A Friend Indeed: Does The Use of Digital Identity Make Welfare Programs Truly Counter Cyclical ?

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We examine the responsiveness of the world's largest workfare program to distress and ask whether a techno-administrative intervention involving biometric digital identity enabled direct transfer of benefits makes any difference. Wage payment delays, which where high before the intervention, reduce significantly after the intervention. In line with the thesis that delays are more costly and their reduction more beneficial during distress, we find a reduction in demand and supply of jobs during times of economic stress in the pre intervention period and an increase in demand and supply of jobs during times of economic stress in the post intervention period.

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World over, anti poverty programs are designed to help the poor to tide over economic distress (Ravallion (2007); Besley and Coate (1992)). Therefore, it is expected that such programs are implemented in a counter-cyclical manner[1]; resulting in higher and more targeted payouts during times of distress. In fact, most anti poverty programs include counter cyclicality as one of their stated objectives (Abraham, Chopra and Tantri (2018)). However, the implementation of most such programs has been shown to be sub-optimal; marred by leakage, corruption, and delayed wage payments (Reinikka and Svensson (2004); Olken (2006); Muralidharan et al. (2017)). As a response, many governments have attempted to improve execution, mostly through technological interventions (Muralidharan, Niehaus and Sukhtankar (2016)). Therefore, it is interesting to examine if anti poverty programs work in a counter cyclical manner, resulting in increased payouts during times of distress. If not, whether the use of technology in the form of

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[1]By counter-cyclical implementation, we mean that more work is demanded and provided during times of economic distress

biometric enabled unique identity numbers that facilitate beneficiary identification and direct transfer of benefits, helps in better targeting based on economic distress of the target population.

We use the world's largest workfare program administered by the Indian Government as an economic setting. The program named Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA, henceforth) was created through an Act of Parliament in the year 2005 (See Imbert and Papp (2015) and Agarwal et al. (2016) for details relating to the program). Four features of the program are noteworthy. First, the stated objective of the program is to ameliorate farm distress, and hence, the program is targeted at rural parts of the country where close to three fourths of the population depends on farming.[2] Second, MNREGA mandates the executive to provide at least 100 days of employment at minimum wages to anyone who seeks work under the program. Third, the nature of work under the program is manual labor. This acts as an effective screening and deterrence mechanism (Besley and Coate (1992)). Finally, until 2014, significant number of MNREGA workers had to physically visit the designated government office, wait in line and submit their job cards to collect the wages.

The government of India launched an initiative named aadhaar with a goal of providing a unique biometric enabled identity number to all 1.3 billion citizens (Nilekani and Shah (2016)). Approximately 90% of the population has been provided with aadhaar.[3] As aadhaar is a biometric enabled identity number, weeding out fake and duplicates as well as identification of beneficiaries becomes straightforward.

The federal government implemented aadhaar in MNREGA in a phase wise manner. In the first phase, 300 districts were covered in 2014, while all remaining districts were covered in 2015. In operational terms, implementing aadhaar in MNREGA means nudging the beneficiaries to link their bank accounts with their aadhaar number and the biometrics or open a bank account using aadhaar and submit the same to MNREGA program office. Aadhaar linking under MNREGA (ALP,[4] henceforth) could potentially speed up the wage payment cycle in the following two ways. First, since an aadhaar linked account is unlikely to belong to a ghost beneficiary due to stringent biometric requirements, government officials require less time to verify and audit claims from such accounts. Second, the federal government, which ultimately foots the bill for the program, could transfer wages directly to the bank accounts of the beneficiaries cutting the bureaucratic red tape significantly. In addition, as we explain in detail later, linking aadhaar could also potentially lead to tracking down of ghost beneficiaries leading to better targeting of the program and efficient utilization of funds.

De-jure features of MNREGA are intended to work in a counter-cyclical manner, that is, the demand of work under MNREGA is expected to increase during times

[2]Source: The Food and Agriculture Organization of the United Nations, Link: http://www.fao.org/india/fao-in-india/india-at-a-glance/en/

[3]Source: UIDAI website. Link: https://uidai.gov.in/

[4]Aadhaar Linked Payments

of distress. If the beneficiaries are paid promised wages in a timely manner, then it is reasonable to hypothesize that the demand for work increases during times of distress. However, the actual implementation of the program left much to be desired. Multiple studies (Niehaus and Sukhtankar (2013*a*,*b*); Ravallion (2012)) have found evidence suggesting widespread prevalence of corruption, political interference, leakage, and significant delay in wage payments. Given the above de-facto implementation related issues, it is possible to argue that a person in economic distress may not prefer to work under MNREGA. A distressed person requires an immediate and certain liquidity. Working for uncertain promised wages which are likely to be realized with substantial lag, and that too partially, is unlikely to be an attractive proposition for a person in distress. Delayed payments and leakage would effectively mean employment at zero wage during times of distress. In such a situation, a person is better off without work or work at much lower reward than working for MNREGA. Therefore, there is reason to believe that demand for work under MNREGA may not be counter cyclical. Similarly, on the supply side, corrupt officials may care more about extracting rents from the program rather than maintaining its counter cyclicality. Therefore, how demand and supply of work under MNREGA respond to economic distress is an empirical question.

Given that MNREGA targets rural poor who are mostly dependent on agriculture, adverse weather becomes a natural proxy for economic distress. A number of studies (Burgess et al. (2011); Burgess and Donaldson (2010); Sekhri and Storeygard (2014); Singh et al. (2006)) show that droughts lead to significant negative real consequences such as increase in mortality rate, malnutrition among children, especially female children, among others. Therefore, drought is a reasonable proxy for distress given that the target population comprises primarily of either small farmers or landless farm labor (Imbert and Papp (2015)). We obtain data relating to precipitation at a latitude-longitude and follow the definition prescribed by the Indian Meteorological Department (IMD) to identify drought at the block–year level. We obtain data relating to demand for and supply of MNREGA jobs, at the block level from the dedicated MNREGA portal. Using the two data sets, we create a block level panel spanning between FY2012 to FY2017,[5] containing weather and MNREGA outcome related information.

Univariate tests succinctly summarize our main results. We use MNREGA demand for illustration. We obtain similar results using supply. We hypothesize that the first order effect of introduction of aadhaar is likely to be on the delay in wage payment. We find that the proportion of transactions paid with a lag of more than three months declines from 34% to 9% in the post ALP period when compared to the pre ALP period.

Wage payment delays are likely to be costlier when the beneficiary is in distress when compared to normal times. Therefore, given the delay in wage payment in

[5]FY2012 corresponds to financial year 2011-2012, FY2013 corresponds to 2012-2013 and so on. The Indian financial year begins on April 1st and ends on 31st March.

the pre ALP period, we expect lower demand during times of economic distress when compared to normal times. In line with the above hypothesis, we find that in the pre ALP period the demands for work under MNREGA falls to 11686.89 person days during drought from 12498.91 during normal times. In the same spirit as above, it is reasonable to hypothesize that a significant reduction in wage payment delays post ALP is likely to be more valuable during distress. Hence, demand for MNREGA work is likely to be higher during distress when compared to normal times in the post ALP period. Indeed, we find that the demand for increases from 12381.70 person days during normal times to 14113.63 person days during drought.

The planned implementation of ALP was scheduled to be completed by FY2016. ALP was designed to directly transfer wages to beneficiary bank accounts. We hypothesize that if ALP was implemented as planned, the total amount disbursed to bank accounts should increase in the period after ALP implementation. Our tests reveal that the amount disbursed to bank accounts rises significantly in the post ALP period as compared to the pre ALP period. This acts like a first stage test for the impact of ALP on MNREGA.

If ALP improves efficiency of MNREGA, we expect to see a significant reduction in delayed wage payments. Delay in wages would bear significant distress to the rural poor and might impact their decision to work under MNREGA. We compare the total number of transactions and total amount of payments that were received after a three month delay in the pre and post ALP periods. We find that there has been a significant decline in delayed payments post ALP. Our results are in line with Muralidharan et al. (2017) and Banerjee et al. (2016), who study technological intervention in MNREGA under experimental settings.

In order to test the impact of ALP on demand and supply of jobs, we use the two phase roll-out of ALP in MNREGA and employ a staggered difference-in-difference (DID, henceforth) specification. The difference in MNREGA outcomes between drought affected and non-drought affected blocks before implementation of ALP is the first difference. The difference in MNREGA outcomes between drought affected and non-drought affected blocks after implementation of ALP becomes the second difference. We consider the difference between the above two differences as the impact of ALP on pro cyclicality of MNREGA.

We start our multivariate analysis by examining the demand for MNREGA during times of distress in the pre and post ALP period. In the pre ALP period, the demand for jobs by households (persons) is lower by 524.6(1045) during times of distress. This represents a 7% (8.36%) decline. Therefore, it is reasonable to conclude that the demand for work under MNREGA moves in a pro cyclical manner in the pre ALP period. The high amount of delayed payments in the pre period seem to be a deterrent for workers to work under MNREGA in distressed times.

Given that there has been a decline in delayed payments in the post ALP period, we expect an increase in demand for work under MNREGA. We find that

the number of households (persons) demanded work is higher by 1,225 (2,219) in drought affected areas in a DID sense in the post period. This represents an increase of 16.36% (17.75%). From the above result, it appears that in the pre period, the rural poor treated MNREGA as an option to earn additional income during good times rather than a shock absorber during bad times, defeating one of the important purposes of the workfare program. This is plausibly explained by the higher amount of delayed payments in the pre ALP period. The directional change in the post period results suggest that after the implementation of ALP, the target population of rural poor quickly learns about possible reduction in leakage and timely payment of wages and hence, starts demanding more work during distress.

We next examine the provision of jobs during distress. Under MNREGA, the state is bound by law to provide jobs to all those who demand it. Dutta et al. (2012) find that there is a gap between supply and demand with demand outpacing supply at times. Therefore, we examine supply separately and find results similar to those related to demand for work.

We then examine the intensive margin using total person days worked and the number of households working for 100 days under MNREGA. In the post period, we find counter cyclical movement in a DID sense in the intensive margin. Person days worked as well as households reached 100 days both increase by 10.81% and 13% respectively. The increase is economically meaningful in the post ALP period.

Finally, there could be an apprehension that weaker sections of the society who are likely to be most vulnerable to economic shocks may not be able to adapt to new technology and hence may get excluded (Khera (2011)). The cost of delayed payments is especially higher for women and other weaker sections of the society in the pre period. Any improvement brought by ALP should lead to substantial increase in the post period. In the pre period, we find a significant decline in the number of jobs provided to women and weaker sections during times of drought when compared to other times. In the presence of significant delayed in wage payments, it is reasonable to conclude that the program fails to help the most vulnerable deferentially during times of economic distress. In the post period, we find that the DID results replicate even when we consider jobs provided to women and weaker sections of the society. In other words, even the people from backward sections of the society demand and obtain more jobs during distress in the post technology intervention period.

There could be a concern that some relevant but unobservable factor might have influenced the timing of selection of districts. We address this concern in three ways. First, we rule out the existence of pre-trends (Bertrand, Duflo and Mullainathan (2004)) which could have continued into the post period and mechanically produced our results. Second, the government order implementing MNREGA[6] explicitly states that districts with high bank and aadhaar penetra-

[6]DBT Bharat Website. Link:https://dbtbharat.gov.in/page/frontcontentview/?id=NjQ=

tion are selected in the first phase of DBT implementation. Burgess and Pande (2005) show that bank penetration in rural parts of India increased mostly due to a government diktat that forced banks to open four branches in an un-banked location to obtain permission to open a branch in a banked location. Also, even if highly banked locations were different from others, it is hard to think of unobservable factors which are not visible in pre-trends but move along with MNREGA implementation in 300 highly banked districts from the year FY2015 and other districts from the year FY2016. It is important to note that entire country was covered by the year FY2016.

Thirdly, we also employ the instrumental variable approach (IV). We use high banking penetration at the district level as an IV for selection into the first phase of implementation. We find strong first stage results. As argued before, bank penetration is unlikely to influence pro or counter cyclicality of the program after ALP implementation through channels other than aadhaar and hence satisfy exclusion restriction. Our main results replicate.

