Administrative Failures in Anti-Poverty Programmes and Household Welfare: An Investigation of India's Employment Guarantee Programme

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Abstract: Administrative failures in anti-poverty programmes are widespread in developing countries. We focus on one such administrative failure—the persistent delay in paying beneficiaries on time in India's iconic anti-poverty programme, the National Rural Employment Guarantee Act (NREGA). Using a life cycle model, we argue that a long wage payment lag in this flagship programme could adversely affect the welfare of the poor through two channels. First, it imposes an implicit consumption tax on the household. Second, it lowers the human and financial net worth of the household and encourages increased household participation in the programme to clear off the initial debt burden. The loss of welfare persists even when the worker has outside employment options. Empirical evidence based on primary data lends support to our key theoretical prediction that wage payment delay encourages worker participation in the NREGA programme. Our findings suggest that a conventional measure of performance of an anti-poverty programme—such as higher NREGA participation of rural households—would be misleading because it does not necessarily reveal the welfare loss suffered by the asset-poor households who face a formidable wage payment delay.

Key words: NREGA, employment guarantee, credit good

JEL classification: I38, J43, O1

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1 Introduction

Anti-poverty programmes in developing countries are typically in the form of cash transfers or workfare programmes (Dreze and Sen 1991; Lipton 1996; Ravallion 1999). There has been considerable debate on the efficacy of cash transfer versus workfare programmes in reaching the poor (Banerjee et al. 2017; Ravallion 2018). One oft-cited advantage of workfare programmes is that in the absence of a sophisticated administrative machinery to identify the poor, they tend to be more effective in reaching the intended beneficiaries (Besley and Coate 1992; Ravallion 1991). This is because the self-targeting nature of these programmes separate out those who are in need of relief from the state from those who are less in such need. While a growing literature questions the effectiveness of such programmes to smooth poor households' consumption and provide adequate food security (Beegle et al. 2017), there is limited understanding of the behavioural and welfare implications of workfare programmes when, contrary to expectations, there is widespread administrative failure in these programmes. In this paper, we focus on the Mahatma Gandhi National Rural Employment Guarantee Act (NREGA hereafter) of the Indian government, the world's largest workfare programme, and the welfare implications of a key administrative failure in this programme—persistent delay in the payment of wages to beneficiaries.

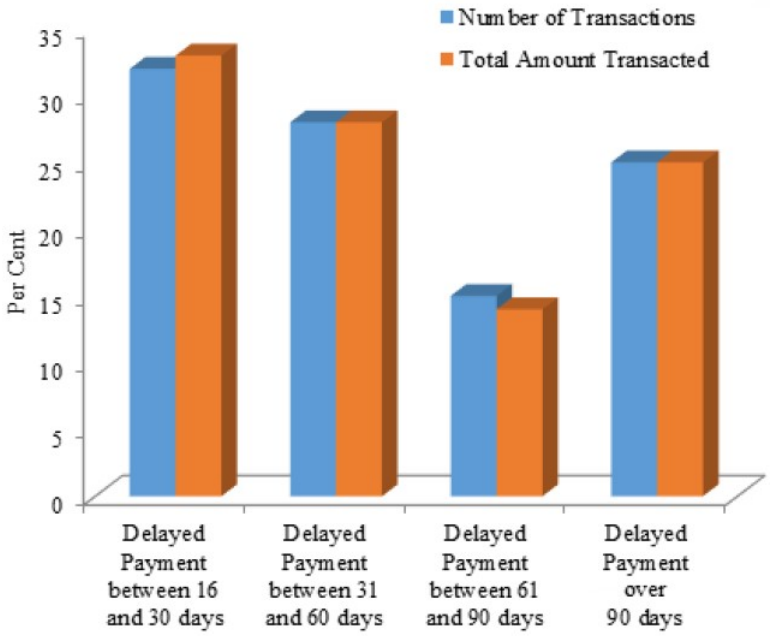
The NREGA programme guarantees 100 days of unskilled work to the poor and provides wages at government-stipulated rates. In the context of India, NREGA has received increasing attention in recent years as an anti-poverty programme (Lal et al. 2010; Subbarao et al. 2013). A key institutional bottleneck in NREGA has been the significant government delay in processing wage payments to rural household workers. The Act mandates that every worker must receive their wages within 15 days of completion of the public work project (Government of India, 2013). However, in practice, workers face delays in payment of wages ranging from 16 to more than 90 days.

This wage payment delay is not a transitional problem. In spite of several government initiatives to reduce wage payment delays, such delays have persisted, especially in the poorer states. The most recent data available from the Government of India on wage payment delays in NREGA (for the financial year 2016–17) show that the average delay is 30 days, with around 40 per cent of payments delayed by 60 days or more and almost one-quarter delayed by 90 days or more across the country (Figure 1). We also find considerable inter-state variation in payment delay, with more than 80 per cent of the transactions delayed in Nagaland and Arunachal Pradesh and more than half of the transactions in West Bengal, Tamil Nadu, Meghalaya, and Jammu and Kashmir. The delays were considerably shorter in the states of Rajasthan, Telengana, Manipur, Kerala, and Jharkand. Further, we calculate the probability of wage payment delay, which is the ratio of total delayed payments to total NREGA payments. We find that about 56 per cent of NREGA payments are delayed, with the probability of delay being over 60 per cent in 40 per cent of the states. These findings suggest that the delay in receiving wage payments is pervasive throughout the country.

Little attention is devoted in the literature to understanding the welfare effect of a wage payment delay in an employment-guaranteed programme such as NREGA. Using a stationary life cycle model, we demonstrate that a wage payment delay in the NREGA programme changes the status of a household's labour from a 'cash good' to a 'credit good' as the payment is received after a few periods of work. The household can use labour as a storage device to smooth consumption. A payment delay shock impacts the household's labour supply and welfare through two channels. First, it lowers the household's present value of labour income flows and thus lowers the value of labour as an asset. In the short run, the household members participate more in the programme to offset this fall in human net worth to pay off the existing debt. Second, in the long run, the household can turn its status from

debtor to creditor and create enough wealth to finance its optimal flow of consumption. However, a longer delay in NREGA still depresses the household's steady-state financial net worth via the implicit consumption tax. The household's steady-state welfare is thus lower due to a longer payment lag. A higher NREGA

Figure 1: Wage payment delays, all India 2016–17



Source: authors' construction, using data from mgnrega.nic.in.

participation of the rural workforce would then be a misleading indicator of success of the workfare programme because it does not necessarily reveal the welfare loss suffered by the asset-poor households who face a formidable wage payment delay. The welfare assessment of employment guarantee to the poor in the presence of wage payment delay is new to the growing literature on workfare. In this respect, our study is novel.

