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Can Workfare Serve as a Substitute for Weather Insurance? The Case of NREGA in Andhra Pradesh

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Abstract

The rural poor in developing countries have great difficulty in coping with adverse weather. In theory, workfare programs may serve as an important mechanism for allowing households to deal with the effects of weather related shocks. If participation in a workfare program is sufficiently flexible households in a village which suffers bad weather may compensate for the loss of income by increasing their participation in the program. If participation in a workfare program is not sufficiently flexible due to, for example, caps on overall participation at the local level, then the program will not allow households to compensate for the effects of a weather shock. We evaluate whether India's new workfare program for rural areas, the National Rural Employment Guarantee Act (NREGA), allowed households in one state to mitigate the effects of weather induced income shocks by looking at whether NREGA participation is responsive to changes in rainfall. We find that NREGA did allow households to mitigate the effects of weather induced income shocks. While we are unable to precisely identify the relationship between changes in income and participation in NREGA, we show that the relationship is strong enough to be practically significant.

1 Introduction

For the rural poor in developing countries, the chance that bad weather will ruin the local harvest is one of the largest risks looming over their lives. It is also one

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of the most difficult to do anything about. Appropriate insurance products are rarely available and informal coping strategies such as increasing one's supply of labour or selling off assets are only marginally effective in the face of such shocks. Due to the aggregate nature of weather shocks, many in an affected region often adopt the same ex post coping strategy at once thereby reducing its usefulness. (It's hard to find additional work when everyone else in a village is also looking for a job or to get a reasonable price on an asset if everyone else is selling the same asset at the same time.) Indeed, research has shown that for the rural poor in developing countries, weather induced changes in income translate directly into changes in consumption levels. (Townsend, 1994, Jacoby and Skoufias, 1998)

Further, for the rural poor, exposure to weather related risk not only leads to highly variable income but also, indirectly, to lower income. Lacking better options, the rural poor are forced to rely on crude ex ante mechanisms for reducing susceptible to weather related risk which, while reducing their exposure to bad weather, also reduces their expected income. Binswanger and Rosenzweig (1993) find that rural households in India over-invest (from a profit maximizing perspective) in relatively low return assets which can be sold off quickly in the event of bad weather. Similarly, Morduch finds that rural farmers often plant lower yield but more predictable crops and delay planting in order to reduce exposure to bad weather. (Morduch, 1999)

Designing effective policies to help the rural poor better cope with weather risks has proved a difficult task. The most salient policy option, crop insurance, has found little success in developing countries. Whether due to lack of trust or lack of understanding, demand from farmers is typically low even when rates are heavily subsidized; payouts are often more responsive to local political pressures than how good or poor the crop is; and even when it is successful, crop insurance does little for landless laborers who are likely to see their wages fall drastically in the event of a village level shock.[1] In theory means tested welfare programs, such as conditional cash transfers, may mitigate the effects of aggregate shocks if receipt of benefits is based on an assessment of potential beneficiaries' income levels and assessments are conducted on a regular basis. Yet in practice these programs are unlikely to be sufficiently responsive to changes in income due to gaps between assessments and imperfections in the assessment method. Less directly, governments may encourage financial institutions to reach out to the poor so that they have better options to save in anticipation of a shock and greater access to consumption credit in case one hits. Research has shown that increased financial inclusion does indeed reduce vulnerability to weather related shocks. Jayachandran (2006) finds that the wage for manual labor falls less in districts with greater access to banking services when there is a negative shock

[1] The nearly opposite criticism of workfare is also plausible – that while it may serve as a mechanism for poor households to deal with weather shocks it may actually increase the risk for large landowners. In the absence of a workfare program, in the event of a village level shock, wages will typically fall thus reducing the impact of the shock on the landowner as his costs of products are lowered. If a workfare program is present though, the impact of the shock on wages is likely to be reduced.

to agricultural productivity. Yet despite the recent growth of microfinance, access to financial products of any kind, including micro-credit, remains low in developing countries, especially among the poorest of the poor.

Workfare programs, though not commonly thought of as a means of reducing vulnerability to weather related risks, may serve as an important mechanism for mitigating the effects of weather shocks by allowing target households to work more to make up for income lost due to a weather shock.[2] Whether or not a workfare program helps target households deal with the effects of weather shocks depends crucially on whether provision of work under the program is sufficiently responsive to changes in demand at the village level and higher though. There are several reasons why provision of work in a workfare program may not be responsive to demand at the village level or higher. Delays in identifying and approving new work projects may cause provision of work to lag behind demand. Alternatively, if demand for work outstrips supply, work will likely be rationed. Chaudhuri et al (1993) find that, despite claims to the contrary, officials in charge of the Maharashtra Employment Guarantee Scheme likely rationed access to the scheme after a large increase in program wages. If rationing takes the form of hard limits on aggregate program participation at the local level, the workfare program will likely not help in mitigating the effects of weather shocks.

In this article, we attempt to assess whether a recently enacted workfare program in India, the National Rural Employment Guarantee Act (NREGA), allowed potential participants to mitigate the effects of weather shocks by investigating whether participation levels in the program in one state were responsive to changes in rainfall. While lack of data prevents us from drawing firm conclusions about the precise impact of rainfall induced changes in income on NREGA participation rates at the household level, we find that sub-district level aggregate NREGA participation does respond to income shocks caused by fluctuations in weather. We also find that NREGA participation levels are more responsive to weather induced shocks than other government welfare programs. Our findings suggest that workfare can indeed be an effective policy tool for mitigating the effects of aggregate shocks even if, as appears to be the case in NREGA, demand for work is not fully met.

The paper is organized as follows. Sections two and three provide a brief introduction to the scheme and its implementation in the state of Andhra Pradesh. In sections four and five, we describe our empirical strategy for assessing whether participation in NREGA is responsive to weather induced changes in income. In section six, we present results from the analysis. In section seven we conclude.

[2]Recently, debate over the relative merits of workfare programs has revolved around whether workfare programs are more effective in targeting the poor than other types of welfare programs. The potential benefits of workfare in reducing vulnerability to weather risk figured largely in early academic discussion of workfare programs though. Notably, Binswanger and Rosenzweig's (1994) seminal article, referred to above, in which they find that poor rural households over-invest in low return assets due to weather risk concludes by pointing out that public work programs may be an effective means of addressing weather risk. Morduch (1999) as well highlights workfare as a potential mechanism for reducing vulnerability to weather related risks.

2 NREGA

The National Rural Employment Guarantee Act, passed by the United Progressive Alliance (UPA) government in 2005, is one of the largest and most ambitious anti-poverty schemes adopted by the Indian government since independence. The act provides a legal guarantee of 100 days of work a year at a minimum wage to all households in India willing to perform unskilled manual labor. According to the act, any household seeking work must be provided with employment within 15 days or else be paid a daily unemployment allowance until work is found. NREGA has been selectively rolled out in three phases, starting with the 200 most backward districts in India, over the past two and a half years and now is being implemented in all districts nationwide.