Finally, we examine the external validity of our results using a national level survey of household consumption. We find that the demand for MNREGA work increases when the average household consumption in a district declines and vice versa in the post ALP period. In other words, higher responsiveness of MNREGA to economic distress extends to cases where the economic distress is caused by factors including localized unobservable factors and not just by drought. Due to data limitations, we can only perform a cross sectional test using household consumption, and hence, despite its wider breadth, we use the above test only for the purpose of external validity.[7]

For further robustness test, we vary the threshold for defining distress and find that our results go through. Additionally, we define a second measure of distress based on abnormal temperature during the cultivation season. We define this measure at the block year level. We find that our main results replicate with similar economic magnitude even when we use this second measure of distress.

We contribute to the large literature that evaluates the actual implementation of anti poverty programs all over the world (Besley and Coate (1992); Saez (2002); Bitler, Gelbach and Hoynes (2006); Chambers (1989)). Muralidharan et al. (2017) find that introduction of biometric enabled smart card for making payment of wages under MNREGA in some parts of one state of India led to significant reduction in leakage and quicker payment of wages. On similar lines, Banerjee et al. (2016), who study technological intervention in MNREGA in the state of Bihar, find reduction in payment delays and detection of ghost employees.

[7]Policy makers can use the negative association between household consumption and MNREGA demand as an advance warning signal of distress. The advantage of using MNREGA demand for this purpose is that data is available in real time, therefore distress can be identified without delay. In contrast, official household consumption numbers are released with a significant lag of close to three years. Based on the above association, we have developed a Graphical User Interface (https://distresstool.github.io/index.html) which helps policy makers identify distressed areas. We are working with government agencies for the implementation of this tool.

Whereas, we evaluate the world's largest workfare program, MNREGA,[8] based on its counter cyclicality, which is one of the stated goals of the program. We show that in the absence of technology intervention in implementation, the program moves in a pro cyclical manner, resulting in lower demand as well as supply of work during times of distress and defeating the very purpose of the program. To the best of our knowledge, workfare programs have not been evaluated based on this dimension. The second part of our findings contribute to the recent and growing literature on building state capacity through technological and administrative intervention (Muralidharan, Niehaus and Sukhtankar (2016); Banerjee et al. (2018); Besley and Persson (2009)). None of the above papers examine whether technology helps in making anti poverty programs counter cyclical.

I. Institutional Background

A. MNREGA: History & Background

MNREGA is an Indian government initiative launched in 2006 with the aim of providing at least 100 days of guaranteed employment to every household that voluntarily enters it. The program aims to guarantee the "right to work". Numerous employment guarantee programs offering minimum wage were tried in the past. Schemes such as Rural Manpower (RMP) [1960-61], Marginal Farmers & Agricultural Labor Scheme (MFAL), Pilot Intensive Rural Employment Program (PIREP) [1972] were attempted to help the poor in India. These pilot projects led to full-fledged schemes such as Food for Work Program (FWP) (1977). Based on prior experience, MNREGA was passed by the parliament for implementation on September 7, 2005.

MNREGA creates a voluntary framework for employment and also makes the government legally accountable for providing employment to those who demand it. The roll out of MNREGA began in 2006 and ended in 2008. The wage was fixed at ₹100 per day in 2005, according to the Minimum Wages Act, 1948. As of 2018, around ₹4.6 trillion ($67B) has been spent on MNREGA and 2.5 billion person days of employment has been generated. The total number of projects under MNREGA stands at 14.6 million of which around 60% have been completed. Since FY2012,[9] all data related to MNREGA is available in public domain. The Act stipulated that a wage to material ratio of 60:40 to be maintained for all projects at all times.

Households have to volunteer in order to enroll under MNREGA. Once enrolled, households are provided with job cards which have designated areas to record employment, work, and payment. Job cards are provided by the gram panchayats[10] or sub districts' offices. After job cards have been issued, workers can legally

[8] A large literature evaluates the impact of MNREGA (Azam (2011); Imbert and Papp (2014); Klonner and Oldiges (2014); Ravi and Engler (2015); Zimmermann (2012)).

[9] The data related to MNREGA is avaialble from FY2012 onwards.

[10] A gram panchayat or village council is the grassroots-level of the local self-governance system in India at the village or small-town level.

demand to be employed under MNREGA. The officials have an obligation to provide work to those who demand it. Work has to be provided within 15 days of demanding. If any work is not provided after such demand, the workers have a right to receive unemployment benefits. In practice, unemployment benefits are rarely provided (Muralidharan, Niehaus and Sukhtankar (2016)). Officials overseeing work projects record attendance and other details in muster rolls. The muster rolls are sent to the district offices and eventually forwarded to the state government. The state government, after scrutiny, releases the necessary funds to pay workers.

MNREGA Payment System: FY2007-FY2014

The Act stipulated gram panchayats to have a single bank account for all workers under their jurisdiction. The panchayat bank accounts were the recipient of the worker wages, which were paid, in cash or through bank transfer, to the workers. Figure 1 depicts the exact system in place for workers to receive their wages. This system worked in a linear-vertical model across all government sub-divisions. The system began with the gram panchayat notifying the mandal[11] offices about the projects undertaken, number of workers worked and wages due. The mandal office forwarded the relevant information to the state government offices for release of funds. After cross-checking, the state government released funds to the district offices. The district offices forward them to mandal offices which would finally transfer it to the gram panchayat accounts.

The complex system of funds transfer, along with numerous steps and offices in between led to widespread leakages and corruption by the middlemen, which is one of the reasons why MNREGA might have had an implementation and leakages problem (Dutta et al. (2012)). The impact of leakages and delayed payments would be directly felt by the workers as it would leave them with either unpaid work or less than the stipulated wages, that too with a significant lag. Officials and middlemen used numerous techniques to siphon state's money out into their own pockets. In one instance in Jharkhand,[12] it was reported that workers were not paid at all and some were given 5 kg rice by private contractors instead (Narayanan (2017)). In rare cases, delayed and non-payments have allegedly led to workers' suicides (Sandeep Pai (2013)).

B. Aadhaar Linked Payments (ALP): Motivation

India's numerous welfare schemes, PDS[13] systems and other have been ridden by corruption, leakages and inefficiency (Dutta et al. (2012)). In a bid to curb problems associated with payments under welfare schemes, the government

[11] Mandal is another name for sub-district.

[12] Jharkhand is a state in Eastern India

[13] The Public Distribution System (PDS) is a system of management and distribution of food grains at subsidized prices by the government of India.

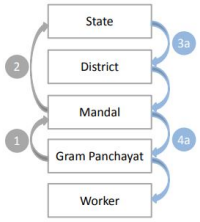


Figure 1. : MNREGA Transfer of Payment

Source: Muralidharan, Niehaus and Sukhtankar (2016) .

initiated the Direct Benefits Transfer (DBT) in FY2014. DBT's motive was to directly transfer the funds of a welfare scheme into the bank account of the beneficiary. DBT was implemented for MNREGA in FY2015 in 300 districts with high banking penetration. For the remaining districts, DBT was implemented in FY2016.

DBT, by itself, was unlikely to be successful in curbing existing issues as fake accounts or identity were still a possibility. Therefore, it was important to bring a credible authentication solution to solve the issue. The biometric-enabled aadhaar was used to provide a credible authentication service. Aadhaar is the Unique Identity (UID) number given by the UIDAI[14] to all residents of India. The UID number is based on biometric and demographic data including fingerprints and iris scans. As aadhaar numbers are secured using biometrics, verifying the authenticity of any bank account becomes straightforward. After implementation of DBT, special aadhaar camps were set up to ensure that the penetration of aadhaar is satisfactory. Figure (1) depicts the total number of beneficiaries and amount disbursed under the DBT scheme.

For a beneficiary, ALP means linking the aadhaar number to a bank account for receiving benefits. The main motive behind linking workers' aadhaar numbers to bank accounts is to eliminate human intervention in disbursement of wages. Before ALP, workers were dependent on the panchayat for any information related to their wages. Post ALP implementation, benefits are transferred directly into the beneficiary bank accounts. The biometric aspect of aadhaar makes it almost impossible to generate duplicate or ghost beneficiaries. This makes it particularly appealing to the government as it drastically improves the transfer of benefit. Since aadhaar linked accounts are unlikely to belong to fraudulent beneficiaries, it reduces the time taken by the government to verify the workers' claims. In situations where verification of beneficiaries is necessary, the process is straightforward as the workers only need to use their biometrics. In the same spirit, as the government does not need to worry about sham beneficiaries, it can

[14]The Unique Identification Authority of India (UIDAI) is the authority which issues a Unique Identification Numbers (UID) number named aadhaar. Prior to becoming a statutory authority, UIDAI was an attached office in the Planning Commission (now NITI Aayog).

directly transfer the benefits into the aadhaar linked accounts. The direct transfer completely ignores the bureaucratic red tape and provides the wages directly to its beneficiary.

The system of disbursement of wages was also streamlined in the post ALP period. To ensure proper implementation, workers were encouraged to link their aadhaar numbers with bank accounts as it led to smooth wage transfers and identity authentication. Once MNREGA workers linked their aadhaar and bank accounts, workers received their aadhaar linked payments in a timely and systematic way as it removed the scope for rent seeking by middlemen. The system behind ALP was also effortless and required minimal human intervention. ALP requires the designated official to provide an APB file[15] containing details of aadhaar number, amount to be paid and the welfare scheme reference number. The bank of the beneficiary, known as sponsor bank, adds an IIN (Institute Identification Number) to the APB file and uploads it to the NPCI[16] servers. The NPCI then processes the file and generates a settlement file which is posted to the banks' accounts with RBI.[17] Once RBI clears the settlement file, destination banks can download the files for credit processing where the wage is directly transferred to the bank account of the beneficiary. Figure (2) depicts the process behind the ALP system. The new payments system eliminated the middlemen or any human intervention completely from delivery of wages to the beneficiary.

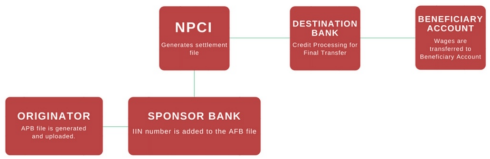


Figure 2. : Aadhaar Linked Payment System

A prerequisite for successful implementation of DBT is the existence of bank accounts for each worker. The impact of DBT would have been very low due to the fact that as of 2014, only 50% of India's adult population had bank accounts.[18] As a major requirement of DBT is an aadhaar enabled bank account, the low banking penetration in India was a crucial shortcoming. Majority of people without bank accounts were the rural poor. The same group was also the target for majority of

[15] Aadhaar Payments Bridge. The system in place by the NPCI to facilitate ALP.
[16] National Payments Corporation of India (NPCI) is an umbrella organization for all retail payments in India.
[17] The Reserve Bank of India(RBI) is India's central banking institution, which controls the monetary policy of the India.
[18] World Bank: http://datatopics.worldbank.org/financialinclusion/country/india

social welfare schemes such as MNREGA. To increase banking penetration, the government launched Pradhan Mantri Jan Dhan Yojana (PMJDY). The scheme, which began in 2014 has seen 310 million new bank accounts being opened as of April 2018.[19] The scheme promises elementary banking facilities such as basic banking accounts with overdraft facility up to ₹5000[20] and RuPay[21] debit card with an accidental insurance cover of ₹100,000. PMJDY drastically improved the platform for ALP. Post PMJDY, the number of beneficiaries in MNREGA increased from 46 million in FY2015 to 111 million in FY2016. The existence of Aadhaar also facilitated opening of new bank accounts as the government mandated that a person with just an aadhaar card as identification will also be allowed to open bank accounts under PMJDY.[22]

II. Data and Variable Description

The data needed for the purpose of this study is described subsequently. We organize our data at the block year level and spans the period between FY2012 to FY2017. For MNREGA related information, we collect data from the 'Public Data Portal'[23] from the official MNREGA website. We download the data at block level for each year, starting from FY2012 to FY2017. We then combine the MNREGA data for these six years into a single dataset. For precipitation and temperature, we collect data from Climatic Research Unit, University of East Anglia.[24] This data is available at daily as well as hourly intervals at the latitude-longitude cross sectional level. We download the daily data for air temperature and precipitation from 1st January 1990 to 31st December 2016. We download the data for delay in payments from MNREGA website[25] and obtain the rankings for programme efficiency from "Healthy States, Progressive India"[26] report by NITI Aayog.[27] We use NSSO[28] round 72 schedule 1.5, survey on Household Expenditure on Services and Durable Goods, to obtain data on consumption expenditure. This data is available at a district level for FY2015.