The positive relationship between NREGA wage payment lag and participation in NREGA is a robust theoretical prediction that continues to hold when the household supplies labour at an intensive margin. We also extend our model to include a private labour market in which wages are competitively determined. The outside employment option of the poor depends on the demand for labour in the private labour market. This demand could vary between lean and peak seasons, which are distinguished in terms of low and high total factor productivity (TFP) in the non-NREGA sector. The wage payment delay in NREGA causes two opposing effects on households' labour supply to the NREGA sector. The substitution effect tilts labour more to the non-NREGA sector while the adverse income effect increases labour supply in both sectors. For plausible parameter values, the latter income effect swamps the substitution effect. Despite the presence of the outside employment option, asset-poor households are still worse off in terms of welfare.

A key counter-intuitive prediction of our theoretical model is that a wage payment delay in a public work programme could induce poor households with few outside options to become more tied to the programme. We provide empirical verification of this prediction using a rich primary individual-level dataset that we have collected on NREGA participation and wage payment delay in the states of Sikkim and Tripura. After controlling for omitted variable bias and the possible reverse causality problem, we

find a positive causal relation between wage payment delay and NREGA participation that supports our theoretical prediction.

The rest of the paper is organized as follows. In Section 2, we give a brief historical sketch of the origin of wage payment delay in NREGA. In Section 3, we develop a stylized life cycle model and demonstrate the relationship between wage payment delay and NREGA participation and resulting welfare in alternative labour market scenarios. In Section 4, we consider a scenario in which the household makes labour supply decisions at an intensive margin subject to a rationing constraint on the availability of NREGA work. This section also considers an extension to a scenario where rural households have alternative employment options. In Section 5, we carry out the empirical validation of the theoretical predictions using a micro dataset that we collected ourselves. This section begins by describing the empirical strategy and the data, especially the data collection and the variable construction, and then discusses the main results emerging from the analysis. Section 6 concludes.

2 Evolution of Wage Payment Delay in NREGA

NREGA is India's main welfare programme for the rural poor and the largest workfare programme in the world, covering 11 per cent of the world's population (Muralidharan et al. 2016). The programme started in the financial year 2005–06 and was rolled out in phases. Initially restricted to the 200 poorest districts of India in 2006, it was extended to 130 more districts in 2007 and to all districts in the country in 2008. In its 2020–21 budget, the Government of India allocated roughly USD 8.22 billion, or 2.02 per cent of its annual budget, to NREGA. The programme has uneven success across the country (Banerjee et al. 2014; Desai et al. 2015).

Since there is no eligibility requirement for the NREGA programme because of the manual nature of the work involved, the poor participate more in this programme (Besley and Coate 1992). Participating households obtain job cards, which are issued by the local Gram Panchayat (GP, or village office). Once issued a job card, workers can apply for jobs at will at the local GP or block office, the lowest and next lowest units in the administrative hierarchy. Officials are legally obligated to provide work on projects within 5 km of the worker's home. The projects vary greatly, though road construction and irrigation earthworks predominate (Niehaus and Sukhtankar 2013). Households work in NREGA projects at stipulated wages set at the state level. The supply of labour from the household for NREGA projects occurs mostly in the lean (dry) season, when alternative private sector casual jobs are not available, while it tails off in the peak (rainy) season (Imbert and Papp 2015).[1] The administration of the projects is run by the key officials of the GP, who are the elected Sarpanch (or village leaders) and the appointed Panchayat secretaries. Project work sites are managed by officials called field assistants, who record attendance and output on 'muster rolls' and send these to the sub-district for digitization. Work records are then sent to the state level, which triggers the release of funds to pay workers.

In the first two years of the programme, payments to workers were often made in cash in several states in India. Under the system of cash payments, wages were paid by the same agency that was responsible for implementing the NREGA (that is, the GP), leading to the embezzlement of funds, with corrupt officials able to inflate muster roll entries and retain the funds that were supposed to be paid to workers (Khera 2010). However, in response to widespread media coverage of corruption in NREGA, in 2008 the Government of India instructed state governments to move to a system of wage payments

[1] According to the 2007–08 National Sample Survey of the Government of India, rural adults spend on average 1.5 per cent of their time on public works during the lean season and less than 0.5 per cent of their time during the peak season.

through bank or post office accounts set up for workers (Adhikari and Bhatia 2010). The immediate rationale for the shift to payments through banks and post offices was to make sure that an independent financial institution is responsible for payments to workers without any outside interference. Finally, an important complementary objective of the shift to payments through banks was to include rural workers in the formal financial sector in order to develop their saving propensity for the future. Therefore, the switch from cash to bank payments was seen by the Government of India as 'the world's largest financial inclusion scheme' (Government of India 2015).

However, the shift from cash to bank payments unfortunately led to long and variable delays in payment to workers (Khera 2010). Initially this delay was due to the huge surge in the number of accounts that had to be opened at banks and post offices for NREGA workers. A complex bureaucratic system then emerged in the approval of payments. Lists of wage payments for individual workers are prepared by the field assistants in charge of the projects. Officers at the block and district (the next level up in the administrative hierarchy) then approve the payments list. It then goes to the bank officer (at the state or central level) who processes the payment, transferring the payment due to the worker from the GP's bank account to the worker's bank account (usually the worker's and GP's account are in the same bank). Delays may occur at each and every stage of the payment process, with GPs entirely dependent on higher-level functionaries to push funds into their accounts (Banerjee et al. 2014). This delay is a pervasive and persistent phenomenon, as documented in the Introduction. In the next section, we develop a life cycle model with the aim to analyse the effect that such payment delay may have on households' labour supply and welfare.

3 The Model

The model is a simple extension of the multi-period model of Blundell and Macurdy (1999). Consider a stationary rural economy in which the household receives utility from consumption, c_t^i and suffers disutility from work effort, l_t^i. The household has an option to work for NREGA at a fixed contract wage w or to not work and consume the endowment every period. We call l_t^i the labour supply in NREGA. In this baseline model, we assume that besides NREGA there is no private labour market option available to the household.[2] Let the instantaneous utility function be $\ln(c_t^i - \bar{c}) - Al_t^i$, where

$\bar{c}$= subsistence consumption.[3] There is a k period delay in the wage payment for the NREGA service that the household renders at date t. This makes labour a 'credit good'. If $k = 1$ there is no delay, which means that labour is a 'cash good'. At date t, b_t^i is the amount of debt the household member carries over from the previous period, which she pays back at a fixed interest rate r and b_{t+1}^i is the new borrowing. If b_t^i is negative, the household is a net creditor at date t. We assume that the household's subjective discount factor β is $1/(1+r)$.