Responsibility for the immense task of generating sufficient work for all who demand it and for supervising worksites is delegated to the Panchayati Raj Institutions in the act.[3] Gram Panchayats are tasked with estimating local demand for work, suggesting suitable projects, issuing job cards for new job seekers, monitoring worksites, and implementing at least 50% of worksites. Intermediate (Block / Mandal) Panchayats are responsible for ensuring that job seekers are provided with work within 15 days and identifying appropriate works if the GP fails to do so. (In some states, these responsibilities have been legally devolved to the GPs.) District (Zilla) Panchayats are required to develop five year plans based on overall district needs and to coordinate NREGA activities at the district level. (Right to Food, 2005)

In practice, implementation of NREGA has varied greatly from state to state. Table 1 lists key figures related to implementation of NREGA by state in India for the most recent fiscal year. As the table shows, there is wide disparity in the overall rates of participation in NREGA.

3 NREGA in Andhra Pradesh

Andhra Pradesh (AP) was chosen for this study not because the state is more affected by aggregate shocks than other states or is particularly interesting for our purposes any other way but rather due to the fact that it is the only state which has made available detailed records of each participant in NREGA to the public over the internet. This fact alone provides some indication of how NREGA has been implemented in the state. In terms of transparency, the implementation of NREGA by the state government has been exemplary. AP is the only state to have established an independent agency to promote and oversee local level audits of NREGA. Initial reports, as well as the anecdotal experience of the authors, indicate that this system has been highly effective in controlling corruption in the scheme. (Aakela and Kidambi, 2007) AP is also

[3]Panchayat Raj Institutions are a system of local governance based on three tiers of locally elected bodies: gram (or village) panchayats, intermediate panchayats, and district (or zilla) panchayats. In addition to NREGA, panchayati raj institutions are also responsible for administering several local infrastructure programs. For an overview of the panchayati raj system see Chattopadhyay and Duflo (2004).

the only state to have implemented an advanced information system for tracking participation data. (It is from this system that the data used in this report was gathered.)

Yet while the state has performed an excellent job in shining light on its own implementation efforts, it is less clear how successful these efforts have been in meeting demand for employment under the scheme. Under pressure from large landowners who complain that NREGA is pushing up agricultural wages, the state has adopted a policy of formulating Gram Panchayat level "work calendars" for NREGA work.[4] These work calendars dictate when NREGA will be allowed and when it will not be allowed for each Gram Panchayat, in explicit violation of the letter of the National Rural Employment Guarantee act. In principle, work calendars are negotiated and agreed upon by Gram Panchayat leaders in consultation with bureaucrats yet, in practice, the authors found that local level leaders were often completely excluded from this process. The practice of formulating work calendars calls into question whether provision of work at the Gram Panchayat level is truly flexible.

Figure 1 provides a map of Andhra Pradesh with districts shaded according to NREGA rollout phase. Figure 2 displays a distribution of the total number of days worked per household for phase one districts. Table 2 presents summary statistics from the data on NREGA participation in Andhra Pradesh. The figures may serve to give readers an idea of the massive scale of the program.

4 Empirical Strategy

Any attempt to estimate whether participation in NREGA is responsive to weather induced changes in income is complicated by the fact that weather may directly affect NREGA participation rates other than by affecting a household's income. For example, some types of NREGA work cannot be performed if there is excessive rain. Thus, a simple regression of NREGA participation on rainfall variables may generate misleading results. To prevent the direct effect of weather on NREGA participation from corrupting our results we divide up the calendar year into two non-overlapping seasons: a lean season from December to May and an agricultural season from June to November. As figures 3 and 4 show, the majority of rain falls during the agricultural season while the majority of NREGA work is performed during the lean season. We restrict our analysis to estimating the impact of rainfall in each agricultural season on NREGA participation in the following lean season. This strategy may lead us to underestimate the impact of weather on NREGA participation (especially for the month of June, when NREGA participation may increase due to a late monsoon) but will prevent us from misattributing a direct effect of rain on NREGA participation to an income related effect.

Our approach to estimating the effect of weather induced income shocks

[4] For an account of the adoption of work calendars see http://www.eenadu.net/homedisplay.asp?qry1=StateNews&qry2=1&qry4=16&qry3=16. (Telugu)

on NREGA participation may still lead to erroneous conclusions if agricultural season rainfall directly affects lean season NREGA participation other than through income. There are a few ways in which, theoretically, this could occur. First, excessive agricultural season rainfall could wash out or otherwise destroy NREGA work done in the previous season and thus cause village planners to increase lean season NREGA participation to rebuild what has been destroyed by the rain. Yet site visits by the authors revealed that NREGA officials and villagers themselves view the usefulness of the output of NREGA work as marginal at best. Further, calculations of the maximum amount of work which can be performed at a worksite are performed when a worksite is first initiated and are not changed in the event of damage to the worksite. Perhaps more importantly, even if it is the case that rainfall induced damage to worksites increases NREGA participation, this would only weaken our main effect since an increase in rainfall would tend to lead to a better harvest and thus more income.

Second, deviations in rainfall may lead people to revise their assessment of the utility of NREGA work. A large portion of NREGA work is engaged in irrigation and water harvesting. (Out of the eight officially sanctioned types of projects that can be undertaken under NREGA, six involve some form of irrigation or water harvesting. (Right to Food, 2005)) A drought or flood may cause villagers or bureaucrats to change their view of the usefulness of this type of work. Yet, as mentioned above, to date bureaucrats and villagers alike view the output of NREGA work as marginal. Further, considering that farmers have vast generations of knowledge on rainfall and methods of irrigation and water harvesting, it is unlikely that a single season would fundamentally alter their preferences toward this type of work.

Third, if overall yearly spending on NREGA at the sub-district level is subject to pre-determined caps but agricultural season participation is still responsive to weather then officials may increase / decrease NREGA in the lean season in order to compensate for rainfall induced changes in participation levels in the agricultural season. Again, if true this would likely only weaken our results as this would lead to a relationship between agricultural season rainfall and lean season participation opposite to the one we have speculated. Fourth, bureaucrats may explicitly tie implementation levels of NREGA to rainfall variables. We found no evidence of this during our discussions with various officials involved in implementation of NREGA nor have we heard or read of this occurring elsewhere. Fifth, poor weather in the agricultural season may lead to increased migration in search of work and thus lower participation in NREGA. As with points one and three, while plausible, if true this would only weaken our results.

A further potential threat to our analysis is that official NREGA participation may not always represent true participation due to corruption. Niehaus and Sukhankter (2008) find that for one area in southern Orissa, the vast majority of official NREGA work was in fact fraudulent. Yet anecdotal accounts suggest that the transparency measures enacted in AP to limit corruption in NREGA have in fact been largely successful. (Aakela et at, 2008) Further, it is unlikely that corruption in NREGA in the lean season would be affected by rainfall in the agricultural season except insofar as increases or decreases in legitimate NREGA participation affect opportunities for hiding corruption.

