.018***
	(0.002)	(0.002)	(4.181)	(4.140)	(0.005)	(0.005)
Education: primary	0.052	0.048	102.162	105.665	-0.021	-0.021
	(0.054)	(0.054)	(94.411)	(93.037)	(0.074)	(0.074)
Education: secondary	0.023	0.024	124.316	127.827	-0.029	-0.027
	(0.060)	(0.061)	(106.122)	(106.184)	(0.087)	(0.087)
Education: tertiary and higher	0.083	0.084	207.648	213.749	-0.056	-0.053
	(0.094)	(0.094)	(179.171)	(177.951)	(0.146)	(0.146)
Hh head male	0.076	0.074	216.584	211.605	1.130***	1.127***
	(0.106)	(0.106)	(193.789)	(194.036)	(0.239)	(0.239)
Hh head is married	-0.081	-0.075	-173.987	-167.080	-0.441*	-0.436*
	(0.089)	(0.090)	(143.742)	(144.285)	(0.182)	(0.183)
Household size	0.143***	0.143***	496.283***	496.571***	0.241***	0.241***
	(0.016)	(0.016)	(26.908)	(26.916)	(0.018)	(0.018)
Observations	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 6: Effect of the NREGS on labour supply to different sectors

	Public works		Own agr. production		Agr. casual work		Casual work		Perm. employment		Self-employment		Migration	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Total employment generated per capita, NREGS (log)	0.231*		0.077		-0.047		-0.035		0.108		-0.072		-0.002	
	(0.116)		(0.098)		(0.117)		(0.154)		(0.127)		(0.070)		(0.007)	
Total spending per capita, NREGS (log)		0.020		0.010		0.013		0.058+		-0.027		-0.013		-0.001
		(0.033)		(0.022)		(0.021)		(0.034)		(0.031)		(0.017)		(0.001)
Age (hh head)	-0.003	-0.003	-0.003	-0.003	-0.011+	-0.011+	-0.015+	-0.015+	-0.009+	-0.008+	0.007	0.006	-0.000	-0.000
	(0.003)	(0.003)	(0.007)	(0.007)	(0.006)	(0.006)	(0.008)	(0.008)	(0.005)	(0.005)	(0.005)	(0.005)	(0.000)	(0.000)
Education: primary	-0.202+	-0.183	-0.005	0.001	-0.117	-0.122	-0.071	-0.077	0.164	0.175	0.183	0.177	0.008	0.007
	(0.111)	(0.111)	(0.147)	(0.145)	(0.172)	(0.173)	(0.150)	(0.151)	(0.133)	(0.135)	(0.117)	(0.117)	(0.010)	(0.009)
Education: secondary	-0.137	-0.127	-0.047	-0.043	-0.171	-0.170	-0.274	-0.266	0.260	0.258	0.450**	0.446**	0.000	0.000
	(0.104)	(0.103)	(0.182)	(0.180)	(0.204)	(0.204)	(0.207)	(0.208)	(0.161)	(0.161)	(0.155)	(0.154)	(0.012)	(0.012)
Education: tertiary and higher	-0.078	-0.063	0.082	0.088	-0.535+	-0.534+	-0.985*	-0.970*	1.239***	1.236***	0.433+	0.426+	-0.009	-0.009
	(0.155)	(0.154)	(0.315)	(0.314)	(0.276)	(0.276)	(0.393)	(0.397)	(0.300)	(0.303)	(0.222)	(0.222)	(0.011)	(0.011)
Hh head male	-0.114	-0.126	0.588*	0.583*	-0.495+	-0.497+	1.320***	1.306***	-0.104	-0.100	0.250	0.255	0.034+	0.035*
	(0.193)	(0.197)	(0.251)	(0.253)	(0.256)	(0.257)	(0.320)	(0.319)	(0.213)	(0.210)	(0.187)	(0.187)	(0.017)	(0.017)
Hh head is married	0.102	0.112	0.173	0.178	0.222	0.228	-0.430+	-0.403	-0.011	-0.024	-0.243	-0.249	-0.022+	-0.023+
	(0.147)	(0.151)	(0.219)	(0.220)	(0.207)	(0.207)	(0.255)	(0.253)	(0.191)	(0.188)	(0.179)	(0.180)	(0.013)	(0.013)
Household size	0.067***	0.068***	0.146***	0.146***	0.089***	0.090***	0.301***	0.301***	0.192***	0.192***	0.066**	0.066**	-0.001	-0.001
	(0.018)	(0.018)	(0.023)	(0.023)	(0.026)	(0.026)	(0.030)	(0.030)	(0.025)	(0.025)	(0.020)	(0.020)	(0.002)	(0.002)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 7: Effect of the NREGS on agricultural production