[2] We relax this assumption in Section 4.

[3] We assume that labour is supplied at an extensive margin, which means that l_t^i is the number of household members participating in the NREGA programme supplying a fixed number of work hours. Greater household participation takes household members away from home production, which lowers the household's direct utility. This explains why labour appears with a negative sign in the direct utility function. Such a utility function can be microfounded by using the indivisible labour argument as in Hansen (1985). A similar utility function without subsistence consumption is used by Kollmann (2002). We also work out the case of labour supply at an intensive margin in Section 4.

Since NREGA wage payment is credited to the household's bank account, in principle all households have access to the credit market to borrow or lend at a contracted interest rate *r*. The household solves the following maximization problem:

$$\text{Max}\{c_t^i\}, \{l_t^i\} \sum_{t=0}^{\infty} \beta^t \left[\ln\left(c_t^i - \bar{c}\right) - A l_t^i\right] \quad (1)$$

$$\text{s.t } c_t^i + b_t^i(1+r) = w l_{t-k+1}^i + b_{t+1}^i \quad (2)$$

The stationary consumption and labour supply functions are given by the following proposition.

Proposition 1 *In an interior solution, the optimal consumption and labour supply are given by:*

$$\text{xc}_t^i(\text{k}) = \left[\bar{\text{c}} + \text{A}^{-1}\beta^{\text{k}-1}\text{w}\right] \quad (3)$$

$$l_t^i(k) = \frac{\bar{c}}{(1-\beta)} \frac{\beta(\beta^{-k}-1)}{w} + \frac{1-\beta^k}{(1-\beta)A} + \frac{b_t^i(\beta^{-k}-1)}{w} \quad (4)$$

The proof of this proposition is relegated to the Appendix. A few clarifications are in order. Notice that by construction the household's consumption is stationary. It depends only on the payment lag *k*. A deferred wage payment (higher *k*) acts as a consumption tax on the household because it lowers the household's consumption. On the other hand, labour supply depends on the payment lag and also on the contemporaneous stock of debt, b_t^i. Given b_t^i, a longer payment lag *k* makes the household work more at date *t*.[4] A higher stock of debt also encourages greater NREGA participation.

3.1 Impact effect of a payment delay shock on labour supply and welfare

It is straightforward to verify from Equation (4) the following key result.

Proposition 2 *If $b_t^i > 0$, a household participates more in the NREGA programme in response to a longer payment delay.*

To see the underlying intuition, note that the present value of labour income, given that there is a payment lag *k*, is given by:

$$\frac{w l_t^i(k)}{(1+r)^{k-1}} \left[1 + \frac{1}{(1+r)^k} + \frac{1}{(1+r)^{2k}} + \frac{1}{(1+r)^{3k}} + \cdots \infty\right]$$

[4] The linear specification of labour in the utility function gives rise to a non-uniqueness problem. Although consumption is constant over time, alternative paths of labour supply are also possible. For example, the household can increase the labour supply by ε and cut back labour supply by ε/β at date $t + 1$. This means the wage income increases by $w\varepsilon$, raising the interest income at t +1 by $w\varepsilon/\beta$, which is offset by an equivalent fall in wage income at t +1 without any wealth and utility consequence. Since our central focus is on the steady state, we only focus on a stationary labour supply plan and ignore these alternative labour supply paths. In Section 4 we work out another model with labour supply at an intensive margin, which has a unique solution for labour supply. The key result that a longer payment delay raises labour supply continues to hold.

A higher payment lag (k) means that the present value of this wage income flow is lower. If the worker/borrower has an outstanding debt b_t^i to repay, he or she has to exert greater work effort to clear this debt burden.

3.2 Short-run welfare effects of an increase in payment lag

The value function of the poor at date t, $W(b_t^i,k)$, depends on the stock of debt and the payment lag. It is characterized as follows:

$$W\left(b_t^i,k\right)=\frac{1}{1-\beta}\left[\ln(A^{-1}w)+(k-1)\ln\beta-Al_t^i(k)\right] \quad (5)$$

where $l_t^i(k)$ is given by Equation (4).[5] Given b_t^i, the comparative statics effect of a change in k on the lifetime welfare of the household is thus:

$$W_k\left(b_t^i,k\right)=\frac{1}{1-\beta}\left[\ln\beta-Al_t^{i\prime}(k)\right]$$

Since $l^i(k)$ is increasing in k as seen in Proposition 2, $W_k(b_t^i,k)<0$. We summarize this key result as follows.

Proposition 3 *The payment delay unambiguously lowers the short-run welfare of borrowers/households*

3.3 Steady-state net worth and welfare

The preceding analysis is based on a short-run analysis assuming a fixed level of debt b_t^i. For a given stock of debt b_t^i, a longer payment lag depresses households' human net worth by lowering the present value of labour income flows, which makes household members participate more in the workfare programme. We now examine the equilibrium debt dynamics and analyse its steady-state behaviour and how it impacts households' long-run welfare.

The evolution of debt can be summarized by plugging Equations (3) and (4) into the flow budget (Equation (2)) to get:

$$b_{t+1}^i=\left(1+\beta^{-1}-\beta^{-k}\right)b_t^i-\left[\bar{c}\left(\frac{\beta-\beta^k}{\beta^k(1-\beta)}\right)+\frac{w}{A}\left(\frac{1-\beta^{k-1}}{1-\beta}\right)\right] \quad (6)$$

Since $(\beta^{-1}-\beta^{-k})<0$ and the second square bracket term in Equation (6) is positive, the stock of debt decreases over time and reaches the steady-state debt (denoted as $\bar{b}$) given by:

[5] To obtain Equation (5), we plug Equations (3) and (4) into Equation (1).

$$\mathrm{b}(k) = \frac{-\left(\beta\bar{c} + \frac{w\beta^k}{A}\right)}{(1-\beta)} < 0 \tag{7}$$

The steady-state debt is negative, which means that the adult, by sending more family members to work for NREGA, could pay off all of his debt in the long run and change status from a debtor to a creditor as long as he does not hit the upper bound *l* of labour supply.
Using Equation (3), the steady-state net worth can be further written as:

$$-b(k) = \frac{\beta c^i(k)}{1-\beta} \quad (8)$$

which means that the steady-state net worth is just the annuity value of the consumption flows. It is straightforward to verify by plugging Equation (7) into Equation (4) that $l^i(k) = 0$. In other words, the adult outgrows the need for working for NREGA because he can amass enough net worth to finance his lifetime consumption stream. The long-run welfare function thus reduces to:

$$W(k) = \frac{1}{1-\beta}[\ln(A^{-1}w) + (k-1)\ln\beta] \tag{9}$$

A higher *k* lowers the long-run welfare of the household because of an implicit tax on consumption.