A more worrying obstacle to our analysis is that we are unable to directly observe income. Ideally, our data on NREGA participation and rainfall would be complemented by detailed household level data on income levels. We could then first estimate the relationship between agricultural rainfall variables and the village wage for manual labor and changes to household income broken up according to whether the change is idiosyncratic or covariate with other households. Alternatively, with access to sub-district measures of income we could at least estimate the effect changes in these variables on participation in NREGA.

Unfortunately, data on incomes was not available and thus our analysis is necessarily restricted to estimation of a reduced form equation. This presents us with a rather tricky problem of interpretation. If we find that there is no effect of agricultural season rainfall on lean season NREGA participation we would be unable to determine whether this is due to the fact that agricultural season rainfall does not affect income or that income does not affect NREGA participation. Likewise, if we do find an effect of rainfall on NREGA participation, we are unable to translate these results into a meaningful conclusion regarding the impact of weather induced income changes on NREGA participation.

In the results section of this paper, we attempt to partially overcome these obstacles through two methods. First, we translate the relationship between rainfall variables and NREGA participation into more intuitive terms through a variety of methods. Second, we compare the responsiveness of NREGA participation to rainfall induced income variation, as estimated by our specific model, with the responsiveness of another government program to rainfall induced income variation as estimated by the same model.

5 Empirical Model

Our empirical model seeks to capture the effect of agricultural season rainfall on lean season participation in NREGA. In coding rainfall data, we have adopted a flexible approach along the lines of Ravallion et al (1988) and Binswanger and Rosenzweig (1993). Our model includes five rainfall variables in total: an estimate of how early the monsoon arrived if it did in fact arrive early (EARLY), an estimate of how late the monsoon arrived if it did in fact arrive late (LATE), the number of days excess or deficit rainfall (DAYS), the total excess rainfall for the entire agricultural season if there was in fact excess (EXCESS), and the total deficit rainfall for the entire agricultural season if there was in fact deficit (DEFICIT). "Normal" monsoon start dates, total number of days of rain in the agricultural season, and total rainfall in the agricultural season are defined as the median values of these variables over the entire eight years for which we have data (2001-2008). The start of the monsoon is considered to be the first day after June in which there was rainfall in excess of 15 millimeters and for which there was at least 70 additional millimeters of rainfall in the subsequent two weeks.[5] This approach allows for the effect of rainfall on participation to vary according to whether rainfall was in excess or deficit and likewise for the effect of monsoon start date to vary according to whether the monsoon arrived early or late. Our source for weather data is the Andhra Pradesh Department of Economics and Statistics.

We take (log) NREGA wages per working age adult as our primary outcome variable on interest where data on the number of working age adults per sub-district has been gathered from the 2001 national census. NREGA wages per working age adult represents the best overall measure of participation in NREGA as it captures the proportion of the population engaged in NREGA, the average number of days worked per NREGA participant, and the average wage paid per day. In addition, the analysis has been also conducted using the proportion of working age population engaged in NREGA, the average number of days per worker engaged in NREGA, and the average wage paid per day for NREGA work as outcome variables individually. Directly interpreting results for these secondary outcome variables may lead to misleading conclusions (for example, the average days per worker will likely fall if the proportion of working age population rises and many new workers work less than their peers), but this analysis may be useful for identifying potential sources of changes in overall wages per working age adult.

Our reduced form equation, controlling for sub-district level fixed effects and including year dummies is

$$Y_{my} = \alpha + \delta_y + y_m + \beta_1 EARLY_{my} + \beta_2 LATE_{my} + \beta_3 DAYS_{my} + \beta_4 EXCESS_{my} + \beta_5 DEFICIT_{my} + \varepsilon_{my} \quad (1)$$

where subscript m indicates sub-district, subscript y year, and Y_{my} is our outcome variable of interest.

Only data from districts which were in the first phase of the implementation rollout is included in the analysis. NREGA was rolled out to these districts on 1st Jan, 2006, providing us with three years of lean season NREGA participation data. NREGA was further extended to phase two districts on 1st April, 2007 and to phase three districts on 1st April, 2008. Thus, for these districts we do not have data for at least two complete lean seasons and including these districts would not contribute to our analysis. Since over half of AP's districts were included in the first phase of the rollout, excluding other districts does not severely limit our analysis.

In addition, due to the inevitable hiccups in program adoption and the low levels of participation in the first year compared to the following two years (total lean season wages in phase one districts increased roughly five fold from 2006

[5] Binswanger and Rosenzweig (1993) code monsoon start date as the first day past June in which there was at least 20 millimeters of rainfall for that day and several subsequent days. This proved to be an overly high threshold for in the case of our data: if this rule is applied for many sub-districts in many years there is monsoon start date identified.

to 2007), we have replicated our analysis with data from year 2006 excluded for each outcome variable.

6 Results

Table 3 presents results from an estimation of equation (1) on our primary outcome variables – (log) NREGA wages per working age adult. Overall, the null hypothesis that agricultural season rainfall does not affect lean season NREGA participation is convincingly rejected (p value $< .00005$). Only two of the coefficients, those for the DAYS and DEFICIT variables, are individually statistically significant but both of these are significant at the .1% level. The coefficients for these variables indicate that each millimeter in deficit rainfall suffered by a sub-district results in nearly 20 rs in additional NREGA wages per working age person while each extra day of rain decreases NREGA wages per working age person by slightly over 7 rs.

Our empirical strategy prevents us from saying exactly what portion of rainfall induced changes in NREGA wages per working adult is caused by changes in average wages, what portion is caused by changes in average days worked, and what portion is caused by changes in the proportion of the population engaged in NREGA. Results from estimation of equation (1) on our secondary outcome variables, presented in table 4, may provide some general clues as to what is driving these changes in overall wages though. Out of the three secondary variables, it appears as the proportion of the population engaged in NREGA is by far the most sensitive to changes in agricultural season rainfall. This suggests that in times of bad weather, more people participate in NREGA but that workers do not, on average, work considerably more days or receive considerably more per day.

Our results strongly confirm that NREGA participation is indeed responsive to rainfall induced variation in income yet they provide little understanding as to how rainfall affects income or how these changes translate into changes in NREGA participation and thus whether this result is practically significant. In the remainder of this section, we employ several different approaches to attempt to grasp the practical relevance of this result. For purposes of clarity, we focus mainly on the results from the model in which the dependent variable is wages per working age person and in which data from 2006 is excluded (column 2 in table 3). Focusing on results from a regression in which the dependent variable is not expressed in log form greatly simplifies the task of interpretation. Our motivation for focusing on a model in which data from the 2006 lean season is excluded lies is that we find it unlikely that participation in the first few months of program adoption is representative of current or future functioning of the program. As the table shows, in most cases, the models yield very similar results.