The precipitation and temperature data is available from 90°N to 0°N latitude

[19] PMJDY Website: https://www.pmjdy.gov.in/account

[20] ₹is the currency sign for the Indian rupee from 15 July 2010.

[21] RuPay is a card scheme started by the National Payments Corporation of India. RuPay cards were issued along with all PMJDY accounts

[22] The simultaneous implementation of PMJDY and aadhaar linked DBT was part of a larger strategy for streamlining welfare scheme payments: known as the JAM Trinity. The JAM trinity refers to Jan Dhan Yojana (PMJDY), aadhaar and mobile. While PMJDY led to a vast majority of rural households opening new bank accounts, the unique, biometric-enabled aadhaar numbers enabled straightforward verification of identity. The government also drastically expanded mobile banking and payment options which reduced the requirement of physical bank branches for utilizing banking facilities.

[23] http://nregarep2.nic.in/netnrega/dynamic2/dynamicreport_new4.aspx

[24] https://crudata.uea.ac.uk/cru/data/ncep/dataset_access%20-%20air%20temperature%20data

[25] http://mnregaweb4.nic.in/netnrega/MISreport4_latest.aspx

[26] http://niti.gov.in/writereaddata/files/Healthy-States-Progressive-India-Report.pdf

[27] NITI Aayog is the premier policy 'Think Tank' of the Government of India.

[28] The National Sample Survey Office (NSSO) is responsible for conducting nation-wide household surveys on various socio-economic subjects. The surveys are released after a considerable lag from the year of survey

and 90°W to 90°E longitudes. The data spans from North America in the west to middle of China in the east for the entire northern hemisphere. To obtain India specific data, we restrict the precipitation (temperature) data between India's latitude and longitude extent, that is, from 8°4 N to 37°6 N latitude and 68°7 E to 97°25 E longitude. Certain parts of north eastern India are outside the scope of this study as India's longitudinal limit extends beyond 90°E longitude. Since our climate data uses intersection of latitude and longitude for area markings, we use a 2011 Census of India's block level shapefile[29] to get the climate information mapped to the corresponding block for each year.

In this data, we define annual precipitation (temperature) as the average of daily precipitation (temperature) at the block level for the year in consideration for all years from FY2012 to FY2017. We define normal precipitation (temperature) as the average of annual average precipitation (temperature) from 1990 to 2010. As per Indian Meteorological Department, an area is considered to be suffering from drought if it receives less than 75%[30] of its normal rainfall in the peak monsoon season. In India, monsoon peaks between June to September. In our data, a block is defined to be in distress if its annual average precipitation for the corresponding year is less than 75% of normal precipitation. The variable that captures this information is a dummy variable named drought which takes value one if annual rainfall in a block is less than 75% of normal rainfall, otherwise it takes value zero.

We have a total 23,022 observations with information available for 3,900 blocks out of 5,400 blocks in census 2011, covering 509 districts of 21 states and 2 union territories. Out of the total 29 states, data for blocks of the Indian state Telangana[31] is missing from the MNREGA data portal. The data for the north eastern states of India is unavailable as they fall out of the longitudinal extent of our climate data. Apart from states, India also has administrative units called union territories. Out of the 7 union territories, MNREGA data is available only for 4. From these, 2 did not match with the census 2011 block data. Therefore there are only 2 out 7 union territories in our sample.

The 6 panels of figure 4 show distribution of districts suffering from drought for each of the years under study. Figure 3 shows total number of blocks in distress annually. It is evident from figure 4 and figure 3 that droughts were spread all across India and not concentrated in certain specific regions of India for the period of our analysis. We get a diverse dataset with distressed blocks spread evenly across the country and across years. Table 2 gives the summary statistics for the key variables in this study. The average number of person days worked

[29]A shapefile is a file that contains information on shape of any area. One can operate on a shape file using any of the open source Geographic Information Softwares (GIS). QGIS is one of them. We use QGIS to map blocks of India to these latitude-longitude cross sections.

[30]http://imd.gov.in/section/nhac/wxfaq.pdf

[31]In June 2014, Indian state of Andhra Pradesh was split into two state: Telangana and Andhra Pradesh. The data for the blocks that came to Telangana after the split is missing from the MNREGA data portal.

under MNREGA is 326,019. The average number of individuals (households) allotted work is 12,597 (7,579) which is quite close to the number of individuals' (households') average demand which is 12,631 (7,593). The average number of persons (households) actually worked is 11,276 (7,249).

Once we have the MNREGA data along with climate based distress indicators, we define the post ALP period. As mentioned in the section I, ALP was implemented in a staggered manner in MNREGA. First, 300 districts came under the scope of ALP in FY2015. Due to reasons mentioned previously, our data contains 247 out of these 300 districts. ALP was then introduced in the remaining districts starting FY2016. Given the staggered implementation of ALP, post variable is defined as a dummy variable which takes value one for the first 247 districts starting from FY2015 onwards. For the remaining blocks, it takes value one starting from FY2016 onwards and zero otherwise.

III. Empirical Strategy

As explained in the introduction, MNREGA should have greater presence in areas suffering from distress. For the rural poor people whose primary occupation is agriculture, drought can have severe consequences. As mentioned in section I, there have been alleged instances where people have been paid in kind instead of cash. There have also been alleged instances of farmer suicides in extreme cases. Since MNREGA workers are poor, timely realization of sustainable wages is extremely important. As mentioned in the introduction, late realization of less than stipulated wages from MNREGA might not be enough for survival. In such a situation, the opportunity cost of MNREGA might force workers to stay away in favor of other employment opportunities or short term migration. To ascertain the movement of work under MNREGA in the pre period, we estimate the following regression equation:

$$Y_{\text{it}} = \alpha + \beta_1 * drought_{it} + \beta_2 * \gamma_i + \beta_3 * \theta_t + \epsilon_{it} \quad . \tag{1}$$

The MNREGA payment system was overhauled with the advent of aadhaar. Workers' bank accounts were linked to aadhaar numbers and a system of direct bank transfer (ALP) was put in place. If delayed payments are the reason behind lack of demand for work in times of distress (Muralidharan, Niehaus and Sukhtankar (2016)), then ALP should increase the demand for work. Therefore, more people should demand MNREGA work in distressed times because the wages received would be substantially higher than before. To estimate the impact of ALP, we exploit the dispersion of distressed and non-distressed areas in pre and post ALP period. This situation lends itself well to a DID setup. The coefficient of difference is given by the interaction of staggered post dummy variable with the drought dummy variable.

As a prerequisite for valid estimation using DID, we need to ensure that there

are no pre trends that might be driving the results (Bertrand, Duflo and Mullainathan (2004)). To check for the existence of pre trends, we plot residuals of regression of the dependent variables on block fixed effects with control variables. We plot total households demanded work and total households alloted work against time. We plot the dependent variables on the y axis. On the x axis, we plot the variable pre that defines the distance of the year in consideration from the year in which ALP is implemented. We also show the 95% confidence interval bar. The variable pre takes value zero for the year in which ALP is implemented in the respective block. Years preceding zero are denoted by negative numbers and years succeeding zero are denoted by positive numbers i.e. 2013 is -1 when base year is 2014 and 2016 is +2 for 2014. As we can see in figure 2, there is no statistically significant difference between distressed and non-distressed areas in the pre period. The lines for drought(0) and drought(1) appear to diverge starting from time 0.

Having ruled out pre trends, we then proceed to estimate the following regression equation:

(2)
$$Y_{\text{it}} = \alpha + \beta_1 * drought_{it} + \beta_2 * post_t + \beta_3 * drought_{it} * post_t + \beta_4 * \gamma_i + \beta_5 * \theta_t + \epsilon_{it} \quad .$$

The main independent variable is the interaction of $post_t$ and $drought_{it}$. It takes the value one if $block_i$ which is suffering from drought in $year_t$ is in the post period otherwise it takes the value zero. The coefficient of the interaction term can be explained as the difference between the difference in outcomes of distressed and non-distressed blocks in the post period, and distressed and non-distressed blocks in the pre period. γ captures the time invariant block effects and θ captures the time fixed effects. We report the results with state-year fixed effects in appendix C. We also use the post variable in the estimation equation because ALP was implemented in a staggered manner, and does not get absorbed by time fixed effects. We estimate equations 1 and 2 for each of our dependent variables.

IV. Results

A. Univariate Tests

We start our analysis with univariate tests. We perform this test on the following four variables: total persons demanded work, total persons allotted work, total muster rolls filled and amount disbursed to bank accounts.[32] Total persons demanded work is the number of individuals that demand work under MNREGA. Total persons allotted work is the number of individuals that are allotted work under MNREGA. Number of muster rolls filled gives the number of attendance

[32]Muster roll is an attendance register that workers have to sign when they come to work on site

registers filled. The data for these variables is available at the block year level. Drought and post variables are as defined in section II. Table 3 reports the result for univariate test.

We perform the following three tests on the outcome variables: (i) whether there is difference in non-distressed (drought = 0) and distressed (drought = 1) areas in pre period (first row of each panel in Table 3); (ii) whether there is difference in non-distressed and distressed areas in the post period (second row of each panel in Table 3); and (iii) whether there is difference between the above mentioned differences in pre period (post = 0) and post period (post = 0) (third row of each panel in Table 3). The difference is calculated between mean (0) and mean (1). We also check if the difference between distressed areas in pre and post periods is positive. Positive difference would mean that there is an increase in the outcome variables in distressed areas in the post period as compared to the pre period. We report the t-statistic of each of the differences in the last column.

Panel (A) reports the result for total persons demanded work, panel (B) and panel (C) report the result for total persons allotted work and number of muster rolls filled respectively. As the results show, in the pre period, number of individuals demanding work is greater in non-distressed areas than in distressed areas. In the post period, the trend reverses, and it is observed that more individuals demand work in times of distress. Note also that there is also an overall increase in the demand for work in the post period. We find a 20% increase demand for work in distressed areas in post period. As is shown in Table 3, the trend holds for allotment of work to individuals and muster rolls filled by individuals. It means that there has been an increase in work demanded and allotted in distressed areas post implementation of ALP. Therefore, it is reasonable to infer that post ALP, there might be an overall improvement in the counter-cyclicality of MNREGA.

As ALP involves transfer of wages directly to bank, there should be an increase in amount transferred to bank account in the post period if ALP is implemented as per plan. We test if there is an increase in amount transferred to banks at block year level in the post period. As reported in panel (D), the average amount transferred for pre period is ₹18.2 million and that for post period is ₹39.8 million. We find that there is an almost double increase in amount transferred to bank account in the post period. Based on these results, we can infer that ALP was implemented as per plan. The increase is significant at conventional statistical levels.

B. Demand for Work

We first study the reaction of demand for work. In distressed times, as there are reduced opportunities for work, especially agricultural work, demand for MNREGA work should increase. However due to leakages and corruption, it is possible that workers stay away from MNREGA as the actual amount paid to workers is substantially less than promised (Muralidharan, Niehaus and Sukhtankar (2016)). We test the above conflicting hypotheses using equations 1 and 2. The dependent

variable for this purpose is total households (persons) demanded work which tells the number of households (persons) that demanded work under MNREGA. We report these results in table 4. Column 1 (3) reports the results for regression of total households (persons) demanded work on drought in the pre period. Column 2 (4) reports the results for regression of total households (persons) demanded work on drought and interaction of drought and post.

In column 1 (3), results show that there is a decline of 524.6 (1,045) households (persons). The average number of households (persons) that demand work is 7,419.24 (12,498.91). As compared to the average, the number of households (persons) that demand work falls by 7% (8.36%). Once we add the interaction term, we find in column 2 (4) that post the implementation of ALP, number of households (persons) demanding work during times of distress increases by a magnitude of 1,225 (2,219). As compared to the average demand, there is a substantial increase of 16.36% (17.75%) in households (persons) that demand work under MNREGA. The coefficients are significant at conventional statistical level.