4 Extensions

4.1 Labour supply at an intensive margin and rationing

Until now we have assumed that household supplies labour at an extensive margin which implies that a household member works either a fixed number of hours in NREGA or may opt out. In this section, we analyse two further cases: (1) the case in which the household supplies labour at an intensive margin, to take into account an important feature of the programme, where households are guaranteed a maximum of 100 days of work; and (2) introducing the possibility of unmet demand in the NREGA, given the widespread rationing of demand for NREGA (greater than 50 per cent for more than half the states, according to Dutta et al. 2014). The household now solves the following maximization problem:

$$\text{Max} \ \sum_{t=0}^{\infty} \beta^t \left[\ln\left(c_t^i - \bar{c}\right) + B\ln\left(1 - h_t^i\right)\right] \tag{10}$$

s.t.

$$c_t^i + b_t^i(1+r) = wh_{t-k+1}^i + b_{t+1}^i \tag{11}$$

$$h_{t-k+1}^i \leq \bar{h} \tag{12}$$

where h_t^i is labour hours and $\bar{h}$ is the upper limit to work hours.

Assuming an interior solution, the Lagrangian of the problem is given by:

$$L_1^p = \sum_{t=0}^{\infty} \beta^t \left[\ln\left(c_t^i - \bar{c}\right) + B \ln\left(1 - h_t^i\right)\right] + \sum_{t=0}^{\infty} \gamma_t \left[w h_{t-k+1}^i + b_{t+1}^i - c_t^i - b_t^i(1+r)\right] + \sum_{t=0}^{\infty} \nu_t \left[h - h_{t-k+1}^i\right]$$

where $\{\gamma_t\}$ is the sequence of Lagrange multipliers associated with the flow budget constraints (Equation (11)) and $\{\nu_t\}$ are the Lagrange multipliers associated with the inequality constraints (Equation (12)).

The first-order conditions are given by:

$$\frac{\partial L_1^p}{\partial c_t^i} = \frac{\beta^t}{c_t^i - \bar{c}} - \gamma_t = 0$$

$$\frac{\partial L_1^p}{\partial h_t^i} = \frac{-\beta^t B}{1 - h_t^i} + \gamma_{t+k-1} w - \nu_{t+k-1} = 0$$

$$\frac{\partial L_1^p}{\partial b_{t+1}^i} = -\gamma_t + \gamma_{t+1}(1+r) = 0$$

In the case of an interior solution, given the assumption that $\beta(1+r) = 1$, it is easy to verify from the Euler equation (Equation (16)) that the steady-state consumption and labour supply depend only on the payment lag k and is subject to the following restriction:

$$c^i(k) = \bar{c} + \beta^{k-1} B^{-1} w(1 - h^i(k)) \tag{17}$$

Substitution of Equation (17) in the lifetime budget constraint of the household with a no-Ponzi game condition yields:

$$-b_0^i \beta^{-1} + \beta^{k-1} w h^i(k)[1 + \beta^k + \beta^{2k} + \beta^{3k} + \cdots .. \infty] = \left[\bar{c} + \frac{\beta^{k-1} w \left(1 - h^i(k)\right)}{B}\right] \cdot \frac{1}{1-\beta}$$

(18)

which after simplification yields the following labour supply function:

$$h^i(k) = \frac{\beta^{-k} b_0^i + \bar{c}\{(1-\beta)\beta^{k-1}\}^{-1} + wB^{-1}(1-\beta)^{-1}}{w\left[\frac{1}{1-\beta^k} + \frac{1}{B(1-\beta)}\right]}$$

(19)

It is easy to verify that $\partial h^i/\partial k > 0$ if $b^i_0 > 0$, meaning $h^i(k)$ is unambiguously increasing in k for poor indebted households. Thus greater payment delay increases labour supply.

Substitution of Equation (18) in Equation (17) yields the optimal consumption policy. Unlike the previous model of labour supply at an extensive margin, the consumption is not invariant to income. Since $h^i(k)$ is increasing in k, $c^i(k)$ is decreasing in k. Thus the steady-state welfare is decreasing in k. The key conclusion that a payment delay could increase the NREGA participation of the household member and make him worse off is thus a robust result that continues to hold in the case of this model, where the household supplies labour at an intensive margin.

If the rationing constraint binds, then $h^i(k) = \bar{h}$. The optimal consumption policy (Equation (17)) still holds. A higher payment delay (k) unambiguously lowers consumption and thus depresses household welfare.

4.2 Alternative employment option

How does the labour supply behaviour of the adult change when he has an option to work at a nonNREGA job that has no payment delay? An outside employment option may exist in the rural private labour market, such as working for a rich neighbour as a casual labourer.

Let the labour supply for such a non-NREGA job be n_t^i. The production function facing this sector is given by a simple Cobb–Douglas form, $zn_t^{i\alpha}$ with $0 < \alpha < 1$ and z is the exogenous TFP in the nonNREGA sector. The wage w^i earned by the ith household in such a non-NREGA job is determined by e the profit-maximizing, risk-neutral private employers.

Given that there is a payment delay in the NREGA sector, the non-NREGA labour supply is determined by the arbitrage condition: $w^i = \beta^{k-1}w$ which, when equated to the marginal product of labour, $\alpha z(n_t^i)^{\alpha-1}$ in the non-NREGA sector yields the optimal labour supply in the non-NREGA sector as follows:

$$\text{Non-NREGA: } n_t^i(k) = \left\{\frac{\alpha z}{\beta^{k-1}w}\right\}^{1/(1-\alpha)} \tag{20}$$

Using the same line of reasoning as before the NREGA labour supply (Equation (4)) under an extensive margin changes to:

$$l_t^i(k) = \frac{\left(\bar{c} - \widetilde{w^i} n^i(k)\right)\beta(\beta^{-k}-1)}{(1-\beta)w} + \frac{1-\beta^k}{(1-\beta)A} + \frac{b_t^i(1-\backslash bta^k)}{\beta^k w} \tag{21}$$