First, we may look at how much of the overall variation in wages per working age person is explained by rainfall variables. Comparing the R squared of the restricted model without rainfall variables (.4684) with the R squared of the model with these variables included (.4417), reveals that slightly less than 5% of the variation in lean season NREGA wages per working age person not explained by time invariant sub-district specific factors or general year on year trends may be explained by changes in these rainfall variables. This figure by itself appears rather low but we must also consider that, perhaps due to the relative youth of the program, there is a huge amount of overall variation in wages per working age person at the sub-district level. Figure 5 shows a scatter plot of 2008 lean season wages per working age person vs. 2007 lean season wages per working age person by sub-district. The correlation coefficient between these two sets of figures is only .5314.

Second, we may consider the absolute size of the variation in wages per working age person which may be explained by rainfall variables. Figures 6 and 7 present the distribution of the change in wage person working age person explained by rainfall. These figures represent NREGA wages averaged across the entire working age population so to arrive at an estimate of the change in wages per member of the target population we should first scale up these figures by the inverse of the proportion of the working age population we are interested in. Assuming roughly 30% of the rural working age population in these districts may engage in NREGA at one point in time (a rough estimate based on the fact that around 30% of rural households are classified as "below poverty line" by the government), then these figures should be multiplied by around 3 to get a true estimate of the changes in rainfall on total wages received per member of the target population. As the figures show, the change in wage per working age person explained by rainfall, although not huge, is certainly large enough to be practically significant. In approximately 40% of cases, the magnitude of the explained change in wages per working age person was greater than 50 rs – or roughly 150 rs per member of the target population. For those living in extreme poverty, 150 rs is certainly a non-trivial amount. Further, readers are reminded that our model does not capture the effect of agricultural season rainfall on agricultural season participation in NREGA and likely misses a substantial portion of the effects of weather induced income change on NREGA participation due to misspecification or measurement error in our rainfall variables.[6] On the other hand, this figure does not take into account income forgone as a result of participating in NREGA (though if there were adequate outside employment opportunities in times of bad weather there would be no need for NREGA in the first place).

Making use of results from Jayachandran (2006) and the figures generated above, we may make a crude comparison of the practical significance of NREGA and other measures in mitigating aggregating shocks. Using rainfall as an exogenous source of variation in agricultural productivity, Jayachandran conducts a district level analysis to determine what factors affect wage elasticity with respect to crop yield. Her results for access to banking services are particularly

[6] We assume here that workers' wages are not subject to skimming by venal officials. While accusations of skimming are common in other states, they are extremely rare in AP due, most likely, to the system of social audits described above. When corruption does occur, it nearly always takes the form of "ghost workers."

striking. Jayachandran finds that going from one standard deviation below the mean on her measure of access to banking services to the mean reduces wage elasticity with respect to crop yield from 25% to 16%. Assuming a mean wage in AP of 60 rs per day and that a typical worker works 100 days a year regardless of conditions, this translates into 105 rs of extra income in the face of a one standard deviation shock to agricultural productivity.[7] Our comparison relies on several strong assumptions and suffers from many weaknesses, but nevertheless provides tentative support for the thesis that the effect of access to NREGA is at least as strong as that of access to banking services in mitigating aggregate shocks.

Third, we may replicate our analysis for another government program which is ostensibly responsive to weather induced changes in income and compare results. If we perform the analysis using the same time period and set of sub-districts, then the effect of our rainfall variables on sub-district level income, which remains undetected, will be the same (though it might not be exactly identical for the target populations of the programs). Thus, results from this analysis may provide us with a rough benchmark for how much we might expect rainfall variables to explain changes in NREGA participation.

For purposes of comparison, the ideal program to replicate this analysis on would be a scheme such as crop insurance which is explicitly designed to mitigate the effects of weather related shocks. Unfortunately, detailed sub-district level data on government programs remains a rarity in India and the authors were unable to obtain data on sub-district level payouts for AP's official crop insurance program. Serendipitously, the NREGA participation available on the AP government website also includes data on payments made under a separate program, the Indiramma subsidized housing scheme. The Indiramma scheme provides beneficiaries with materials and a cash payment of 3200 rs to improve or construct a new home. Beneficiaries must be designated as "below poverty line" but otherwise local authorities have broad flexibility in selecting who receives the benefits.

The Indiramma program was obviously not designed primarily to serve as a cushion to mitigate the effects of aggregates shocks yet, if bureaucrats were seeking a policy tool for mitigating such shocks Indiramma would be a good fit. While payments under the program must ostensibly be used for the paying for labor for construction of the home, in practice officials rarely ever enforce this provision and beneficiaries are free to use the money as they please. Thus, it may provide more immediate relief to those who have suffered a negative shock than other programs which provide assets which cannot be immediately sold off.

Table 5 presents results from a regression of Indiramma payments per working age person in each sub-district on our rainfall variables using an identical

[7] Change in wage is equal to (WAGE_ELASTICITY'-WAGE_ELASTICITY')*CHANGE_IN_CROP_YIELD where the change in crop yield corresponding to one standard deviation is roughly 21 log points. (According to Jayachandran, "21 log points is likely an upper bound on the standard deviation of crop yield." p.18)

specification as in our analysis of the relationship between rainfall and NREGA participation. Overall, the null hypothesis that agricultural season rainfall does not influence lean season Indiramma payments is still rejected but much less convincingly than was the case in the NREGA analysis (this hypothesis was rejected in two out of the four models at the 5% level, one model at the 10% level, and was not rejected in one of the models). Further, the only two coefficients which are statistically significant, the coefficient on the number of days of rain and the coefficient on excess rain, appear to be opposite in sign if Indiramma payments were used as a device for compensating those suffering from a rainfall induced drop in income.

7 Conclusion

According to our analysis, NREGA doesn't just provide money to poor households, it provides money when they most need it – that is when they are hit with bad weather. Our results are limited in that they provide no clear estimate of just how much of a weather induced income shock poor households are able to compensate for by increasing participation in NREGA and are only for half of the districts in one state of India. Nevertheless, they suggest that NREGA may have a long term effect above and beyond what would be expected just based on a simple glance at the magnitude of funds flowing through the program. If households are able to use NREGA as an ex post substitute for formal weather insurance, they may be able to shift away from investments in low-risk, low-return assets which are used as crude mechanisms by the poor to hedge against risk of aggregate shocks to higher-risk, higher-return assets. Further research is needed to determine if NREGA has in fact led to such a shift in the risk profile of the assets held by poor households.

8 References

References

[1] Aakela, Karuna Vakati, and Sowmya Kidambi. 2007. "Social Audits in Andhra Pradesh: A Process in Evolution" *Economic and Political Weekly.* 24th November: 18-19.