From the above values, it is reasonable to deduce that demand for work under MNREGA moves in a countercyclical manner after implementation of ALP. Possible reasons at work behind this could be better realization of wages, which might make working in MNREGA at par with other opportunities.

C. Allotment of Work

We now estimate equations 1 and 2 for provision of work. The variable that contains this information is households (persons) alloted work. Even though the demand for work increases, we study the reaction for allotment of work in order to check if the government actually provides work or not. As allotment of work depends on demand for work, work provided might follow similar trend as demand for work. As explained earlier, there is also a possibility that the actual work allotted to people is lesser than the person days demand by them in distressed times (Muralidharan, Niehaus and Sukhtankar (2016); Dutta et al. (2012)). The results for equation 1 for allotment of work to households (persons) are reported in columns 5 (7) of table 4. The results for equation 2 for allotment of work to households (persons) are reported in columns 6 (8) of table 4.

In column 5 (7), we observe that work allotted in distressed times declines by 525.5 (1,045) households (persons). The average number of households (persons) allotted work is 7,413.81 (12,486.65). As compared to the average, there is a decline of 7% (8.36%) in households (persons) allotted work. In column 6 (8), once we add the interaction term, we find an increase of 1,207 (2,170) households (persons) allotted work. As compared to the average , there is an increase of 16.28% (17.37%) of households (persons) allotted work. These results help us infer that in the post ALP period, provision of work also moves in a counter cyclical manner in the post period. The coefficients are significant at conventional statistical level.

From the above mentioned results on demand and allotment of work, it can be concluded that the effect of drought on work demanded and allotted is negative in the pre period. It is interesting to note that post the implementation of ALP, there is an increased demand as well as increased allotment during distressed times. It can be concluded that ALP has resulted in making MNREGA more counter cyclical.

D. Extensive Margin and Intensive Margin

Now, to estimate the results for extensive margin and intensive margin, we use total muster rolls filled, total households worked, total persons worked, total person days, total households reached 100 days. Total households (persons) worked gives the number of households (individuals) that worked. Total person days is the sum of total number of days worked by each individual. Total households reached 100 days reports the number of households that have completed 100 of work days which the maximum amount of guaranteed work. Total households worked and total persons worked explain extensive margin. Total person days and total households reached 100 days explain intensive margin. We study these results to see if more people are engaged in more work. Table 5 reports the results for extensive and intensive margin. Results for equation 1 are given in columns 1, 3, 5, 7, and 9. Results for equation 2 are given in columns 2, 4, 6, 8, and 10.

In column 1, we find that before the implementation of ALP, lesser number of muster rolls are filled in distressed areas. Average number of muster rolls filled is 5,236.7. There is a decline of 372.3 in muster rolls filled, which represents a reduction of 7.1%. In column 2, coefficient of the interaction term is positive. Total muster rolls filled increases by 1,583. As compared to the average, there is an increase of 30.2%. This points to either an increase in number of individuals joining MNREGA workforce or same people turning up more often or both. The coefficients are significant at conventional statistical level.

Intensive Margin

Columns 3(5) and 4(6) report the effect on total households (persons) worked. We find that the coefficient of drought is negative in distressed areas in the pre period. The average number of households (persons) worked in distressed times in the pre period is 7,368.21 (12,270.9). As shown in column 3 (5), there is a reduction of 106.3 (231.3). The coefficient of interaction term shows an increase of 479.9 (792.5) in the number households (persons) worked. As compared to the average, there is an increase of 6.5% (6.4%) households (persons) worked post implementation of ALP. The coefficients are significant at conventional statistical level.

Extensive Margin

Columns 7 and 8 report the results for total person days. The average number of person days is 316,632.9. In column 7, we find that coefficient of drought is negative. There is a decline of 10,148 person days which represents a reduction of 3.2%. In column 8, we find an increase of 37,823 person days. As compared to the average, there is an increase of 11.94% person days post ALP. Columns 9 and 10 give the results for total households reached 100 days. As can be seen, these results follow the same trend as that of person days. We find that 163.8 more households complete 100 days of MNREGA work in the post ALP period. The average number of households that reach 100 days is 599.13 in distressed areas in the pre period. As compared to the average, there is an increase of 27.33%. The coefficients are significant at conventional statistical level.

Based on the results for extensive and intensive margin, we can infer that in the post ALP period more people are joining MNREGA work in distressed times. There is also an increase in the work done by those who are coming for work post ALP i.e., even the individuals who have been provided with MNREGA work are turning up more.

E. Effect on Disadvantaged Groups

As economic shocks affect vulnerable sections of society most drastically, there are concerns that they might not be able to adapt easily to new technology and hence get excluded (Khera (2011)). For this purpose, we see if the positive impact of ALP has proliferated across various socio-economic sections of the Indian society. Our sample contains information on total person days worked by women, total persons with disability, and various variables describing SCs and STs[33] in MNREGA. Total persons with disability gives the number of people with disability who are a part of MNREGA. Table 6 reports the result of estimating equations 1 and 2 on these variables. It has been divided into two panels. Panel A reports the results for person days worked by women and total persons with disability. Panel B reports the results for SC and ST variables.

In panel A, the number of person days worked by women decreases by 13,167 in the non-DID specification. In the DID specification, we find an increase of 30,587 person days worked by women. The average number of person days worked by women in MNREGA is 148,516.2. As compared to the average, there is an increase of 20.5% person days by women in the post ALP period. These coefficients are significant at conventional statistical levels. In the post period, women workforce increases under MNREGA and women work more in distressed areas compared to non-distressed areas.

[33]The constitution of India identifies some historically disadvantage sections and provides them special treatment. Schedule Caste (SC) and Schedule Tribe (ST) are officially designated groups of historically disadvantaged people in India. (Pande (2003)).

In panel B, we study the effect of ALP on SCs and STs in MNREGA. In columns 1 (5) and 2 (6), we report the result for total SC (ST) households worked. We observe an increase of 51.3 (124.8) in SC (ST) households that worked in the post period. The average number of SC (ST) households working in MNREGA in distressed areas in the pre period is 1,626.48 (1,319.36). Implementation of ALP increases the number of SC (ST) households by 3.1% (9.5%). In columns 3 (7) and 4 (8), we report the result for total person days worked by SC (ST). We find that there is a statistically significant increase of 4,742 (5,752) person days worked by SC (ST) in the post ALP period. The average number of person days worked by SC (ST) is 67,762.98 (61,223). As compared to the average values, there is an increase of 6.99% (9.3%) person days worked by SC (ST).

F. Amount Disbursed to Bank and Post Office Accounts

Based on the above results, we hypothesize that there should be an increase in amount transferred to bank accounts in distressed areas in the post period. The variable containing information on amount transferred to bank account in our data is amount disbursed to bank account.

To ascertain the effect of implementation of ALP we estimate equations 1 and 2 for amount disbursed to bank account. Table 7 reports the results for amount disbursed to bank account. The average value of amount disbursed to bank account in non-distressed areas in the pre period is ₹17.6 million. In column 1 of the table, the coefficient of drought is negative. We see that amount disbursed to bank account in distressed areas in the pre period is lower by ₹2.17 million. There is a decline of 12.9%. In the DID specification, we find amount transferred to bank account increases by ₹7.39 million. As compared to the average, there is an increase of 42%. We also estimate equations 1 and 2 for amount disbursed to post office accounts and find similar results. The results are reported in columns 3 and 4 of table 7.

The increase in amount disbursed to bank account in distressed areas in the post period can be attributed to the positive effect of ALP. Given that there is an increase in amount disbursed to bank account in the post period, we can infer that MNREGA behaves in a countercyclical manner in the post period.

G. External Validation

So far we have seen the effect of drought on demand for MNREGA. We find that after the implementation of ALP, demand for MNREGA increases during drought. Even though drought is the primary source of rural distress, there is a possibility of extremely localized unobservable distress such as pest attack, disease outbreak etc. The distress under such events would be extremely local. Irrespective of the source, distress should lead to a decline in the consumption expenditure of the rural poor. Therefore, we use the reduction in consumption expenditure as a proxy for distress and hypothesize that it should lead to an increase in demand for MNREGA work in the post ALP period.

To test for any unobservable distress, we utilise the reduction in consumption expenditure as a measure of distress for external validation of our results. The data for this purpose has been obtained from NSSO round 72 survey. The NSSO survey was conducted in FY2015 at the household level. As the survey does not include block level identification, we aggregate the MNREGA as well as NSSO data at the district level. Therefore the data for this test is limited to FY2015. First, we identify the geographical neighbours of each district. We define our observations at the district neighbour pair level. There is a possibility that ALP endogenously affects consumption. To circumvent the endogeneity of ALP, we define a new dummy variable called post_nsso. It takes the value one if ALP was implemented in both the district and its neighbour. Similarly, it takes the value zero if ALP was not implemented in both the district and its neighbour.

For the purpose of the test, our two main variables are consumption factor and demand factor. The demand factor is constructed by dividing the total persons that demanded work under MNREGA in the concerned district by the total persons that demanded work in the neighbouring district. The consumption factor is constructed by dividing the consumption expenditure of the concerned district by its neighbours'. We define a dummy variable for distress called treatment. The treatment variable takes the value one if the total consumption expenditure of the district is less than the total consumption expenditure of the neighbour, else zero.

We estimate equations 1 and 2 with demand factor as the dependent variable. Our independent variables are the treatment dummy variable and consumption factor in two separate specifications. Table 8 reports the results for this test. We estimate the impact of decline in consumption separately for ALP districts and non ALP districts. Column 1(4) reports result for ALP districts. In column 1, we find a 63.2% increase in the demand factor for districts with less consumption, defined by treatment dummy. As shown in column 4, a unit decrease in consumption factor leads to 1.5 times increase in the demand factor. The coefficients are significant at conventional statistical levels. We find in column 2 and 5 that in non ALP districts, decreased consumption expenditure has no effect on demand for MNREGA work.

In column 3 (6) we use the DID approach where we compare the difference between ALP and non ALP district-neighbour pairs based on economic distress. We find that there is an increase demand for MNREGA work in districts with less consumption post implementation of ALP. We find that the demand factor increases further by a magnitude of 0.512 (column 3). In a DID sense, this can interpreted that the implementation of ALP has led to an increase in number of people that demand work under MNREGA in distressed areas. That is, people are more willing to seek work under MNREGA in districts with ALP implementation. The relation between demand factor and consumption is negative by 1.175 times (column 6). This implies that MNREGA has become more counter-cyclical. Also, in districts with ALP, the relation between consumption and demand is becoming

even more negative. This corroborates the results in section IV.B. The DID coefficients are significant at conventional statistical levels.

From this test, we find that irregular increase in MNREGA demand can serve as a signal for distress. As compared to other data sources such as NSSO, the data related to MNREGA is updated in reasonably short intervals. By utilizing MNREGA demand and identifying abnormal variations, the government can distinguish areas under local distress and take action in a timely and systematic manner. This provides the policy makers and government officials a tracking mechanism to identify areas under distress in real time.

H. Alternate Measures of Distress

As a robustness check, we examine if our results hold when we use alternative measures of distress. We estimate the equations given in the following sections for total persons demanded work, total persons allotted work, total persons worked and total person days.

Temperature

We use temperature as the first alternate measure of distress because higher than normal temperature adversely affects agricultural productivity (Burgess et al. (2011); Burgess and Donaldson (2010); Sekhri and Storeygard (2014); Singh et al. (2006). As mentioned in section II, a block is defined as distressed in a year if its annual temperature is higher than its base temperature.

$$Y_{\text{it}} = \alpha + \beta_1 * high\_temp_{it} + \beta_2 * \gamma_i + \beta_3 * \theta_t + \epsilon_{it} \quad . \tag{3}$$

$$Y_{\text{it}} = \alpha + \beta_1 * high\_temp_{it} + \beta_2 * post + \beta_3 * high\_temp_{it} * post_t + \beta_4 * \gamma_i + \beta_5 * \theta_t + \epsilon_{it} \quad . \tag{4}$$

$High\_temperature_{it}$ is a dummy variable that takes value one if a block is distressed in the year of consideration, otherwise it takes value zero. Post is the staggered post period dummy variable as explained in section II. Product of high temperature and post period dummy variables gives the interaction term to estimate the effect of ALP in distressed areas in post period.