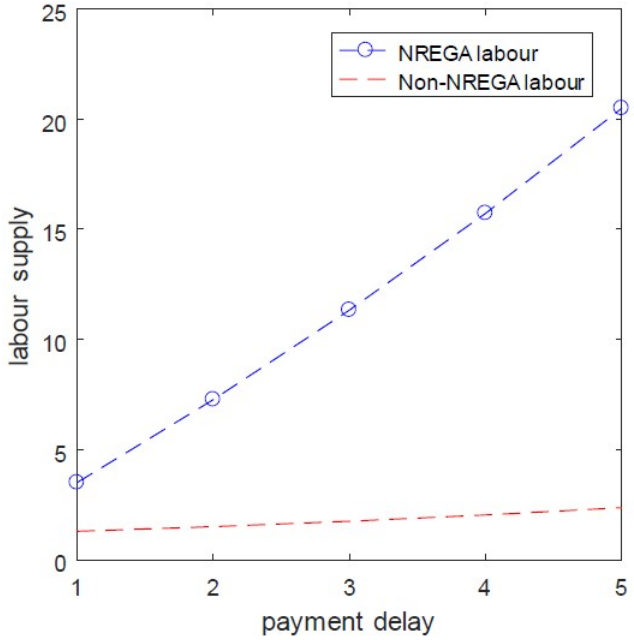
Likewise, the NREGA labour supply (Equation (19)) under the intensive margin changes to:

$$h^i(k) = \frac{\beta^{-k}b_0^i + \bar{c}\{(1-\beta)\beta^{k-1}\}^{-1} + wB^{-1}(1-\beta)^{-1}\{1-n_t^i(k)\}}{w\left[\frac{1}{1-\beta^k} + \frac{1}{B(1-\beta)}\right]}$$

The non-NREGA labour supply does not depend on households' asset position, while NREGA participation (Equation (21)) does. We characterize lean and peak seasons as low and high TFP (z) due to agro-climatic shocks. As a result, the labour demands in the non-NREGA sector are low and high in lean and peak seasons respectively. As in Basu et al. (2009), in a lean season with lower TFP (z) in the non-NREGA sector, NREGA participation rises because it lowers the non-NREGA wage. On the other hand, a greater payment delay (k) has an ambiguous effect on NREGA participation $l^i(k)$ and $h^i(k)$.

Since $n^i(k)$ is rising in k, the wage income from non-NREGA is also increasing in k.[6] This gives rise to a substitution effect that discourages NREGA participation in response to a higher k. A countervailing income effect due to lower present value of deferred wages from NREGA pushes the indebted worker to work more in both sectors. The relative strengths of these income and substitution effects now depends on the initial debt b^i_0 and the TFP z in the non-NREGA sector. The effect of an increase in k on NREGA participation is not obvious. For the sake of illustration, Figures 2 and 3 compare the household's short run labour supply responses in lean and peak seasons in the case of the extensive margin.[7]

Figure 2: Payment delay and labour supply of a borrower in a lean season



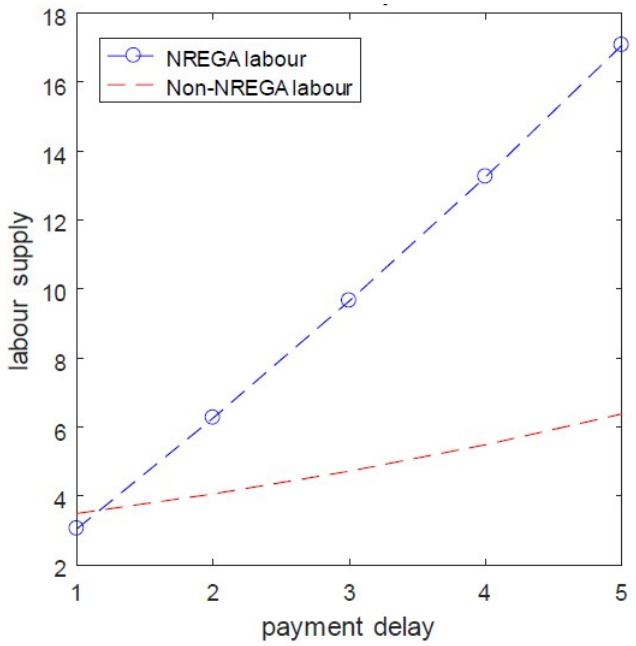
Notes: NREGA labour is labour supplied for NREGA work, non-NREGA labour is labour supplied for non-NREGA work; payment delay is in number of days.

Source: author's calculation.

[6] To see it, note that wage income from non-NREGA is given by $\tilde{w}^i n^i(k)=(w\theta^{k-1})^{-\alpha/(1-\alpha)}.(\alpha z)^{1/(1-\alpha)}$, which is increasing in k.

[7] The values of z are fixed at 1 and 2 for lean and peak seasons respectively. Other parameters are set as follows: θ = 0.9, which means a steady-state real interest rate of 10 per cent, w=4, $\bar{c}$ = 2, and b^i_0 = 100. The direction of comparative statics is reasonably robust to alternative choices of parameter values.

Figure 3: Payment delay and labour supply of a borrower in a peak season



Notes: NREGA labour is labour supplied for NREGA work, non-NREGA labour is labour supplied for non-NREGA work; payment delay is in number of days.

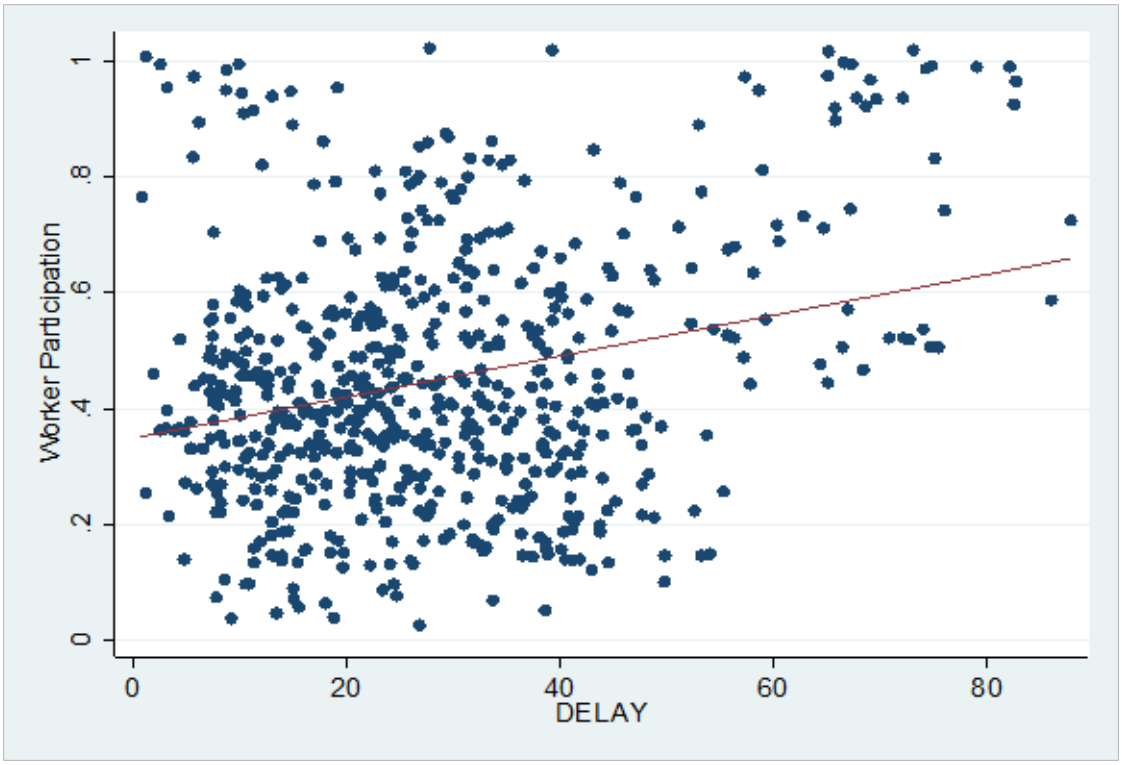
Source: author's calculation.