[2] Binswanger, H. and Mark R. Rosenzweig. 1993. "Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments" *The Economic Journal.* Vol. 103, No. 416 (Jan., 1993), pp. 56-78. Stable URL: http://www.jstor.org/stable/2234337

[3] Besley, Timothy and Stephen Coate. 1992. "Workfare versus Welfare: Incentive Arguments for Work Requirements in Poverty-Alleviation Programs". *The American Economic Review.* Vol. 82, No. 1 (Mar., 1992), pp. 249-261. Stable URL: http://www.jstor.org/stable/2117613

[4] Chattopadhyay, Ragavendra and Esther Duflo. 2004. "Women as Policy Makers: Evidence from a Randomized Policy Experiment in India" Econometrica, Vol. 72, No. 5 (Sep., 2004), pp. 1409-1443. Stable URL: http://www.jstor.org/stable/3598894

[5] Chaudhuri, S., Gaurav Datt and Martin Ravallion. 1993. "Does Maharashtra's Employment Guarantee Scheme Guarantee Employment? Effects of the 1988 Wage Increase". Economic Development and Cultural Change, Vol. 41, No. 2 (Jan., 1993), pp. 251-275. http://www.jstor.org/stable/1154421

[6] Datt, Gaurav, and M. Ravallion. 1992. "Behavioral responses to work fares: Evidence for rural India". Washington, D.C.: World Bank.

[7] Deolalikar, A., and R. Gaiha. 1993. "Targeting of rural public works: Are women less likely to participate?" Discussion Paper Series 93-05. Seattle, Wash., U.S.A.: Institute for Economic Research, University of Washington.

[8] Jacoby, Hanan and Emmanuel Skoufias. 1998. "Testing Theories of Consumption Behavior Using information on Aggregate Shocks: Income Seasonality and Rainfall in Rural India". American Journal of Agricultural Economics. Vol. 80, pp 1-14

[9] Jayachandra, Seema. 2006. "Selling Labor Low: Wage Responses to Productivity Shocks in Developing Countries". Journal of Political Economy. vol. 114(3), pp 538-575

[10] Murgai, Rinku and Ravallion, M. 2005. "Employment Guarantee in Rural India: What Would It Cost and How Much Would It Reduce Poverty?". Economic and Political Weekly. 2005, Vol. 40; No. 31, pp 3450-3471.

[11] Morduch, Jonathan. 1999. "Between the State and the Market: Can Informal Insurance Patch the Safety Net?" The World Bank Research Observer, Vol. 14, No. 2 (Aug., 1999), pp. 187-207 Stable URL: http://www.jstor.org/stable/3986364

[12] Niehaus, Paul and Sandip Sukhtankar. 2008. "Corruption Dynamics: The Golden Goose Effect" Available at http://dss.ucsd.edu/~pniehaus/papers/nrega.pdf

[13] Ravallion, Martin. 1991. "Reaching the rural poor through public employment, arguments, evidence, and lessons from South Asia". The World Bank Research Observer 6 (2): 153-175.

[14] Right to Food. 2007. Employment Guarantee Act: A Primer. Available at http://www.sacw.net/Labour/EGAprimer.html

[15] Townsend, R. 1994. "Risk and Insurance in Village India". Econometrica, Vol. 62, No. 3 (May, 1994), pp. 539-591. Stable URL: http://www.jstor.org/stable/2951659

[16] Walker, T. S., and J. G. Ryan. 1990. Village and household economies in India's semi-arid tropics. Baltimore, Md., U.S.A.: Johns Hopkins University Press.

Appendix A: Figures

Figure 1: Map of Andhra Pradesh Displaying Districts by Rollout Phase

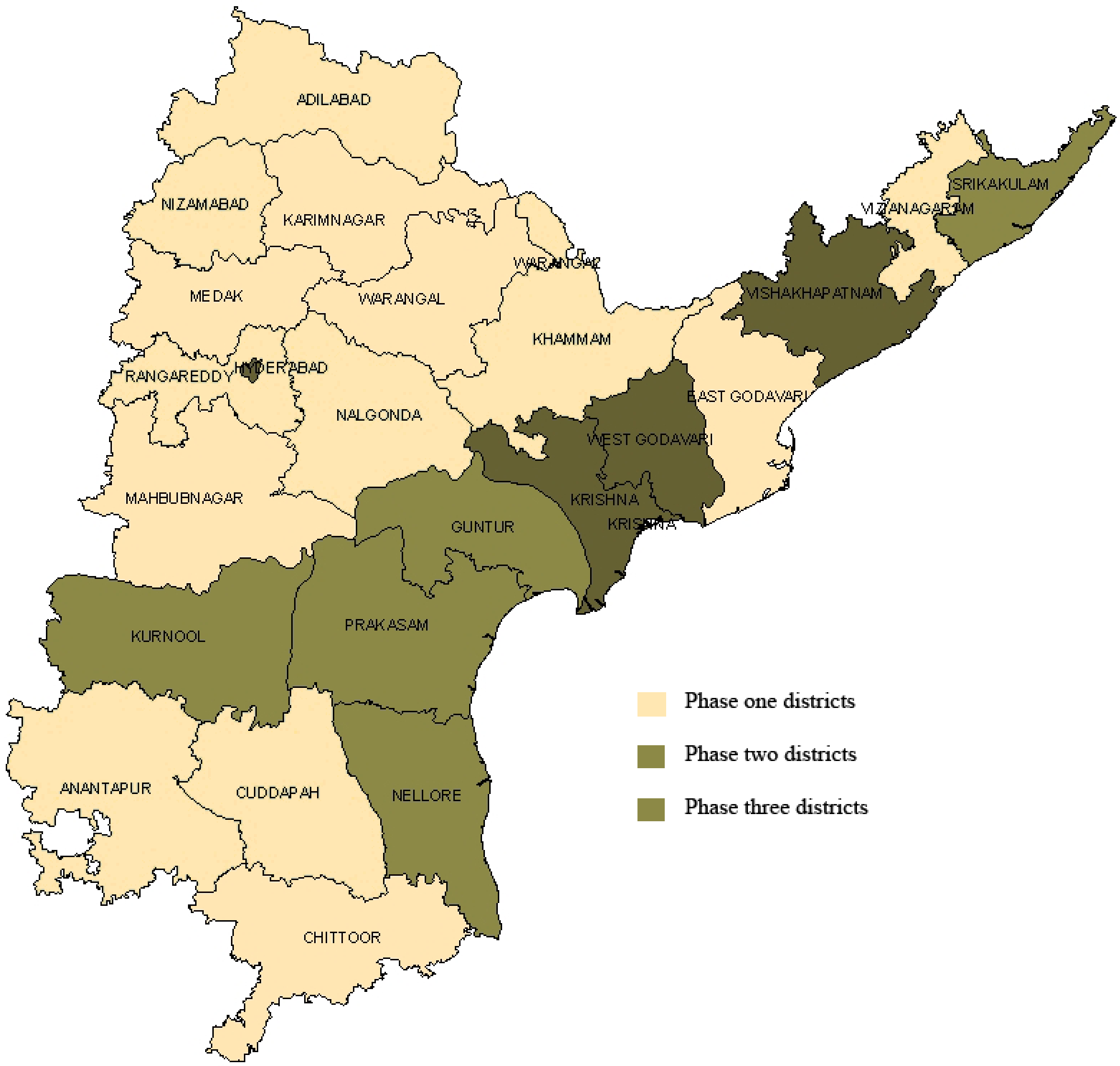


Figure 2: Distribution of Total Days per Household (Phase 1 Districts)