Table 9 reports the results for this analysis. The results are provided in the following order: total persons demanded work, total persons allotted work, total persons worked and total person days respectively for both the equations. The results for equation 3 are given in columns 1, 3, 5, and 7. For equation 4, the results are given in columns 2, 4, 6 and 8. These results corroborate the results reported in sections IV.B, IV.C and IV.D. We can infer that even with a different measure of distress, ALP is the drives work under MNREGA towards countercyclicality. More people are doing more work under MNREGA in distressed areas after the implementation ALP.

Varying Threshold of Drought

In this section, we test if varying the threshold of drought produces different results than what we find previously. We do this in order to check whether the 75% cut off holds some special meaning. Here we measure drought in two ways: (i) we define a variable $drought_{80it}$ if annual precipitation in the block is less than 80% of the base precipitation; (ii) we define a variable $drought_{70it}$ if annual precipitation in the block is less than 70% of the base precipitation. Both drought_80 and drought_70 are dummy variables that take value one if a block is distressed otherwise they take value zero.

$$Y_{\text{it}} = \alpha + \beta_1 * drought_{jit} + \beta_2 * \gamma_i + \beta_3 * \theta_t + \epsilon_{it} \quad . \tag{5}$$

$$Y_{\text{it}} = \alpha + \beta_1 * drought_{jit} + \beta_2 * post + \beta_3 * drought_{jit} * post_t + \beta_4 * \gamma_i + \beta_5 * \theta_t + \epsilon_{it} \quad . \tag{6}$$

$Drought_{jit}$ is a dummy variable that takes value one if a block is distressed in the year of consideration, otherwise it takes value zero. Post is the staggered post period dummy variable as explained in section II. Product of drought and post period dummy variables gives the interaction term to estimate the effect of ALP in distressed areas in post period.

Table 10 reports the result for these estimations in two panels. Panel A reports the result for drought_80 and panel B reports the result for drought_70. The results are provided in the order of total persons demanded work, total persons allotted work, total persons worked and total person days respectively for both the equations. The results for estimating equation 5 are reported in columns 1, 3, 5 and 7. For equation 6, the results are reported in columns 2, 4, 6 and 8. We find that even after varying the threshold of drought, the impact of ALP is such that implementation of MNREGA becomes countercyclical. These results corroborate the results reported in sections IV.B, IV.C and IV.D.

I. Instrument Variable

To address residual concerns, we use instrumental variable approach. For this purpose we use bank penetration (total bank branches) at the district year level as our instrument. We obtain the data for this test from the RBI website.[34] Since ALP involves the transfer of wages directly to bank account, bank penetration is likely to predict the selection of districts for the implementation of ALP. As shown by Burgess and Pande (2005), bank penetration in rural parts of India can be attributed to a government regulation that forced banks to open four branches in an unbanked location for every branch they open in a banked location. Therefore, bank penetration is unlikely to affect counter cyclicality of MNREGA

[34] https://rbi.org.in/Scripts/PublicationsView.aspx?id=12671

in post period apart from selection of districts for ALP implementation and hence satisfies exclusion restriction.

We capture the information about bank penetration in a dummy variable called bank dummy. It takes the value one if the district under consideration has more than median number of bank branches in that year, otherwise it takes the value zero. A new post dummy variable called post 2 is defined for the purpose of this regression. The variable post 2 takes the value one if a block was selected for ALP in 2014, otherwise it takes the value zero. As only the first phase saw selection of districts based on bank penetration (second phase was for all remaining districts), we use only these districts for IV regression. We make a new interaction variable between drought and bank dummy variables. This interaction along with post 2 dummy variable is used for an IV regression on post 2 and interaction of drought and post 2. The first stage F statistic for the IV regression shows that our instrument strongly predicts the independent variable. The regression equation we estimate is as follows:

$$bank\_dummy_{it} = \alpha + \beta_1 * post\_2_t + \beta_2 * \theta_t + \epsilon_{it} \quad . \tag{7}$$

Table 11 reports the results of equation 7. We use the estimated values of drought*post 2 and post 2 for a regression on our four main results (Same as equation 2 but with post 2 instead of drought as one of the independent variable), total persons demanded work, total persons allotted work, total persons worked and total person days. All of our initial results hold even after regressing them on the IV. The coefficients of all our main variables of interest are positive and statistically significant. This might reduce some concerns about the selection bias of districts.

J. Plausible Mechanism

We hypothesize that delayed payments and leakages are the causes behind inefficiency of MNREGA in the pre period. Due to minimal human interaction in payment of wages after ALP, we hypothesize that the reduction in delayed payments and leakages might lead to increased participation in MNREGA in the post period. As we cannot verify leakages, we use the block level data on delayed payments from the MNREGA MIS reports to test if delayed payments have decreased in the post ALP period.[35] We also use the ranking of states based on parameters such as efficiency of program implementation from a report by NITI Aayog to test whether less efficient states have seen greater improvement in outcomes.

[35] http://mnregaweb4.nic.in/netnrega/MISreport4.aspx

Delayed Payments

The data used for the purpose of this test contains information on the total transactions delayed and total amount delayed in terms of payment of wages at the block-year level. Both set of variables are varied across four time frames, i.e delayed by 15-30 days, 30-60 days , 60-90 days and 90 plus days. The maximum level of delay available is 90 plus days. We use the proportion of transactions (amount) delayed by 90 plus days out of total transaction (amount) delayed as our variable of concern to understand how delayed payments have changed post implementation of ALP. We hypothesize that due to the improved implementation of MNREGA post ALP, the proportion of transactions (amount) delayed should decline.

For this test, we do not utilize the DID framework. This is done to ensure that we assess the impact of ALP on our concerned variables. As such, we estimate the following regression equation for our variables. The variables are the same as defined in section II.

$$Y_{\text{it}} = \alpha + \beta_1 * post_t + \beta_2 * \gamma_i + \beta_3 * \theta_t \tag{8}$$

The results for equation 8 are reported in panel A of table 12. Columns (1) and (2) report the results without year fixed effects. Columns (3) and (4) report the same results with time fixed effects. The coefficients of the post variable in all of the regressions are negative. For the fixed year effect specifications, we see a decline of 13.7% (13.9%) in the proportion of transactions(amounts) delayed in the post period . In regressions without fixed year effects, we find a decline of 17.2%(17.5%) in the proportion of transactions(amounts) delayed in the post period. This implies that post implementation of ALP, there has been a decline the proportion of delayed transactions (amounts).

Implementation of Social Welfare Programs

The efficiency of implementation varies across different states of India. We anticipate that workers in states with less efficient implementation would be less inclined to work under MNREGA as a result of the prevalent corruption as compared to workers in efficient states. Given this scenario, we hypothesize that technological interventions such as ALP should have a larger positive impact in less efficient states as compared to efficient states as the scope of improvement is greater.

We test the hypothesis by using the overall ranking of Indian states based on their progress in a variety of parameters such as outcomes, governance and processes from "Healthy States, Progressive India"report by NITI Aayog. Based on the states that are present in our data, we divide the ranking into tertiles. Those states that are ranked in the topmost tertile are marked as efficient states,

while those that are ranked in the bottom tertile are marked as less efficient states. This information is stored in a dummy variable called rank which takes value one for less efficient states and one otherwise.

Given our results, we test if the outcome variables were lower in the pre ALP period and whether post ALP intervention, there has been greater improvement in less efficient states. We focus the test on our four main variables namely total persons demanded work, total persons allotted work, total person days and total persons worked. For this purpose, we estimate the following regression equation:

(9)
$$Y_{\text{it}} = \alpha + \beta_1 * drought_{it} + \beta_2 * drought_{it} * post_t + \beta_3 * post_t * rank_i + \beta_4 * drought_{it} * rank_t + \beta_4 * rank_i * post_i * drought_{it} + \beta_5 * \gamma_i + \beta_6 * \theta_t + \epsilon_{it}$$

In the given estimation equation, the coefficient of interest is that of the triple interaction term. It can be interpreted as the effect of implementation of ALP in distressed areas in less efficient states as compared to more efficient states. The results for equation 9 are reported in panel B of table 12 in the order total persons demanded work, total persons alloted work, total persons worked and total person days. The coefficient of triple interaction term is positive for our variables of interest. The coefficient for all variables except total person days is significant at conventional statistical level. This means that less efficient states show a greater improvement in work done under MNREGA in distressed areas after the implementation of ALP. After the implementation of ALP, rural workers are realizing benefits of MNREGA more efficiently. As a result implementation MNREGA has become counter cyclical.

K. Placebo Tests

To test whether our results are unique to our situation and not a part of a larger trend, we perform a series of placebo tests. For our placebo tests, we randomly select the districts in drought for the drought variable. We also randomly select the districts for the post variable i.e whether the districts were a part of ALP or not. For the post variable sample selection, we assign random values between zero and one to all districts in FY2015 when the first stage of ALP selection was done. As all remaining districts came within purview of ALP in FY2016, the sample selection is necessary only for FY2015. The random values are then ranked in ascending order and the first 247 ranked districts[36] are selected as the treatment group. All remaining districts were assigned value of one from FY2016 onwards. Similarly, we assign random blocks to be in drought across our time frame. We assign blocks to be in drought, based on the number of blocks that were actually in drought for the year in consideration. That is, if FY2013 has 50 blocks in drought, we rank the random numbers and assign the bottom 50 blocks

[36]300 pan-India districts were assigned ALP in FY2015; our data contains 247 out of those 300

as drought.

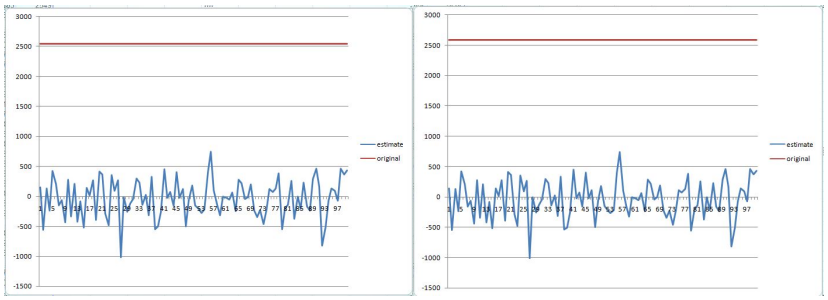
Following the same methodology, the post and drought variables are randomly selected 100 times. We estimate equation 2 using the placebo variables on the following 4 variables: Total households demanded work, total persons demanded work , total households allotted work and total persons allotted work. We implement the regressions in three different combinations. First, we use the placebo drought variables and interacted the variable with the actual post variable to get 100 new interaction variables for the regression. Second, the post variable is randomized with the actual drought variable for 100 new interaction variables. Third, both drought and post variables are randomized and 100 new interaction variables were made.

For each variable, we estimate 100 regressions for each specification and store the coefficients of the interaction variable. We then plot the coefficients in a graph along with our original coefficient for the same variable. The graphs show us that the actual coefficient is significantly greater than that of the placebo tests. This supports our argument that the results obtained are a result of ALP implementation and have not been calculated mechanically. Figure 3 (a) depicts the graph with both drought and post placebo. In appendix A, figure 3 (b) and Figure 3 (c) depict the graph with drought placebo and post placebo alternatively. The red line depicts the coefficients from our original regressions. The blue line depict the coefficients of the placebo tests.

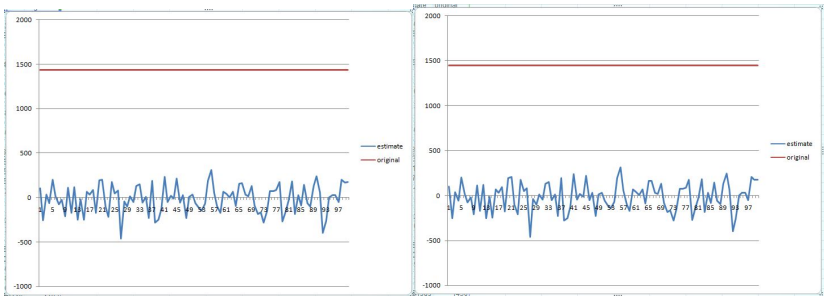
V. Conclusion

Anti-poverty programs, in spirit, are supposed to be used by the poor during times of economic distress. However, a large number of studies that evaluate the efficacy of anti-poverty programs have shown that the implementation of such programs leaves much to be desired. In this study, we examine the world's largest workfare program–MNREGA–implemented by the government of India and ask whether the provision of jobs under the program moves in a counter cyclical manner. Given that the program is targeted at the rural poor who are primarily dependent on farm income, weather shocks can be effectively used as proxies for economic distress.