To sum up, the key theoretical finding from our life cycle model is that a longer payment delay would encourage greater NREGA worker participation because poor indebted households experience a negative wealth effect due to the payment delay and work harder to clear off the debt and become debt-free. Second, the existence of an outside option of a higher market wage would discourage NREGA work participation. Third, a longer payment delay has adverse welfare consequences for households because it entails consumption loss. We next turn to the data to verify these theoretical predictions.

5 Empirical Strategy

In this section, we discuss the empirical strategy employed to test for the key prediction of our theoretical model—that wage payment delays lead to higher worker participation in the NREGA programme. We test this relationship using both household- and district-level datasets. At the district level, there is evidence to show that worker participation is systematically linked to delays in wage payment (see the supplementary material online and footnote 10). This positive relationship between worker participation and payment delay is clearly captured in Figure 4, using all-India nationally representative administrative data.

Figure 4: Scatter plot: worker participation and delays in wage payment



Notes: DELAY is the average time to wage payment in NREGA and WP is the proportion of households demanding NREGA work in total registered households.

Source: authors' construction, using data from mgnrega.nic.in.

The baseline regression model for the household data takes the following form:

$$WP_{i,j,d,s} = \beta_0 + \beta_1 Delay_{i,j,d,s} + \beta_2 WD_{i,j,d,s} + \sum_{k>1} \gamma_k Z^W_{i,j,d,s} + \sum_{m>1} \gamma_m Z^V_{j,d,s} + \delta_d + \varepsilon_{i,j,d,s} \quad (22)$$

where WP is the number of days of worker participation in the NREGA programme. The subscript *i* stands for worker, *j* for village, *d* for district, and *s* for state. There are district fixed effects, which are included to control for unexplained differences in NREGA participation across districts, potentially related to differences in the competencies of district administrations to implement the NREGA (Narayanan et al. 2017). DELAY is our main variable of interest, capturing the delay in NREGA wage payments, and the sign of the coefficient of DELAY (β_1) is indeterminate. The variable WD denotes the differences between the NREGA wage rate and the market wage rate. A negative and significant coefficient of WD (β_2) would suggest that higher market wage relative to NREGA wage discourages NREGA participation, while a positive and significant coefficient of WD would indicate that higher market wage vis-à-vis NREGA wage leads to greater worker participation in the NREGA. We also include in Equation (22) a number of worker-specific, household-specific, and village-specific controls that are likely to affect the participation of workers in the NREGA programme. Z^W is the vector of individual- and household-level attributes that may affect an individual's participation decision. Individual-level control variables include a male dummy (MALE), age (AGE), social group represented by three dummy variables for Other Backward Caste (OBC), Scheduled Caste (SC), and Scheduled Tribe (ST), number of years of education (EDNL) and a dummy for financial literacy (FINLIT). Household-level control variables include family size (FAMSIZE), land ownership (OWNLAND), and a dummy variable for income shock in the family (SHOCK).

Z^V is the vector of control variables representing the location characteristics of the area where the household lives. We consider three village-level control variables, namely the distance of the nearest town from the village (DISTOWN), the presence of social and physical infrastructure in the villages (INFRASTRUCTURE), and availability of water sources in the villages (WATERSOURCE). We capture remoteness of the villages through DISTOWN, as we believe that remote villages tend to have lower levels of economic activity and access to services; hence demand for NREGA work is likely to be higher in these areas.

To control for the regional-level variations in social and economic development influencing NREGA participation, we introduce the variable INFRASTRUCTURE, which captures the presence of infrastructure in villages. We identified five important infrastructural dimensions relating to the availability of social and physical infrastructure in villages. These five public goods are schools, hospitals, roads, transport, and power. We first construct an index separately for each of these public goods and then add up the scores for all five dimensions to obtain an overall score for the index of infrastructure. As we assign equal weights to each dimension, the value of the index ranges between 0 and 5, where a value of 0 indicates absence of public goods and a value of 5 indicates presence of all public goods. As the demand for NREGA jobs increases during the agricultural off-peak season, NREGA participation is likely to be lower in villages with agricultural activities throughout the year. To control for its influence on NREGA participation, we include the availability of water sources year-round as a proxy for agricultural activities all through the year. Two such water sources are identified: (1) rivers and canals and (2) tanks, ponds, and lakes. We first create a dummy variable for each of these sources (1 for their presence and 0 for their absence) and then construct an index by adding up the scores of the two variables. The index thus ranges between 0 and 2.

We also estimate a specification with outstanding loan amount (LOAN) as an additional variable. There is a possibility that the outstanding loans may be driving the workers to participate in the NREGArelated activities even when there are significant wage payment delays. If this is true, the coefficient of DELAY is likely to capture the effect of the prevailing stock of debt on worker participation in addition to its own effect on participation. Hence, LOAN is introduced as a separate variable.

The coefficient of DELAY in Equation (22) is also likely to be affected by the presence of reverse causality, and for the same reason. To circumvent this problem, we use the instrumental variable (IV) estimation method. This methodology of course requires one to identify appropriate instruments, in this case variables that are correlated with DELAY, but uncorrelated with NREGA participation. We identify two such instruments that we believe represent the village-level administrative (in)efficiency. Although channelling wage payments through banks and post offices has helped in curbing corruption substantially, weak and limited banking and disbursement infrastructure has restricted the capacity of banks and post offices. The limited expansion of disbursement infrastructure has led to long delays in payment of wages, and compelled workers to travel long distances or wait for hours in overcrowded banks to withdraw wages (Adhikari and Bhatia, 2010; Bhatti, 2012). The instruments that we have identified for DELAY capture these supply-side constraints and, in particular, measure the availability of wage disbursement agencies in areas where the workers live as well as the distance the workers will have to travel to reach these agencies.