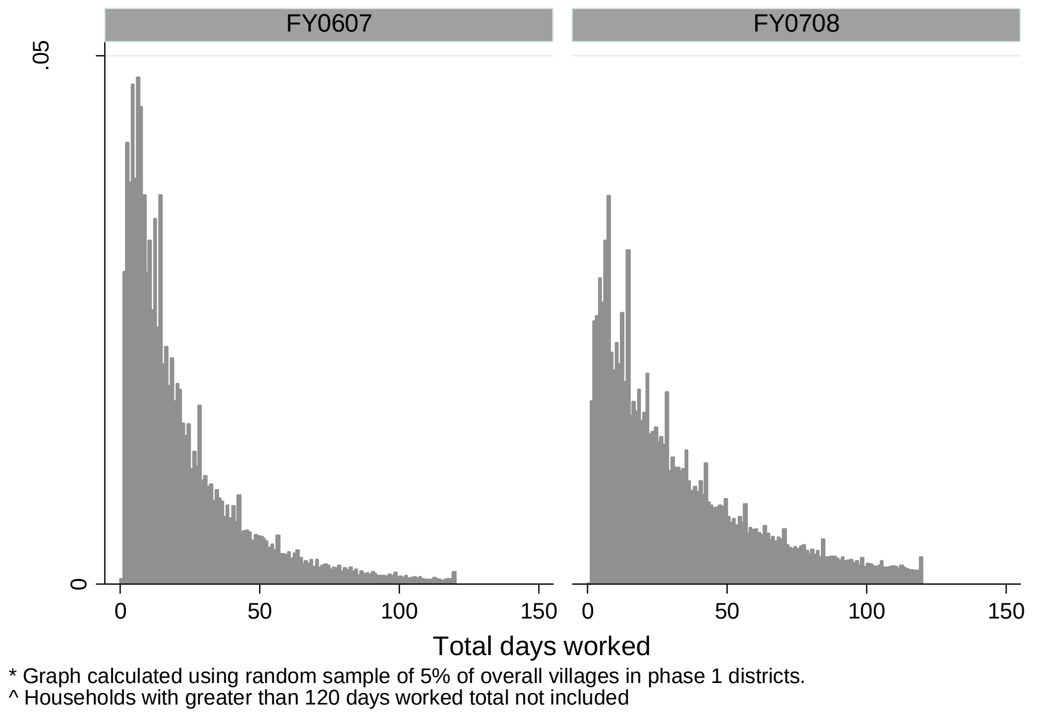


Figure 3: Total NREGA Wages by Month (Phase 1 Districts, 2008)

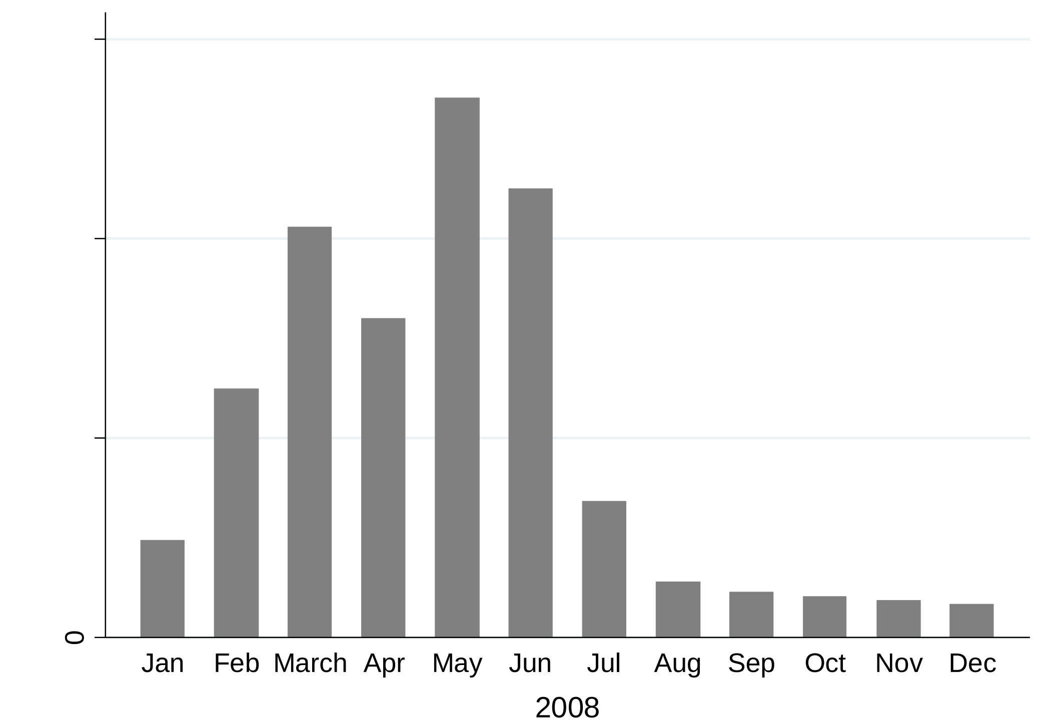


Figure 4: Average Total Rainfall by Month (Phase 1 Districts, 2001-2008)

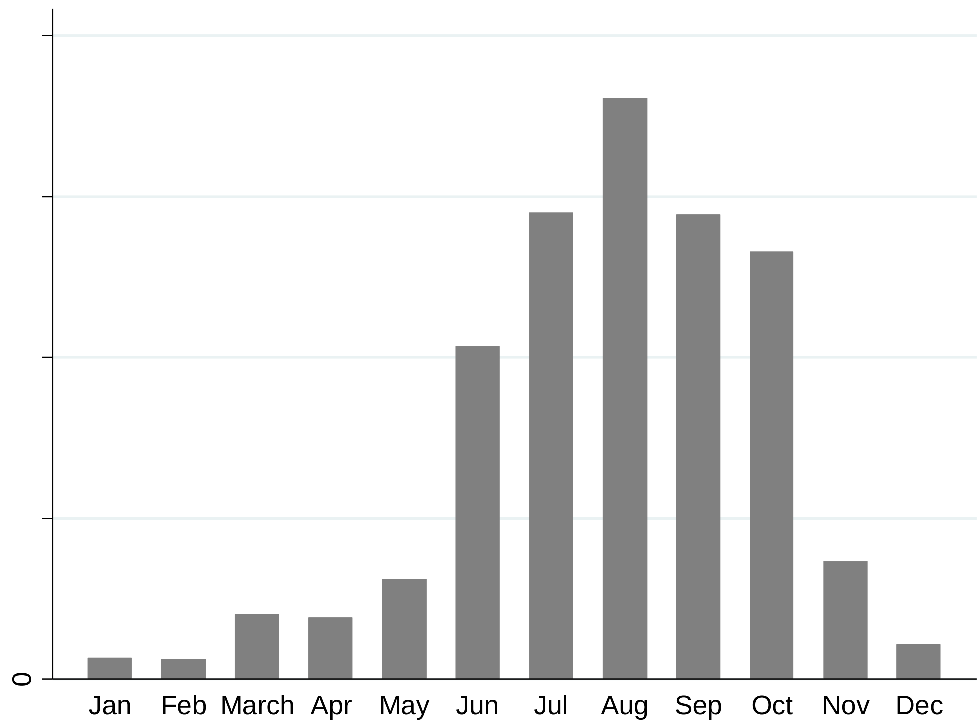


Figure 5: Lean Season Wages per Working Age Person, 2008 vs 2007

Figure 6: Distribution of Change in Wage per Worker Explained by Rainfall (Histogram)