We find that both the demand for and supply of work under MNREGA decreases significantly during times of local economic distress. We find a decrease both in terms of extensive as well as intensive margins. We find this result even when we consider the impact on jobs provided to weaker sections of the society and women. It is possible that due to leakages and delays, distressed poor find it uneconomical to work for the workfare program, which is supposed to be a shock absorber for the poor. In addition, rent-seeking officials may not have any incentive to pro actively identify distress and supply jobs accordingly. Finally, in the absence of credible identification of beneficiaries, the capacity of the state to monitor implementation and force the bureaucracy to effectively implement the program, true to its spirit, may be limited.



(a) Persons Allotted Work (b) Persons Demanded Work



(c) Households Allotted Work (d) Households Demanded Work

Figure 3. : (A) Both Drought and Post Placebo

We then examine the impact of the introduction of biometric enabled national identity number, named "Aadhaar"for identifying beneficiaries under MNREGA. Muralidharan, Niehaus and Sukhtankar (2016) show that introduction of local smart cards in social security schemes in one Indian state, reduced leakages and ensured speedy payment. We ask if this administrative intervention based on technology helps to make the program truly counter-cyclical. We use the phase wise roll-out of ALP and implement a staggered DID approach. We find that both demand for and supply of jobs under the program responds positively to distress after the techno-administrative intervention. It appears that the target segment repossess more faith in MNREGA after the intervention and hence demands more work during economic distress in the post-intervention period. Similarly, increased state capacity due to the availability of timely and reliable data, and also the ability to transfer benefits directly to beneficiary bank accounts, which led to a decline in delayed payments, seems to have led to better monitoring and implementation of the program.

From the results presented in this paper, we conclude that techno-administrative intervention in the form of introduction of biometric enabled identity cards and direct benefit transfer of benefits enables anti poverty programs to respond more efficiently to distress. It is important to note that our study is based on block

level data. It is possible that technology may have heterogeneous impact on different type of individuals. Although we find that overall participation of the marginalized sections of the society increases after the intervention, it is important to acknowledge that we only capture aggregate effect for the entire group of marginalized people at the block level. It is possible that certain type of individuals, who are either not familiar with the use of new technology or are averse to change, are excluded while certain others join after technological intervention. The topic of exclusion of individuals is beyond the scope of this study. Future research may throw light on this topic.

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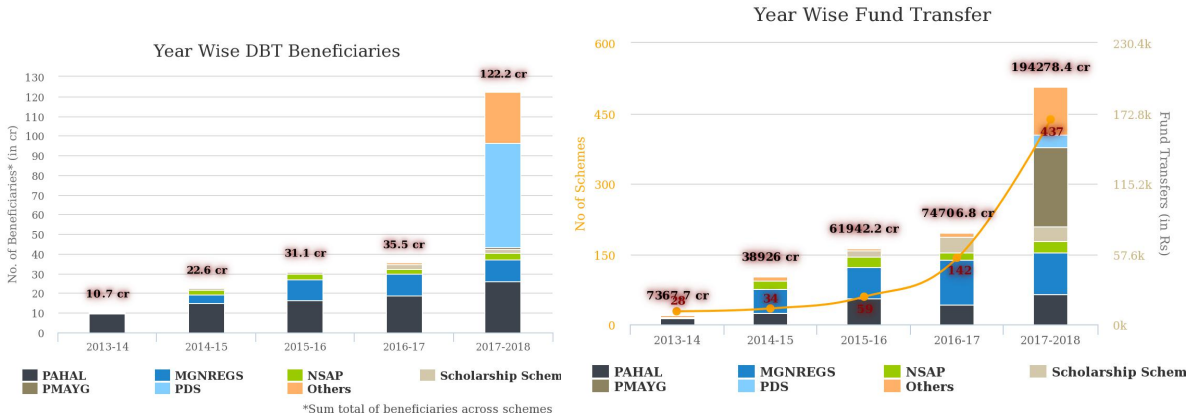
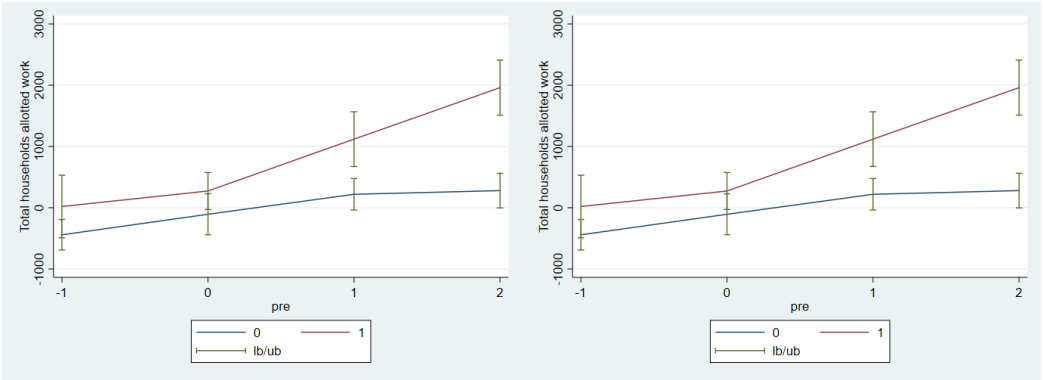


(a) Total Beneficiaries (b) Total amount disbursed

Figure 1. : Direct Benefits Transfer



(a) Total households demanded work (b) Total households allotted work

Figure 2. : Pre period trends

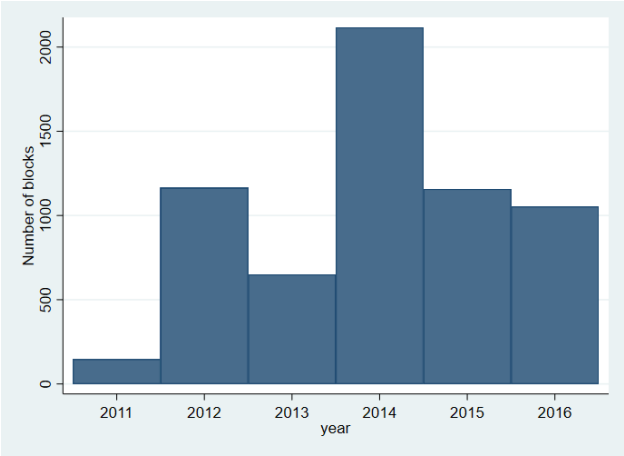
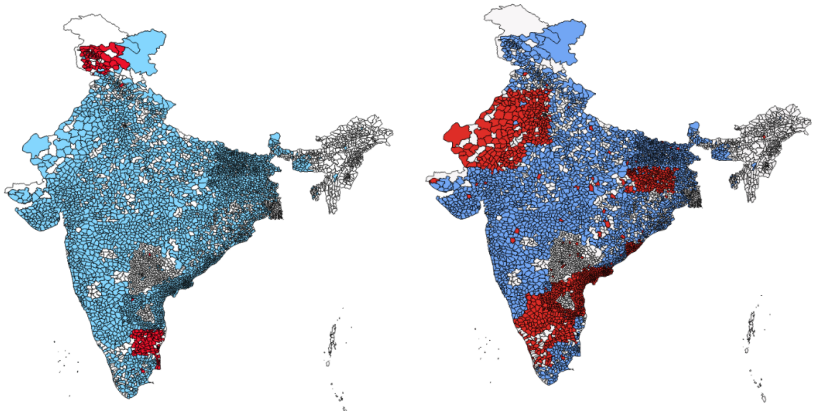


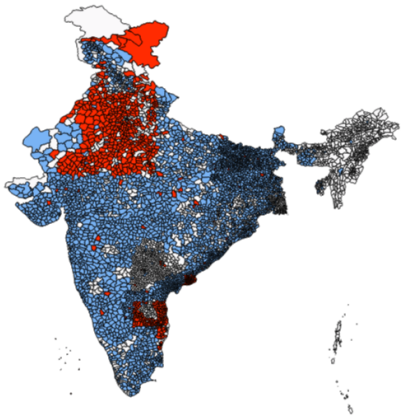
Figure 3. : Total number of blocks in drought across years

Figure 4. :

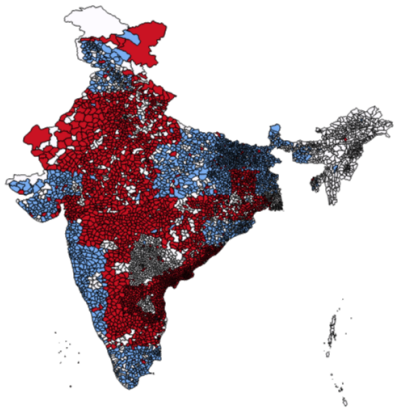
Drought blocks on the map of India. Red: Block under drought. Blue: blocks without drought. White: no data

(a) 2011 (b) 2012

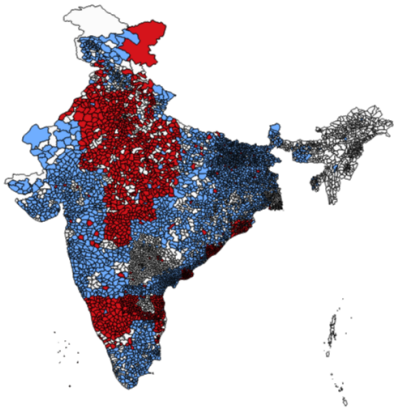




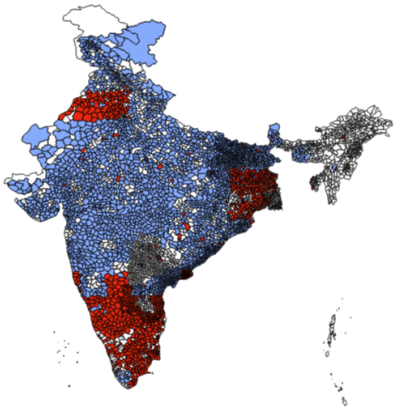
(c) 2013



(d) 2014



(e) 2015



(f) 2016

Table 1—: VARIABLE DESCRIPTION

Name	Description
State	Name of the State
Block Code	Unique Block ID; generated at state-district-block level
Total person days	Total person days worked at block year level
Total households demanded work	Number of households that demanded work at a block year level
Total persons demanded work	Number of persons that demanded work at block a year level
Total households allotted work	Number of households allotted work at block a year level
Total persons allotted work	Number of persons allotted work at block a year level
Total musterrolls filled	Muster rolls is a kind of an attendance register for workers; available at the block year level
Total households worked	Number of households worked at a block year level
Total persons worked	Number of persons worked at a block year level
Total households reached 100 day	Number of households that reached 100 days of MNREGA work at a block year level
Total households applied for job	Number of households that applied for job cards to be eligible to demand work in MNREGA at a block year level
Total persons with disability	Number of persons with disability in MNREGA at a block year level
Total person days worked by women	Total person days worked by women at a block year level
Total SC households worked	Number of SC households worked at a block year level
Total person days worked by SCs	Total Person Days by SC Worked at a block year level
Total ST households worked	Number of ST households worked at a block year level
Total person days worked by STs	Total person days by ST worked at a block year level
Total SC households over 100 day	Number of SC households that reached 100 days of MNREGA work at a block year level
Total ST households over 100 day	Number of ST households that reached 100 days of MNREGA work at a block year level
Amount disbursed to bank account	Amount of wages (in INR) disbursed to bank accounts of MNREGA job card holders at a block year level
Amount disbursed to post office	Amount of wages (in INR) disbursed to post office accounts of MNREGA job card holders at a block year level
Post	Dummy variable that takes value one whenever the block is assigned DBT based MNREGA payments, else zero.
Bank Dummy	Dummy variable that takes a value one for only the 300 districts that were above median based on the number of bank branches at the district level.
Drought	Dummy variable that takes value one if block is in drought as per the IMD definition of drought, else zero
Drought 1	Drought variable that takes the value one if the block receives 80% of the normal rainfall, else zero.
Drought 2	Drought variable that takes the value one if the block receives 70% of the normal rainfall, else zero.
High temperature	Dummy that takes value one if the annual average temperature is more than 20 years average temperature

Table 2—: SUMMARY STATISTICS

The table describes the summary statistics of the variables of interest.