	Agr. production		Agr. productivity		Inputs		Hh time agr.		Labour demand agr.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
NREGS job card	0.003		-0.050		0.196 +		-0.064		-0.016	
	(0.115)		(0.094)		(0.113)		(0.077)		(0.090)	
Hours worked in public works (log)		-0.025		-0.025 +		-0.019		0.006		0.005
		(0.018)		(0.014)		(0.018)		(0.012)		(0.013)
Total spending per capita, NREGS (log)	0.009	0.007	0.002	0.001	0.015	0.012	0.005	0.006	0.011	0.011
	(0.013)	(0.014)	(0.012)	(0.012)	(0.035)	(0.037)	(0.017)	(0.017)	(0.020)	(0.019)
Age (hh head)	0.006 *	0.006 *	0.001	0.000	0.002	0.002	0.008 **	0.008 **	0.013 ***	0.013 ***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Education: primary	0.075	0.074	-0.005	-0.005	-0.036	-0.038	-0.050	-0.050	0.042	0.042
	(0.079)	(0.079)	(0.068)	(0.068)	(0.068)	(0.069)	(0.061)	(0.061)	(0.062)	(0.062)
Education: secondary	0.055	0.053	-0.069	-0.070	-0.023	-0.027	-0.106	-0.104	0.018	0.019
	(0.092)	(0.092)	(0.084)	(0.085)	(0.081)	(0.083)	(0.072)	(0.072)	(0.075)	(0.075)
Education: tertiary and higher	0.122	0.120	-0.062	-0.063	0.012	0.007	-0.013	-0.012	0.207 +	0.207 +
	(0.129)	(0.128)	(0.104)	(0.104)	(0.121)	(0.120)	(0.108)	(0.109)	(0.110)	(0.110)
Hh head male	0.486 **	0.484 **	0.366 **	0.363 **	0.390 **	0.393 **	-0.061	-0.062	0.049	0.049
	(0.155)	(0.155)	(0.123)	(0.122)	(0.126)	(0.126)	(0.110)	(0.110)	(0.138)	(0.138)
Hh head is married	-0.348 **	-0.347 **	-0.277 **	-0.272 **	-0.079	-0.092	0.098	0.102	0.024	0.025
	(0.119)	(0.119)	(0.095)	(0.094)	(0.097)	(0.096)	(0.094)	(0.094)	(0.106)	(0.106)
Household size	0.029 **	0.030 **	0.008	0.010	0.008	0.011	0.029 **	0.028 **	0.051 ***	0.050 ***
	(0.011)	(0.011)	(0.009)	(0.009)	(0.013)	(0.013)	(0.009)	(0.009)	(0.010)	(0.010)
Cultivated area (acres)	0.047 ***	0.047 ***	-0.022 ***	-0.022 ***	-0.020 ***	-0.019 ***	-0.032 ***	-0.033 ***	0.036 ***	0.036 ***
	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)
Observations	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 8: Effect of the NREGS on household time allocation