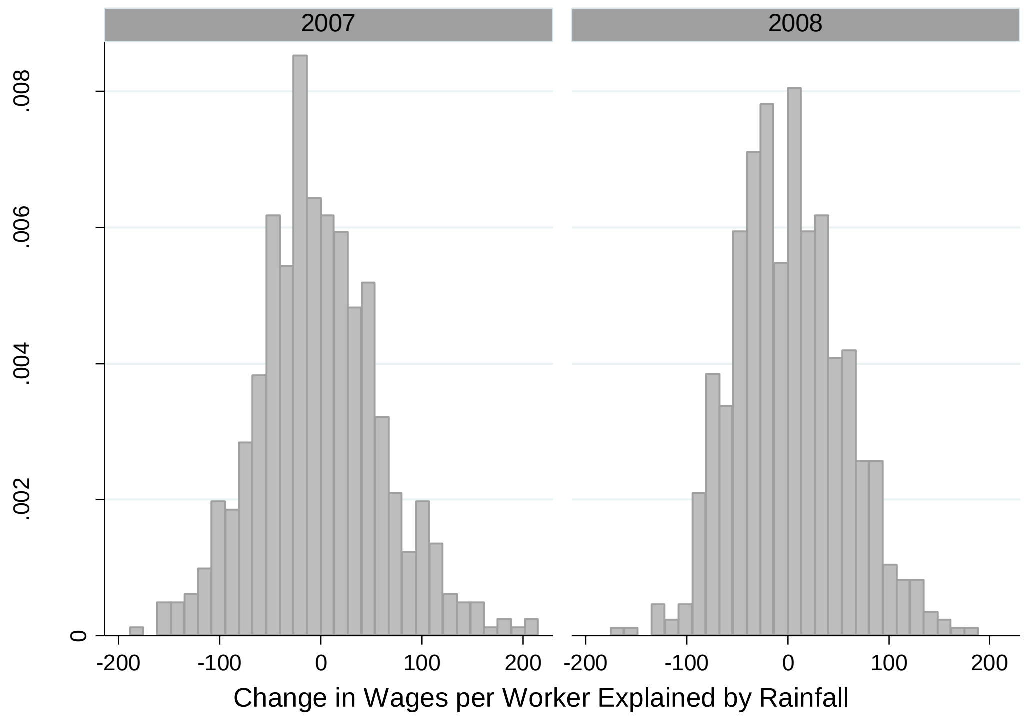
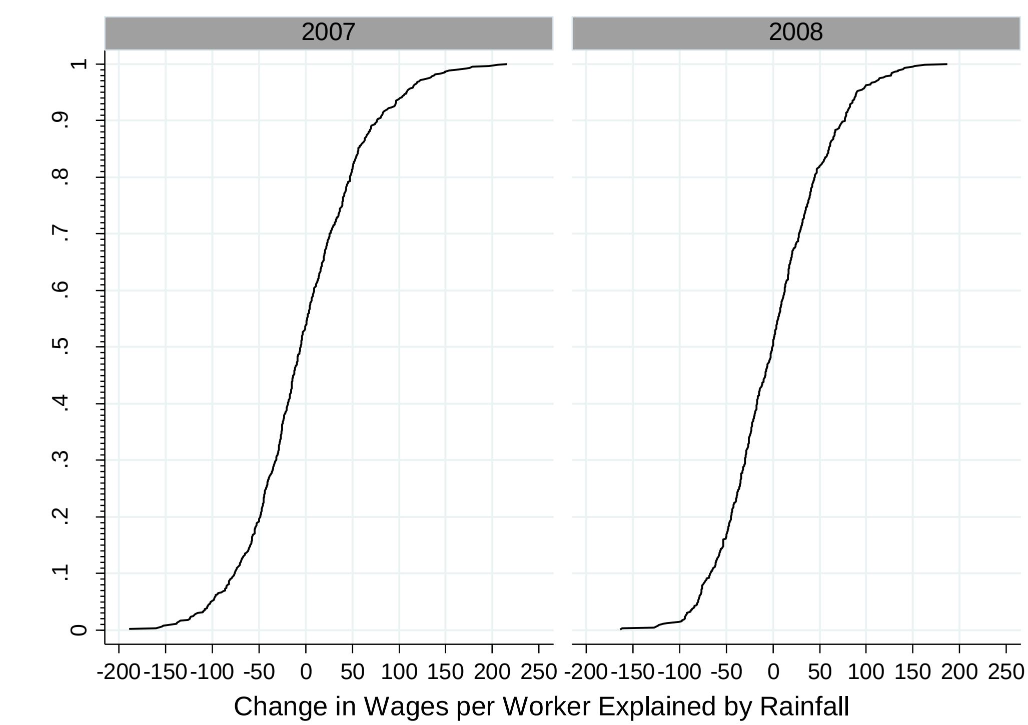


Figure 7: Distribution of Change in Wage per Worker Explained by Rainfall (CDF)



Appendix B: Tables

Table 1: Selected State specific NREGA indicators for fiscal year 2008-09.

State	NREGA Employment (Person-days per rural household)	Share of women in NREGA employment (%)	Share of SC/ST in NREGA employment (%)	Share of unskilled labour in NREGA expenditures (%)	Avg. wage (Rs./day)
Mizoram	160.45	36.59	99.95	79.39	108.98
Manipur	97.36	45.92	74.56	62.16	72.62
Nagaland	77.5	36.71	100	54.37	80.77
Tripura	66.39	51.01	68.64	59.12	85.61
Rajasthan	63.37	67.11	52.03	67.4	88.31
Chattisgarh	38	47.43	57.73	61.78	73.2
Madhya Pradesh	36.69	43.28	64.63	57.55	73.17
Sikkim	29.05	37.66	49.85	58.25	92.88
Meghalaya	26.58	41.35	95.17	64.81	70.13
Andhra Pradesh	**22.15**	**58.15**	**39.09**	**74.38**	**82.55**
Jharkhand	20.03	28.51	58.01	48.46	90.45
Himachal Pradesh	18.86	39.02	41.3	57.2	99.07
Assam	18.06	27.16	44.86	57.67	77.13
Arunachal Prasesh	16.28	26.7	76.6	63.3	58.06
Tamil Nadu	14.7	79.67	62.01	95.55	79.68
Uttar Pradesh	11.25	18.04	55.5	60.13	99.62
Uttarakhand	8.83	36.86	32.3	63.19	84.64
Bihar	8.21	30.02	52.72	59	85.08
Jammu & Kashmir	7.29	5.76	35.89	44.04	67.54
West Bengal	7.13	26.53	52.26	62.76	78.21
Orrisa	6.22	37.02	56.32	60	89.15
Karnataka	4.38	50.42	41.64	69.58	80.99
Gujarat	3.98	42.82	63.23	72.7	67.8
Maharashtra	3.87	46.22	60.68	83.41	74.01
Kerala	3.13	85.01	28.73	80.14	120.06
Haryana	2.84	30.64	53.03	76.52	122.3
Punjab	1.46	24.63	74.28	57.65	111.32