Our first instrument is constructed based on a question to the NREGA participants in the field survey schedule. Each respondent is asked about the distance of the nearest bank branch or post office from his/her place of residence. We make use of this information and construct a variable DISTANCE that

measures the distance (in kilometres) of the wage disbursement agency from the participant's place of residence.[8]

Our second instrument is an indirect measure of the presence of a wage disbursement agency in the village where the household is located. This measure is constructed using the data on village amenities obtained from the Population Census 2011. The census provides detailed information on amenities available in the villages of the Indian Union. We construct a dummy variable for the presence of post offices in the surveyed villages, given that post offices are the key partners in wage payments (Planning Commission 2011). We denote this variable POSTOFF, which takes the value 1 for villages with a post office and 0 for villages without a post office. We believe that the length of delays in wage payment experienced by the workers to a large extent depends on the absence of wage disbursement agencies where they live. Further, both DISTANCE and POSTOFF will meet the necessary exclusion criterion as IVs as they are not expected to influence workers' decisions to participate in NREGA, except through the wage payment delays that they face. In any case, we test for the suitability of DISTANCE and POSTOFF as instruments in the first-stage regressions of the two-stage least squares estimation method.[9]

5.1 Data

Our household data come from a well-designed primary survey conducted in selected locations in the states of Sikkim and Tripura. These two states topped the country in the just-concluded 2016–17 fiscal year in providing jobs under NREGA. Tripura has consistently figured among the states that have provided the highest number of days of employment to households through NREGA over the period 2006–07 to 2013–14 (Kumar 2013). However, the percentage of households that have completed 100 days of employment in the state was significantly lower at 20 per cent (Kumar 2013). As for wage payment delays, the state turned out to be one of the better-performing states as only 10 per cent of the transaction were delayed by more than 15 days. Similarly, Sikkim continued its superior performance in employment generation under NREGA and retained third position in the last fiscal year. However, compared to Tripura, in Sikkim, the programme has been less effective in terms of provision of employment for 100 days and payment of wages within the stipulated time period. Available estimates suggests that only 3 per cent of households have been provided with 100 days of work (based on the data available from nrega.nic.in) in Sikkim. There have been significant delays in the payment of wages across most districts in Sikkim and, within districts, across GPs. Our computations for the financial year 2016–17 suggest that more than one-quarter of the wage payments in Sikkim are delayed by more than 15 days, and in the district of West Sikkim alone, about 40 per cent of wage payments are delayed by more than 15 days. It would be interesting to see whether and how the delay in wage payment influences the participation of workers in NREGA in the best-performing states of India.[10]

[8] A concern might arise related to the randomness of the instrument DISTANCE, where one could argue that families may choose to relocate, especially once banks and post offices become important for programme participation. But such relocation is very unlikely as the Act mandates that the jobs are to be provided within a 5 km radius of the village where the card holder lives. If the worksite is more than 5 km from the village, the worker will be entitled to a travel and subsistence allowance. Still, we also control for individual and household characteristics to rule out the possibility of this concern influencing our main findings.

[9] We also ran IV regressions using variables capturing the presence of bank branches in villages as instruments for DELAY and found no change in the results.

[10] The regions and states in India differ in physical, social, and cultural aspects, as well as in policy making and execution. The available evidence also points to the existence of substantial inter-state heterogeneity in NREGA performance. For instance,

5.2 The survey

The survey instrument contained questions that seek information pertaining to the socio-demographic characteristics of the NREGA participants as well as family members, household spending on food and non-food items, asset endowments, investments in land, time spent and income earned in NREGA and non-NREGA activities, delay and other details relating to wage payments, income shock and informal group risk-sharing mechanisms, savings and accounts, access to and availability of wage disbursement mechanism, and credit and borrowing.

The target population for the survey comprised all households who have registered with the programme and obtained job cards. The survey covered all districts in the selected states of Tripura and Sikkim. A three-stage stratified sampling procedure was employed to identify the final list of households for the survey. The first stage involved the selection of GPs from each district. We ranked the GPs in all the districts using a backwardness indicator, namely the number of households below the poverty line (BPL). We then constructed four quintiles based on the ranking and randomly selected two GPs from the bottom two quintiles of each district. The second stage involved selection of village councils (VCs) from the GPs. Our survey focused on all VCs that are part of the selected GPs. In all, the survey covered 86 VCs—42 from Sikkim and 44 from Tripura. The final stage involved selection of households from the selected VCs. We set a target of not fewer than 50 households from the selected GPs, which are distributed among the villages of the respective GPs. These households were identified based on the list of households obtained from the selected GPs.

5.3 Variable construction

The dependent variable, NREGA participation (WP), is the average number of days worked over the past 12 months under NREGA, and is generated from the respondents' reported number of months worked over the last year and average number of days worked per month. We take the average of the days worked per month and the months worked per year, and multiply them by each other to get the average number of days worked in a year. A concern that is usually expressed about the length of the reporting period is that a longer recall period can affect the accuracy of the information collected. In other words, the shorter the reporting period, the more likely are respondents to accurately recall the number of days that they worked. Our choice of 30 days (one month) as the recall period for collecting data on the number of days worked is based on the possibility that a shorter recall period, say, a week, might yield 'zero' days as the answer. That could then skew the estimate for the entire year for those persons. This may not necessarily be the case because they were not available for work, or there was no work available under the NREGA programme, but could simply be a matter of timing. A short recall period is most effective in situations in which the respondent is asked to recall frequent, routine events. Our field survey was carried out during the agricultural off-season, when NREGA jobs are most in demand. We believe this would make it less difficult for the respondents to recall the number of days they had worked, making recall bias less likely to affect the quality of the data collected. Wherever possible, we have also cross-verified the number of workdays reported in the survey with the employment details recorded in the job cards of the workers. Further, the 30-day recall period is the standard recall period for the National Sample Survey Organisation's Consumption Expenditure surveys. Finally, we have also compared the workdays reported in the survey to the average workdays

Imbert and Papp (2015) find significant inter-state differences in the provision of public employment under NREGA and ascribe it to supply factors like administrative capacity and political will. Given that this paper draws heavily from the experience of two small states in North-East India, it could be asked how valid the results are for other states and for the country as a whole. We address this by checking the external validity of our results using all-India data extracted from the official web portal of NREGA. The results are presented in the supplementary material online.

from official administrative data sources available in the public domain (the NREGA portal). These comparisons did not reveal significant bias in data collection due to a longer recall period.