	Own agr. production		Self-employment		Perm. employment	
	(1)	(2)	(3)	(4)	(5)	(6)
NREGS job card	0.181		0.039		-0.136	
	(0.173)		(0.149)		(0.174)	
Hours worked in public works (log)		0.018		-0.012		0.003
		(0.029)		(0.020)		(0.026)
Total spending per capita, NREGS (log)	0.008	0.009	-0.013	-0.012	-0.026	-0.028
	(0.021)	(0.021)	(0.017)	(0.017)	(0.032)	(0.031)
Age (hh head)	-0.002	-0.002	0.006	0.006	-0.008+	-0.008+
	(0.007)	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)
Education: primary	0.010	0.005	0.179	0.175	0.169	0.175
	(0.143)	(0.142)	(0.115)	(0.116)	(0.135)	(0.135)
Education: secondary	-0.075	-0.082	0.448**	0.444**	0.252	0.259
	(0.177)	(0.176)	(0.155)	(0.154)	(0.160)	(0.160)
Education: tertiary and higher	0.055	0.055	0.427+	0.426+	1.234***	1.236***
	(0.277)	(0.275)	(0.222)	(0.222)	(0.302)	(0.303)
Hh head male	0.577*	0.579*	0.255	0.254	-0.100	-0.100
	(0.244)	(0.245)	(0.187)	(0.187)	(0.210)	(0.209)
Hh head is married	0.112	0.115	-0.250	-0.248	-0.020	-0.024
	(0.209)	(0.208)	(0.180)	(0.180)	(0.188)	(0.188)
Household size	0.108***	0.109***	0.065**	0.067**	0.194***	0.192***
	(0.023)	(0.023)	(0.021)	(0.020)	(0.025)	(0.025)
Cultivated area (acres)	0.135***	0.135***				
	(0.021)	(0.021)				
Observations	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 9: Effect of the NREGS on agricultural production by farm size

	Agr. production			Agr. productivity			Inputs			Labour demand agr.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Total employment generated per capita, NREGS (log)	-0.125*			-0.102*			0.145			0.012		
	(0.051)			(0.042)			(0.129)			(0.060)		
Total spending per capita, NREGS (log)		0.009	0.017		0.002	0.007		0.013	0.021		0.005	0.000
		(0.013)	(0.014)		(0.012)	(0.013)		(0.036)	(0.036)		(0.017)	(0.017)
Total spending per capita, NREGS x Cultivated area			-0.001**			-0.001*			-0.001**			0.001*
			(0.000)			(0.000)			(0.000)			(0.000)
Age (hh head)	0.006*	0.006*	0.005+	0.001	0.001	0.000	0.002	0.002	0.001	0.008**	0.008**	0.008**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Education: primary	0.082	0.074	0.062	0.002	-0.005	-0.011	-0.052	-0.038	-0.049	-0.052	-0.050	-0.042
	(0.080)	(0.079)	(0.077)	(0.069)	(0.068)	(0.068)	(0.070)	(0.068)	(0.067)	(0.061)	(0.061)	(0.061)
Education: secondary	0.065	0.055	0.042	-0.059	-0.069	-0.076	-0.048	-0.026	-0.038	-0.109	-0.105	-0.096
	(0.092)	(0.092)	(0.091)	(0.085)	(0.084)	(0.083)	(0.082)	(0.082)	(0.080)	(0.073)	(0.072)	(0.070)
Education: tertiary and higher	0.119	0.122	0.109	-0.060	-0.061	-0.068	-0.003	0.009	-0.003	-0.016	-0.012	-0.004
	(0.129)	(0.128)	(0.129)	(0.104)	(0.104)	(0.104)	(0.125)	(0.120)	(0.120)	(0.109)	(0.109)	(0.107)
Hh head male	0.483**	0.486**	0.461**	0.360**	0.365**	0.352**	0.413**	0.395**	0.372**	-0.058	-0.062	-0.047
	(0.157)	(0.155)	(0.148)	(0.123)	(0.122)	(0.119)	(0.127)	(0.127)	(0.123)	(0.107)	(0.110)	(0.112)
Hh head is married	-0.355**	-0.348**	-0.329**	-0.277**	-0.274**	-0.264**	-0.094	-0.093	-0.075	0.100	0.102	0.090
	(0.121)	(0.120)	(0.115)	(0.094)	(0.095)	(0.093)	(0.099)	(0.097)	(0.094)	(0.094)	(0.094)	(0.094)
Household size	0.028*	0.029**	0.031**	0.008	0.008	0.009	0.009	0.009	0.011	0.028**	0.028**	0.027**
	(0.011)	(0.011)	(0.011)	(0.009)	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)	(0.009)	(0.009)	(0.009)
Cultivated area (acres)	0.046**	0.047**	0.058**	-	-	-	-0.019***	-0.019***	-0.009+	-	-	-
	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)
Observations	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759	3759