Table 2: Selected Summary Statistics of NREGA Implementation in Andhra Pradesh

	Total Disbursed			Total Days Worked			Number Workers		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
FY0607	3,986,274,561	NA	NA	49,356,477	NA	NA	6,393,254	NA	NA
FY0708	10,211,970,096	2,818,590,243	NA	124,308,311	34,875,497	NA	15,011,592	4,313,332	NA
FY0809*	9,314,046,706	4,246,734,517	719,231,094	113,387,289	50,716,765	9,002,675	13,524,284	5,746,054	1,319,347

Source: Official NREGA website located at http://nrega.nic.in

* Data from FY0809 only includes first 8 months of the fiscal year.

Table 3: NREGA Amount per Capita and Rainfall Variables

	Dependent var wages per working age person		Dependent var log wages per working age person	
	2006 Data Included	2006 Data Not Included	2006 Data Included	2006 Data Not Included
EARLY	-50.729***	-74.96	-0.017	0.043
	(0.0037916)	(0.12803157)	(0.74318319)	(0.57188642)
LATE	-71.002***	-25.239	-0.008	0.024
	(0.00319214)	(0.47404634)	(0.91500723)	(0.77299648)
DAYS	-3.356**	-7.034***	-0.003	-0.022***
	(0.03143158)	(0.00093554)	(0.52607469)	(0.00000002)
EXCESS	-1.807	-5.004	-0.017**	-0.019***
	(0.45863726)	(0.23088888)	(0.01853772)	(0.00179773)
DEFICIT	18.794***	19.665***	0.033**	0.056***
	(0.0002012)	(0.00353464)	(0.03470069)	(0.00021858)
2007 DUMMY	135.820***		2.238***	
	(0.00000003)		(0)	
2008 DUMMY	547.057***	419.796***	3.272***	1.184***
	(0)	(0)	(0)	(0)
CONSTANT	84.747***	199.792***	2.761***	4.869***
	(0.00000181)	(0)	(0)	(0)
R Squared	0.55	0.468	0.825	0.655
F test that all rainfall paramaters equal to zero	F = 7.78, p = 0.000	F = 7.84, p = 0.000	F = 3.59, p = 0.0032	F = 15.33, p = 0.000

Notes: Sub-district fixed effects included. Errors clustered on the sub-district level. A single asterisk indicates significance at the 10% level, two asterisks significance at the 5% level and three asterisks significance at the 1% level. P-values in parentheses.

Table 4: Secondary Outcome Variables and Rainfall Variables

	Dependent var % engaged in NREGA		Dependent var avg wage		Dependent var avg days worked	
	06 Included	06 Not Included	06 Included	06 Not Included	06 Included	06 Not Included
EARLY	-0.056**	-0.120*	-0.126	1.056	-0.550**	0.199
	(0.0026)	(0.0465)	(0.8839)	(0.3356)	(0.0021)	(0.3981)
LATE	-0.097***	-0.025	2.684*	1.425	-0.586*	-0.092
	(0.0001)	(0.5051)	(0.0290)	(0.1302)	(0.0154)	(0.6313)
DAYS	-0.001	-0.005*	0.029	-0.211***	-0.021	-0.021
	(0.6879)	(0.0131)	(0.6677)	(0.0000)	(0.1160)	(0.0603)
EXCESS	-0.006*	-0.017***	-0.004	0.087	0.043	0.065***
	(0.0146)	(0.0000)	(0.9774)	(0.3843)	(0.1232)	(0.0002)
DEFICIT	0.027***	0.029***	0.154	0.069	-0.075	0.039
	(0.0000)	(0.0001)	(0.5570)	(0.6757)	(0.1651)	(0.2837)
2007 DUMMY	0.262***		-3.608**		-0.313	
	-		(0.0023)		(0.2524)	
2008 DUMMY	0.732***	0.470***	1.489	7.596***	0.467*	0.879***
	-	-	(0.1855)	-	(0.0475)	-
CONSTANT	0.093***	0.344***	79.649***	75.032***	8.888***	8.033***
	(0.0000)	-	-	-	-	-
R Squared	0.655	0.589	0.048	0.335	0.028	0.105
F test that all rainfall paramaters equal to zero	F = 13.04, p = 0.000	F = 15.82, p = 0.000	F = 1.13, p = 0.3445	F = 4.03, p = 0.0013	F = 5.28, p = 0.0001	F = 4.23, p = 0.0009

Notes: Sub-district fixed effects included. Errors clustered on the sub-district level. A single asterisk indicates significance at the 10% level, two asterisks significance at the 5% level and three asterisks significance at the 1% level. P-values in parentheses.

Table 5: Indiramma Amount per Capita and Rainfall Variables

	Dependent var wages per working age person		Dependent var log wages per working age person	
	2006 Data Included	2006 Data Not Included	2006 Data Included	2006 Data Not Included
EARLY	-4.188	2.787	-0.106	-0.022
	(0.58499083)	(0.82097596)	(0.35419573)	(0.83743215)
LATE	-12.525**	-12.219*	-0.223**	-0.155*
	(0.02976914)	(0.07457029)	(0.02345094)	(0.08791344)
DAYS	0.995**	1.241**	0.001	0.002
	(0.0274995)	(0.01706176)	(0.83346052)	(0.67962687)
EXCESS	1.552*	1.572*	0.009	0.016
	(0.05671709)	(0.08874788)	(0.47137176)	(0.14967457)
DEFICIT	-0.851	-1.167	-0.033	-0.028
	(0.60492983)	(0.51409576)	(0.11597542)	(0.14176373)
2007 DUMMY	89.252***		3.000***	
	(0)		0	
2008 DUMMY	118.995***	28.642***	3.339***	0.335***
	(0)	(0.00000007)	0	-0.00000013
CONSTANT	0.439	89.329***	1.230***	4.164***
	(0.95965687)	(0)	0	0
R Squared	0.281	0.151	0.581	0.108
F test that all rainfall paramaters equal to zero	F = 2.70, p = 0.0199	F= 2.86, p = 0.0145	F = 1.60, p = 0.1565	F= 1.91, p = 0.0905

Notes: Sub-district fixed effects included. Errors clustered on the sub-district level. A single asterisk indicates significance at the 10% level, two asterisks significance at the 5% level and three asterisks significance at the 1% level. P-values in parentheses.