VARIABLES	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
Total person days	23,022	326,019	367,448	0	4725000
Total households demanded work	23,022	7,593	7,527	0	67,951
Total persons demanded work	23,022	12,631	13,699	0	150,125
Total households allotted work	23,022	7,579	7,523	0	67,951
Total persons allotted work	23,022	12,597	13,669	0	149,927
Total muster rolls filled	23,022	5,727	6,342	0	85,312
Total households worked	23,022	7,249	7,044	0	66,490
Total persons worked	23,022	11,726	12,274	0	147,080
Total households reached 100 day	23,022	621.0	1,123	0	22,877
Total households applied for job	23,022	21,724	13,234	0	108,301
Total persons with disability	23,022	73.21	244.1	0	12,727
Total person days worked by women	23,022	169,081	247,204	0	3296000
Total SC households worked	23,022	1,632	2,219	0	29,138
Total person days worked by SCs	23,022	71,673	105,123	0	1406000
Total ST households worked	23,022	1,200	2,776	0	48,646
Total person days worked by STs	23,022	56,171	154,783	0	3566000
Total SC households over 100 day	23,022	125.9	293.3	0	6,884
Total ST households over 100 day	23,022	111.1	459.9	0	18,281
Amount disbursed to bank account	23,022	27280000	41890000	0	672000000
Amount disbursed to post office	23,022	9860000	20100000	0	388100000

Table 3—: UNIVARIATE RESULTS

(a)
Total persons demanded work

Mean	**Drought = 0**	**Drought = 1**	**t-values**
Post = 0	12498.91	11686.89	2.5644
Post = 1	12381.70	14113.63	-6.6867
Post(0) - Post(1) = -3.8099			

(b)
Total persons allotted work

Mean	**Drought = 0**	**Drought = 1**	**t-values**
Post = 0	12486.65	11670.83	2.578
Post = 1	12339.33	14016.35	-6.5075
Post(0) - Post(1) = -3.5438			

(c)
Total muster rolls filled

Mean	**Drought = 0**	**Drought = 1**	**t-values**
Post = 0	5236.71	4840.40	3.039
Post = 1	6233.79	6974.12	-5.2715
Post(0) - Post(1) = -16.0857			

(d)
Amount disbursed to bank accounts

Post(0) - Post(1) = 2.16 million***

Table 4—: Impact on Demand and Allotment of Work

The table reports the regression estimated based on equations (1) and (2). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests are total households demanded work (columns 1-2) , total persons demanded work (columns 3-4), total households allotted work (columns 5-6) and total persons allotted work (columns 7-8). Column 1, 3, 5 and 7 present the results of the regression of the respective dependent variables on drought along with block level and time fixed effects. Columns 2, 4, 6 and 8 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total households demanded work		Total persons demanded work		Total households allotted work		Total persons allotted work	
Drought	-524.6***	-811.0***	-1,045***	-1,553***	-525.5***	-806.1***	-1,045***	-1,542***
	(86.20)	(82.10)	(174.9)	(162.5)	(86.18)	(81.94)	(175.1)	(162.2)
Post		589.7***		959.8***		601.3***		989.9***
		(94.93)		(185.9)		(94.91)		(185.7)
Drought * Post		1,225***		2,219***		1,207***		2,170***
		(98.89)		(206.6)		(98.69)		(206.3)
Constant	7,303***	7,117***	12,324***	12,107***	7,300***	7,113***	12,318***	12,100***
	(37.79)	(49.17)	(83.85)	(105.6)	(37.79)	(49.09)	(83.91)	(105.5)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.939	0.906	0.915	0.879	0.939	0.907	0.915	0.879

Table 5—: Extensive Margin & Intensive Margin

The table reports the regression estimated based on equations (1) and (2). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests total muster rolls filled (columns 1-2) , total households worked (columns 3-4), total persons worked (columns 5-6) total person days (columns 7-8) and total households reached 100 day (columns 9-10). Column 1, 3, 5, 7 and 9 present the results of the regression of the respective dependent variables on drought along with block level and time fixed effects. Columns 2, 4, 6, 8 and 10 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

VARIABLES	(1) Total muster rolls filled	(2)	(3) Total households worked	(4)	(5) Total persons worked	(6)	(7) Total person days	(8)	(9) Total households reached 100 day	(10)
Drought	-372.3***	-866.2***	-106.3	-260.1***	-231.3	-506.5***	-10,148**	-14,683***	0.676	-9.644
	(109.2)	(101.4)	(73.85)	(67.47)	(150.9)	(132.4)	(5,120)	(4,697)	(23.28)	(20.01)
Post		499.4***		529.5***		695.0***		2,192		-172.8***
		(117.7)		(84.31)		(166.0)		(6,279)		(29.61)
Drought * Post		1,583***		479.9***		792.5***		37,823***		163.8***
		(130.6)		(82.87)		(174.2)		(6,166)		(29.22)
Constant	4,633***	4,509***	7,834***	7,716***	13,259***	13,159***	328,928***	328,304***	584.3***	599.0***
	(51.07)	(65.04)	(35.60)	(41.83)	(79.65)	(94.93)	(2,516)	(2,821)	(10.17)	(10.71)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.809	0.772	0.951	0.924	0.927	0.890	0.901	0.861	0.781	0.702

Table 6—: Disadvantaged Sections

Panel (A) reports the regression estimated based on equations (1) and (2). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests are total persons with disability (columns 1-2) and total person days worked by women(columns 3-4). Column 1 and 3 present the results of the regression of the respective dependent variables on drought along with block level and time fixed effects. Columns 2 and 4 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. Panel (B) reports the same results as above on four additional variables related to disadvantaged sections of the society. The variables reported in panel (b) are total SC households worked (columns 1-2), total person days worked by SCs (columns 3-4), total ST households worked(columns 5-6), total person days worked by STs (columns 7-8), total SC households over 100 day(columns 9-10) and total ST households over 100 day(columns 11-12) The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

(A)	(1)	(2)	(3)	(4)
VARIABLES	Total persons with disability		Total person days worked by women	
Drought	1.765	-2.788	-13,167***	-11,940***
	(3.056)	(2.202)	(3,072)	(3,051)
Post		13.04***		-19,031***
		(3.865)		(3,642)
Drought*Post		3.288		30,587***
		(2.339)		(3,843)
Constant	69.83***	69.28***	156,684***	159,990***
	(2.785)	(3.516)	(1,422)	(1,625)
Block Level Fixed Effects	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022
R-squared	0.841	0.815	0.931	0.900

(B)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total SC households worked		Total persondays worked by SCs		Total ST households worked		Total persondays worked by STs	
Drought	58.47***	-30.49	1,369	-1,398	-65.31***	-80.58***	-3,624**	-4,545***
	(22.50)	(19.06)	(1,489)	(1,225)	(21.40)	(19.18)	(1,637)	(1,376)
Post		153.5***		-378.9		-17.82		2,807
		(26.99)		(2,031)		(32.33)		(2,184)
Drought * Post		51.53**		4,742***		124.8***		5,752***
		(24.27)		(1,762)		(26.04)		(1,880)
Constant	1,740***	1,712***	71,514***	71,602***	1,339***	1,307***	62,196***	60,832***
	(10.13)	(12.30)	(689.3)	(776.8)	(11.15)	(14.00)	(835.8)	(1,033)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.956	0.939	0.904	0.877	0.970	0.944	0.941	0.902

Table 7—: Bank Details

The table reports the regression estimated based on equations (1) and (2). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests are amount disbursed to bank account (columns 1-2) and amount disbursed to post office (columns 3-4). Column 1 and 3 present the results of the regression of the respective dependent variables on drought along with block level and time fixed effects. Columns 2 and 4 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. Values in the table are in INR million. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

	(1)	(2)	(3)	(4)
VARIABLES	Amount disbursed to bank account		Amount disbursed to post office	
Drought	-2.28***	-2.17***	2.41***	1.86***
	(0.72)	(0.79)	(0.41	(0.35)
Post		-4.26***		4.87***
		(0.82)		(0.42)
Drought * Post		7.39***		1.51***
		(1.031)		(0.42)
Constant	1.26***	1.23***	1.44***	1.41***
	(0.25)	(0.40)	(0.27)	(0.32)
Block Level Fixed Effects	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022
R-squared	0.790	0.719	0.756	0.610

Table 8—: External Validation

The table reports the regression estimates based on equations (1) and (2). The sample is at the district-neighbour level for the year 2014. The dependent variables in the test is demand factor. The demand factor variable is constructed by dividing the total persons that demanded work under MNREGA in the concerned district by the total persons that demanded work in the neighbouring district. The independent variables for the test are consumption factor and treatment. The consumption factor variable is constructed by dividing the consumption expenditure of the concerned district by the neighbours'. The treatment variable is a dummy which takes the value one if the total consumption expenditure of the district is less than the total consumption expenditure of the neighbour, else zero. Column 1 (4) present the results of the regression of demand factor on treatment (consumption factor) in ALP implemented districts. Column 2 (5) present the same regressions results but for non ALP districts only. Column 3 (6) present the results of demand factor on the interaction of treatment and ALP in a DID specification. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

VARIABLES	(1) Demand Factor	(2) Demand Factor	(3) Demand Factor	(4) Demand Factor	(5) Demand Factor	(6) Demand Factor
Treatment	0.632***	0.120	0.120			
	(0.139)	(0.123)	(0.124)			
Treatment * ALP			0.512***			
			(0.185)			
Consumption Factor				-1.568***	-0.393	-0.393
				(0.281)	(0.255)	(0.257)
Consumption Factor * ALP						-1.175***
						(0.378)
Constant	1.156***	1.457***	1.333***	3.094***	1.931***	2.409***
	(0.0695)	(0.0614)	(0.0461)	(0.291)	(0.269)	(0.199)
District Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
ALP	Yes	No	Yes	Yes	No	Yes
Observations	733	1,051	1,784	733	1,051	1,784
R-squared	0.517	0.453	0.477	0.531	0.454	0.484

Table 9—: TEMPERATURE DISTRESS

The table reports the regression estimated based on equations (3) and (4). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests total persons demanded work (columns 1-2) total persons allotted work (columns 3-4), total persons worked (columns 5-6) and total person days (columns 7-8). Column 1, 3, 5 and 7 present the results of the regression of the respective dependent variables on drought along with block level and time fixed effects. Columns 2, 4, 6 and 8 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

VARIABLES	(1) Total persons demanded work	(2)	(3) Total persons allotted work	(4)	(5) Total persons worked	(6)	(7) Total persondays	(8)
High Temperature	-2,600***	-2,261***	-2,591***	-2,284***	-774.7***	-863.4***	-10,605**	-13,792***
	(171.2)	(159.4)	(171.0)	(159.5)	(132.3)	(128.9)	(4,616)	(4,358)
Post		882.8***		853.4***		309.8		-2,954
		(294.4)		(294.1)		(270.0)		(9,547)
High Temperature * Post		1,493***		1,524***		872.6***		26,289***
		(227.8)		(227.4)		(208.6)		(7,213)
Constant	13,435***	13,020***	13,425***	13,022***	13,592***	13,511***	333,295***	333,671***
	(115.7)	(122.8)	(115.9)	(123.0)	(112.6)	(122.1)	(3,549)	(3,613)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.918	0.880	0.918	0.880	0.927	0.890	0.901	0.861