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 10: Effect of NREGS works on agricultural production

	Crop area	Agr. production	Agr. productivity	Inputs	Labour demand agr.	Own time
	(1)	(2)	(3)	(4)	(5)	(6)
NREGS activities on own or nearby plots	2.836+	15309.363+	233.849	6864.365**	283.800	449.927**
	(1.633)	(8761.131)	(1609.695)	(2343.227)	(440.763)	(148.199)
Age (hh head)	0.018	200.224	-30.744	124.555*	23.981*	1.867
	(0.039)	(163.225)	(21.256)	(58.471)	(10.434)	(2.912)
Education: primary	-0.202	6324.681	-352.544	2802.714+	81.154	26.883
	(0.779)	(5012.502)	(720.404)	(1484.827)	(161.016)	(79.744)
Education: secondary	0.734	8051.182+	-1603.171	3412.957*	251.431	-74.462
	(1.015)	(4441.183)	(966.244)	(1634.369)	(330.853)	(65.412)
Education: tertiary and higher	0.291	11205.472	-2061.389+	5832.415*	427.599	33.942
	(1.205)	(6898.010)	(1156.511)	(2511.608)	(426.337)	(102.448)
Hh head male	-2.069	3120.934	1783.906	1611.945	18.621	80.940
	(1.329)	(7156.711)	(1264.569)	(2455.433)	(314.829)	(101.835)
Hh head is married	0.830	-9251.092	-2310.274**	-1326.425	200.327	-93.912
	(0.835)	(6158.403)	(840.154)	(2001.131)	(259.598)	(93.204)
Household size	0.244*	2501.476**	42.411	560.174*	86.069**	95.067***
	(0.099)	(794.960)	(86.303)	(263.014)	(28.410)	(12.982)
Total spending per capita, NREGS (log)	0.005	577.110	-25.270	-334.458	10.940	14.610
	(0.123)	(425.287)	(172.818)	(604.012)	(36.617)	(14.070)
Cultivated area (acres)			-140.112***			20.699***
			(25.570)			(4.129)
Observations	3759	3759	3759	3738	3759	3759

Notes: Clustered standard errors in parentheses. Education refers to household head. State-time fixed effects, current and lagged rainfall shocks and time trend included, but not reported. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 11: Heterogeneity in effects of the NREGS on total employment by technical aspects

	(1)	(2)	(3)	(4)
Total spending per capita, NREGS (log)	4.700	3.437	7.795	0.008
	(5.104)	(5.387)	(5.673)	(0.017)
Total spending per capita x Material spending to total spending, NREGS	-2.678	9.664		
	(7.174)	(22.083)		
Total spending per capita x Material spending to total spending (square)		-15.210		
		(23.274)		
Total spending per capita x Year, NREGS works started			-0.004	
			(0.003)	
Total spending per capita x No. of work taken up since NREGS implementation				-0.000***
				(0.000)
Age (hh head)	-3.650**	-3.651**	-0.028***	-0.028***
	(1.365)	(1.368)	(0.005)	(0.005)
Education: primary	22.287	22.304	-0.013	-0.023
	(25.926)	(25.919)	(0.075)	(0.074)
Education: secondary	9.127	8.957	-0.033	-0.030
	(27.352)	(27.372)	(0.081)	(0.081)
Education: tertiary and higher	28.427	28.258	-0.130	-0.102
	(46.664)	(46.584)	(0.146)	(0.147)
Hh head male	174.949**	174.978**	0.805***	0.801***
	(64.397)	(64.372)	(0.236)	(0.235)
Hh head is married	-103.319+	-102.809+	-0.154	-0.151
	(52.413)	(52.465)	(0.195)	(0.193)
Household size	19.174***	19.001***	0.173***	0.171***
	(4.669)	(4.677)	(0.019)	(0.019)
Observations	6260	6260	6002	6030

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 12: Heterogeneity in effects of the NREGS on total employment by governance aspects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	0.017	0.021	0.012	0.008	0.021+	0.008	0.001	-0.000	0.018*	0.018
	(0.012)	(0.020)	(0.011)	(0.010)	(0.012)	(0.022)	(0.012)	(0.013)	(0.009)	(0.016)
Total spending per capita x NREGS Registration process open to all	-0.010									
	(0.010)									
Total spending per capita x NREGS Job cards issued		-0.017								
		(0.023)								
Total spending per capita x NREGS Norms for application of work followed			-0.008							
			(0.018)							
Total spending per capita x NREGS Plan for work inclusive				-0.001						
				(0.012)						
Total spending per capita x NREGS Implementation of works transparent					-0.018					
					(0.013)					
Total spending per capita x NREGS Wage Payment correct and on time						-0.001				
						(0.026)				
Total spending per capita x NREGS Monitoring committees in place							0.007			
							(0.010)			
Total spending per capita x NREGS Social Audits conducted								0.010		
								(0.014)		
Total spending per capita x NREGS Worksite facilities in place									-0.024*	
									(0.011)	
Total spending per capita x NREGS implementation										-0.014
										(0.021)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 13: Heterogeneity in effects of the NREGS on total employment by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	10.475	13.689	15.519	15.834	9.004	14.524	14.720	19.184	27.470	12.970
	(18.343)	(18.703)	(19.003)	(18.316)	(19.589)	(18.463)	(18.468)	(18.510)	(18.506)	(18.236)
Total spending per capita x Share of spending on water conservation	15.273									
	(15.140)									
Total spending per capita x Share of spending on drought-proofing		6.864								
		(40.623)								
Total spending per capita x Share of spending on irrigation facilities			-21.049							
			(44.472)							
Total spending per capita x Share of spending on renovation of water bodies				-64.533						
				(82.732)						
Total spending per capita x Share of spending on land development					58.079+					
					(34.833)					
Total spending per capita x Share of spending on flood control						-128.680				
						(276.731)				
Total spending per capita x Share of spending on rural connectivity							-2.342			
							(17.399)			
Total spending per capita x Share of spending on drainage works								-117.403+		
								(69.476)		
Total spending per capita x Share of spending on building/maintenance									-81.312***	
									(18.368)	
Total spending per capita x Share of spending on school buildings										26.206
										(45.823)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 14: Heterogeneity in effects of the NREGS on employment in own agricultural production by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	-4.776	4.753	-0.680	1.470	-1.286	1.127	2.555	2.991	7.561	1.292
	(7.250)	(7.231)	(7.403)	(7.112)	(7.557)	(7.078)	(7.543)	(7.306)	(6.827)	(7.049)
Total spending per capita x Share of spending on water conservation	24.803*									
	(11.185)									
Total spending per capita x Share of spending on drought-proofing		-41.683**								
		(15.303)								
Total spending per capita x Share of spending on irrigation facilities			33.704							
			(23.513)							
Total spending per capita x Share of spending on renovation of water bodies				-4.750						
				(31.340)						
Total spending per capita x Share of spending on land development					29.227					
					(18.843)					
Total spending per capita x Share of spending on flood control						105.785				
						(69.888)				
Total spending per capita x Share of spending on rural connectivity							-5.969			
							(9.939)			
Total spending per capita x Share of spending on drainage works								-38.959		
								(48.286)		
Total spending per capita x Share of spending on building/maintenance									-38.181**	
									(12.923)	
Total spending per capita x Share of spending on school buildings										1.251
										(34.313)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 15: Heterogeneity in effects of the NREGS on employment in casual agricultural work by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	2.453	4.199	8.405	4.137	4.392	2.801	4.973	2.337	1.232	3.547
	(5.756)	(5.905)	(5.951)	(6.146)	(6.104)	(6.140)	(6.336)	(6.288)	(5.984)	(5.816)
Total spending per capita x Share of spending on water conservation	4.952									
	(6.964)									
Total spending per capita x Share of spending on drought-proofing		-6.409								
		(10.526)								
Total spending per capita x Share of spending on irrigation facilities			-78.387*							
			(31.848)							
Total spending per capita x Share of spending on renovation of water bodies				-18.739						
				(29.013)						
Total spending per capita x Share of spending on land development					-7.927					
					(14.731)					