Table 10—: Alternative measures of drought

Panel (A) reports the regression estimated based on equations (5) and (6). The sample is at the block year level spread from 2011 to 2016. The dependent variables in these tests are total persons demanded work (columns 1-2), total persons allotted work (columns 3-4), total persons worked (columns 5-6) and total person days (columns 7-8). Column 1, 3, 5 and 7 present the results of the regression of the respective dependent variables on a new drought variable along with block level and time fixed effects. In Panel (A), the new drought variable takes the value one if the block receives 80% of the normal rainfall, else zero. Columns 2, 4, 6 and 8 shows the results of the regression of the dependent variables on the interaction term between post and drought along with drought. Panel (B) reports the same results as above using a alternative definition of drought. The drought variable take value one if the block receives 70% of normal rainfall, else zero. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

(A)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total persons demanded work		Total persons allotted work		Total persons worked		Total persondays	
Drought_80	-1,045***	-1,553***	-1,045***	-1,542***	-231.3	-506.5***	-10,148**	-14,683***
	(174.9)	(162.5)	(175.1)	(162.2)	(150.9)	(132.4)	(5,120)	(4,697)
Post		959.8***		989.9***		695.0***		2,192
		(185.9)		(185.7)		(166.0)		(6,279)
Drought_80 * Post		2,219***		2,170***		792.5***		37,823***
		(206.6)		(206.3)		(174.2)		(6,166)
Constant	12,324***	12,107***	12,318***	12,100***	13,259***	13,159***	328,928***	328,304***
	(83.85)	(105.6)	(83.91)	(105.5)	(79.65)	(94.93)	(2,516)	(2,821)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.915	0.879	0.915	0.879	0.927	0.890	0.901	0.861

(B) VARIABLES	(1) Total persons demanded work	(2)	(3) Total persons allotted work	(4)	(5) Total persons worked	(6)	(7) Totalpersondays	(8)
Drought_70	-2,031***	-2,723***	-2,024***	-2,700***	-227.4	-850.6***	-16,655***	-24,235***
	(202.3)	(196.2)	(202.6)	(195.4)	(181.2)	(156.2)	(6,435)	(5,835)
Post		1,292***		1,317***		859.3***		7,150
		(190.8)		(190.7)		(168.0)		(6,115)
Drought_70 * Post		3,066***		3,008***		953.3***		45,026***
		(244.3)		(243.8)		(202.6)		(7,341)
Constant	12,289***	12,057***	12,283***	12,050***	13,252***	13,143***	328,596***	327,827***
	(84.97)	(106.3)	(85.02)	(106.2)	(79.27)	(94.18)	(2,507)	(2,807)
Block Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,355	23,022	13,355	23,022	13,355	23,022	13,355	23,022
R-squared	0.916	0.879	0.916	0.879	0.927	0.890	0.901	0.861

Table 11—: Instrument Variable Approach

The table reports the regression estimated based on equation (2). The dependent variables in these tests are total persons demanded work (column 1) , total persons allotted work (column 2), total persons worked(column 3) and total person days(column 4). The study is between the dependent variables and an interaction variable (iv) for post. The IV used to construct the dummy is bank penetration, defined by total number of bank branches, known as bank dummy. As banking penetration was used to select the 300 districts of the first phase of DBT, the bank dummy can be used as an IV for post. Due to the same reason, we use only the fist phase 300 districts that were selected. Our first stage IV regressions corroborate the same. The dummy was made using total bank branches in the concerned district. The dummy was made by dividing the number of bank branches at the median level, with the top half taking a value one, otherwise zero. A further interaction variable was made between the dummy and drought. The IV dummy along with the IV interaction was used to estimate the values of the post variable and its interaction with drought. The columns present the results of the regression of the respective dependent variables on estimated values of drought and its interaction with drought with block level and time fixed effects. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively

Variables	(1) Total persons demanded work	(2) Total persons allotted work	(3) Total persons worked	(4) Total person days
Bank Dummy * Drought	6,218***	6,156***	4,202***	103,633***
	(681.9)	(678.8)	(579.1)	(18,773)
Post_2	-8,688***	-8,695***	-4,441***	5,233
	(1,366)	(1,360)	(1,160)	(37,617)
Constant	13,911***	13,901***	10,556***	209,266***
	(609.0)	(606.1)	(517.1)	(16,764)
Block Level Fixed Effects	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	Yes	Yes	Yes
Observations	11,414	11,414	11,414	11,414

Table 12—: Plausible Mechanism

Panel (A) reports reports the regression estimated based on equation (1). The sample is at the block year level. The dependent variables in these tests are a proportion of total transactions (amounts) delayed by 90 plus days and total transactions (amounts) delayed. We use the 90 plus days classification as it is the largest level of delayed payments classification available. The regression uses the post variable instead of drought variable as mentioned in equation 1. We use post instead of drought to find the change in the proportion of transactions (amount) delayed over 90 days before and after the implementation of ALP. Columns 1 and 3 represent the concerned variables results with year fixed effects. Columns 2 and 4 represents the same result without any year fixed effects. Panel (B) reports the regression estimated based on equation (9). The dependent variables in this test are total persons days (column 1) , total persons demanded work (column 2), total persons allotted worked(column 3) and total person worked(column 4). The study is between the dependent variables and a triple interaction term between post period, drought areas and less efficient states(rank). The columns present the results of the regression of the respective dependent variables on interaction between post and drought, post and rank, drought and rank, and a triple interaction between post, drought and rank with block level and time fixed effects. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively

(A) VARIABLES	(1) Transactions delayed 90 plus	(2)	(3) Amount delayed 90 plus	(4)
Post	-0.137***	-0.172***	-0.139***	-0.175***
	(0.00848)	(0.00753)	(0.00854)	(0.00761)
Constant	0.270***	0.277***	0.272***	0.280***
	(0.00641)	(0.00637)	(0.00648)	(0.00644)
Block Level Fixed Effects	Yes	Yes	Yes	Yes
Year Level Fixed Effects	Yes	No	Yes	No
Observations	10,246	10,246	10,246	10,246
R-squared	0.743	0.738	0.743	0.738

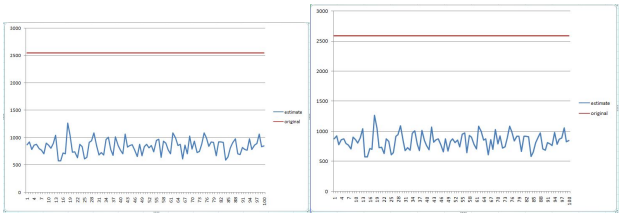
(B) VARIABLES	(1) Total person days	(2) Total persons demanded work	(3) Total persons allotted work	(4) Total persons worked
Drought	2,569	989.5***	983.0***	717.5**
	(10,939)	(339.7)	(340.0)	(334.6)
Post * Drought	54,043***	-1,300***	-1,289***	-891.9**
	(13,646)	(456.3)	(456.5)	(439.1)
Post * Rank	-8,398	905.4***	897.9***	151.6
	(7,154)	(221.2)	(221.1)	(214.3)
Rank * Drought	-11,266	-1,001**	-996.7**	-979.7**
	(14,809)	(425.6)	(425.8)	(415.0)
Rank * Post * Drought	-10,703	1,895***	1,883***	1,690***
	(18,195)	(556.3)	(556.3)	(528.9)
Constant	320,903***	12,277***	12,266***	12,071***
	(3,584)	(109.7)	(109.8)	(113.2)
Observations	14,435	14,435	14,435	14,435
R-squared	0.879	0.890	0.890	0.881

APPENDIX

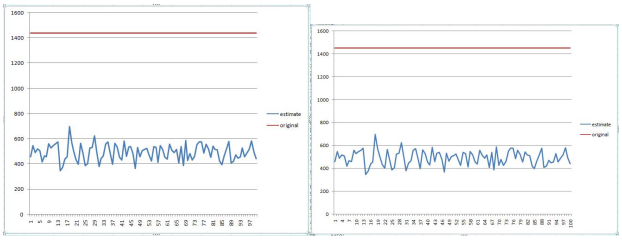
Placebo Tests

In section IV.K, both drought and post were randomized. Below, we depict the results when post and drought were alternatively randomized.

Figure A1. : (B) Drought Placebo

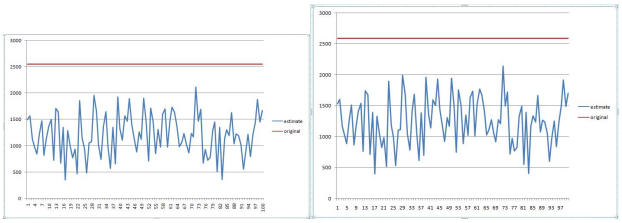


(a) Persons Allotted Work (b) Persons Demanded Work

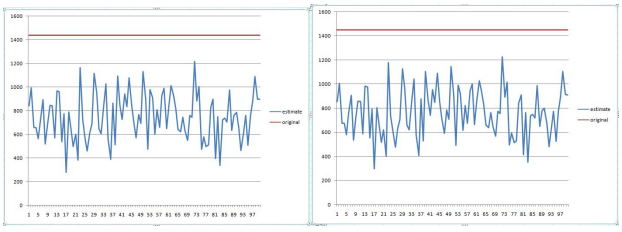


(c) Households Allotted Work (d) Households Demanded Work

(C) Post Placebo



(e) Persons Allotted Work (f) Persons Demanded Work



(g) Households Allotted Work (h) Households Demanded Work

Results with 100% Match

The table reports the regression estimated based on equations (1) and (2). The sample is at the block year level spread from FY2012 to FY2017. The test uses only those block which had a 100% match between the blocks from the MNREGA dataset and the 2011 census dataset. The dependent variables in these tests are total households demanded work (columns 1-2), total persons demanded work (columns 3-4), total households allotted work (columns 5-6) and total persons allotted work (columns 7-8). Column 1, 3, 5 and 7 present the results of the regression of the respective dependent variables on drought along with block level and year fixed effects. Columns 2, 4, 6 and 8 additionally show the results of the regression of the dependent variables on the interaction between post and drought variables. The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Total persons demanded work		Total persons allotted work		Total persons worked		Total person days	
Drought	135.9	-1,289***	103.6	-1,275***	620.8***	-33.65	32,810***	8,537
	(252.1)	(376.3)	(252.3)	(375.7)	(217.2)	(302.4)	(7,131)	(9,081)
Post * Drought		2,373***		2,297***		1,090***		40,436***
		(454.4)		(452.7)		(388.9)		(11,321)
Constant	12,815***	12,856***	12,807***	12,847***	13,360***	13,379***	309,052***	309,748***
	(231.4)	(229.5)	(230.9)	(229.0)	(219.0)	(218.7)	(5,486)	(5,416)
Block Level Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
Year Level Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5,252	5,252	5,252	5,252	5,252	5,252	5,252	5,252
R-squared	0.862	0.863	0.861	0.862	0.861	0.861	0.849	0.850

State Year Fixed Effects

In this section, we run regressions on our four main variables according to equation 2 along with state year fixed effects. We add state-year fixed effects in order to control for any state wide outcomes at the annual level that may distort our results. The addition of state-year fixed effects leads to year fixed effects being omitted as both are correlated. As such, state-year fixed effects are in place, instead of year fixed effects. By controlling for state-year effects, we control for all state wide trends such as government changes, state policy changes etc. among others. The table below reports the regressions based on equation 2. The sample is at the block year level. The dependent variables in the test are total persons demanded work (column 1), total persons allotted work (column 2), total persons worked (column 3) and total person days (column 4).The standard errors are clustered at block level and reported in parenthesis. ***, **, * represent statistical significance at 1%, 5% and 10% respectively.

VARIABLES	(1) Total persons demanded work	(2) Total persons allotted work	(3) Total persons worked	(4) Total person days
Post	-4,245***	-4,214***	-3,928***	-143,077***
	(897.2)	(893.8)	(816.5)	(26,677)
Drought	-2,066***	-2,061***	-2,489***	-74,837***
	(515.9)	(515.9)	(498.0)	(17,584)
Drought * Post	1,526***	1,533***	1,757***	66,042***
	(446.4)	(445.5)	(418.5)	(14,909)
Constant	14,736***	14,686***	13,777***	396,076***
	(471.7)	(470.2)	(432.9)	(14,357)
Block Level Fixed Effects	Yes	Yes	Yes	Yes
State Year Fixed Effecs	Yes	Yes	Yes	Yes
Observations	23,022	23,022	23,022	23,022
R-squared	0.456	0.455	0.429	0.410