Total spending per capita x Share of spending on flood control						409.085*				
						(176.952)				
Total spending per capita x Share of spending on rural connectivity							-6.443			
							(5.735)			
Total spending per capita x Share of spending on drainage works								31.870		
								(38.315)		
Total spending per capita x Share of spending on building/maintenance									15.035+	
									(7.964)	
Total spending per capita x Share of spending on school buildings										2.644
										(16.701)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 16: Heterogeneity in effects of the NREGS on employment in casual work by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	30.236	23.538	27.353	27.727	26.724	28.068	27.781	32.438	32.074	26.449
	(20.617)	(20.481)	(20.930)	(20.735)	(20.922)	(20.677)	(21.265)	(21.310)	(21.576)	(20.419)
Total spending per capita x Share of spending on water conservation	-8.771									
	(12.989)									
Total spending per capita x Share of spending on drought-proofing		55.541								
		(35.406)								
Total spending per capita x Share of spending on irrigation facilities			11.866							
			(17.089)							
Total spending per capita x Share of spending on renovation of water bodies				13.873						
				(25.692)						
Total spending per capita x Share of spending on land development					14.885					
					(41.576)					
Total spending per capita x Share of spending on flood control						0.233				
						(154.964)				
Total spending per capita x Share of spending on rural connectivity							1.430			
							(16.829)			
Total spending per capita x Share of spending on drainage works								-103.956		
								(73.141)		
Total spending per capita x Share of spending on building/maintenance									-24.634	
									(19.085)	
Total spending per capita x Share of spending on school buildings										33.174+
										(19.862)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 17: Heterogeneity in effects of the NREGS on self-employment by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	-6.366	-6.933	-6.135	-6.130	-7.657	-6.058	-5.378	-7.034	-4.168	-6.533
	(4.865)	(5.004)	(5.066)	(4.963)	(4.939)	(4.986)	(4.987)	(5.041)	(4.924)	(4.963)
Total spending per capita x Share of spending on water conservation	0.043									
	(5.752)									
Total spending per capita x Share of spending on drought-proofing		7.081								
		(7.873)								
Total spending per capita x Share of spending on irrigation facilities			-3.649							
			(12.780)							
Total spending per capita x Share of spending on renovation of water bodies				-9.139						
				(15.487)						
Total spending per capita x Share of spending on land development					14.413					
					(8.774)					
Total spending per capita x Share of spending on flood control						-138.494				
						(150.565)				
Total spending per capita x Share of spending on rural connectivity							-4.855			
							(6.096)			
Total spending per capita x Share of spending on drainage works								16.160		
								(26.571)		
Total spending per capita x Share of spending on building/maintenance									-13.449 **	
									(4.902)	
Total spending per capita x Share of spending on school buildings										3.640
										(9.205)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table 18: Heterogeneity in effects of the NREGS on permanent employment by activity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Total spending per capita, NREGS (log)	-14.854	-16.003	-15.617	-15.160	-15.981	-14.843	-17.658	-15.119	-13.701	-15.346
	(13.122)	(12.332)	(12.692)	(12.636)	(12.285)	(12.734)	(13.272)	(12.543)	(11.576)	(12.462)
Total spending per capita x Share of spending on water conservation	-3.989									
	(8.662)									
Total spending per capita x Share of spending on drought-proofing		2.001								
		(16.630)								
Total spending per capita x Share of spending on irrigation facilities			-3.703							
			(19.750)							
Total spending per capita x Share of spending on renovation of water bodies				-27.668						
				(40.138)						
Total spending per capita x Share of spending on land development					1.566					
					(15.691)					
Total spending per capita x Share of spending on flood control						-465.780***				
						(137.139)				
Total spending per capita x Share of spending on rural connectivity							9.035			
							(11.059)			
Total spending per capita x Share of spending on drainage works								-17.159		
								(64.590)		
Total spending per capita x Share of spending on building/maintenance									-13.157	
									(11.077)	
Total spending per capita x Share of spending on school buildings										-10.122
										(14.337)
Observations	6260	6260	6260	6260	6260	6260	6260	6260	6260	6260

Notes: Clustered standard errors in parentheses. Controls are those of main model. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

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