Our main IVs of interest are delays in wage payment (DELAY), wage difference (WD), and loan amount (LOAN). DELAY represents the average delay experienced by the respondents and refers to the number of additional days the wages were delayed beyond the specified 15 days. The DELAY variable measures the actual delays in wage payments—the number of days it takes, beyond the stipulated 15 days, to credit the wages to the bank account of the NREGA worker. Our measure of delay excludes any delays on the part of the workers in collecting their wages from the disbursement agency. A worker gets an automatically generated SMS alert when wages are credited to his or her bank account and thus knows clearly the actual number of days the wages were delayed. The delay variable captures only this delay beyond the actual 15 days allowed for the wage to be paid. The direct credit process also does away with any delays on the part of workers in collecting their wages from the disbursement agency.

The variable WD stands for the differences between the NREGA wage rate and the wage rate for the non-NREGA jobs prevailing in the locality where the workers live. LOAN represents the outstanding loan commitments of the NREGA participants. Table 1 suggests a clear across- and within-district and -village variation for all of our main dependent and independent variables.

We now turn to the construction of control variables. A number of control variables representing the socio-demographic characteristics of the households (MALE, CASTE, FAMSIZE, and AGE), educational attainment and numerical ability (EDNL and FINLIT), asset ownership (OWNLAND), and income shock in the form of illness or contingencies (SHOCK) have been introduced. The variable MALE is a dummy variable that takes the value 1 for a male participant and 0 for a female participant. The caste of the participants (CASTE) is represented by three dummy variables: OBC for Other Backward Caste participants, SC for Scheduled Caste participants, and ST for participants from Scheduled Tribe communities. FAMSIZE refers to the number of members in the household and AGE represents the age of the participant. The variable EDNL refers to the number of years of education of the NREGA participant. In the survey, a set of questions were included to capture the financial literacy of the participants in the NREGA programme. For example, the respondents were given a simple problem to compute the interest rate. Based on the responses, the trained investigators made a judgement about the financial literacy of the respondents. We utilized this information to construct the variable FLIT, which takes the value 1 if the participant is found to be financially literate and 0 otherwise. The asset ownership variable, OWNLAND, stands for the amount of total land owned in acres. SHOCK is included to capture any income shock in the form of illnesses or contingencies that the family had to face in the last year. This variable is constructed as a dummy variable, taking the value 1 if the participant experienced any income shock, and 0 otherwise.

Table 1: Analysis of variance of the main variables

	Total variance	Within district	Across district	Within village	Across village
WP	2169979.8	1923215.4	246764.4	1462883.6	707096.15
DELAY	2188276.2	1096658.7	1091617.5	939172.68	1249103.5
WD	33715046	32848292	866754	29602189	4112856.2
LOAN	6.037e+11	5.598e+11	4.389e+10	4.822e+11	1.215e+11

Source: authors' estimates based on field survey data.

We have also controlled for the influence of regional-level variation on our core results by introducing village-level control variables such as the distance to the nearest town from the village (DISTOWN), the presence of social and physical infrastructure in the villages (INFRASTRUCTURE), and availability of water sources in the villages (WATERSOURCE). Information pertaining to these variables is obtained

from the data on village amenities drawn from the Census of India 2011. A brief summary of the variables and their construction is presented in Table 2.

Descriptive statistics are presented in Table 3. On average, the beneficiary households have received employment for far fewer than the stipulated 100 days. An average participant has received only 38 days of employment, which is about two-fifths of the workdays promised by the programme. When it comes to payment of wages to beneficiaries, our survey data suggest substantial delays. According to our estimates, on average, it took almost 44 days beyond the stipulated time frame of 15 days to disburse wages to the beneficiaries. As expected, the NREGA wage rate is considerably lower than the market wage rate; our computation points to an average wage difference to the tune of 120 INR per day. In our dataset, male workers outnumbered their female counterparts; more than 70 per cent of the beneficiaries surveyed are male workers. We also find that the beneficiaries are, on average, aged around 44 years, indicating that most of the workers are in the most productive group. Average educational attainment is found to be considerably lower among the NREGA participants, the majority of whom are financially illiterate too. One-fifth of the participants are reported to have experienced some income shock in the previous year. On average, NREGA participants owned land amounting to 1.9 acres. The NREGA households are also found to be situated away from the market. On average, the distance to the nearest town for NREGA households is around 21 km. While only 11 per cent of the villages seem to have post offices, the average distance to the wage disbursement agencies is found to be around 10 km.

Table 2: Variables and their construction

Variable	Definition	Type	Source
Dependent variable			
WP	Number of days of participation in the NREGA programme	Continuous	Field survey data
Independent variables			
DELAY	Number of additional days the wages are delayed past the stipulated time frame of 15 days	Continuous	Field survey data
DW	The difference between NREGA wage rate and market wage rate (Rs.)	Continuous	Field survey data
LOAN	Outstanding loan amount (Rs.)	Continuous	Field survey data
GENDER	Dummy for male participant (male = 1, female = 0)	Dummy	Field survey data
CASTE			
OBC	Dummy for participant from Other Backward Caste category (OBC = 1, others = 0)	Dummy	Field survey data
SC	Dummy for participant from Scheduled Caste category (SC = 1, others = 0)	Dummy	Field survey data
ST	Dummy for participant from Scheduled Tribe category (ST = 1, others = 0)	Dummy	Field survey data
AGE	Age of the participant (years)	Continuous	Field survey data
EDU	Number of years of education	Continuous	Field survey data
FLIT	Financial literacy (1 = financially literate, 0 = financially illiterate)	Dummy	Field survey data
SIZE	Number of members in the family	Continuous	Field survey data
ASSET			
OLAND	Amount of total land owned (acres)	Continuous	Field survey data
SHOCK	Whether the family had to face any income shock in the form of illnesses or contingencies last year (Yes = 1, No = 0)	Dummy	Field survey data
TOWNDIST	Distance from the village to the nearest town (km)	Continuous	Population census 2011
INF	Index for the presence of social and physical infrastructure in villages (value ranges from 0 to 5)	Index	Population census 2011
WS	Index for the availability of water sources in villages (value ranges between 0 and 2)	Index	Population census 2011
Instruments			
PO	Presence of post office in villages (1 = yes, 0 = no)	Dummy	Population census 2011
DISTANCE	Distance of the wage disbursement agency from the place of residence of the worker (km)	Continuous	Field survey data
COMBK	Presence of commercial bank in villages (1 = yes, 0 = no)	Dummy	Population census 2011
COOPBK	Presence of cooperative bank in villages (1 = yes, 0 = no)	Dummy	Population census 2011
BANK	Presence of any bank in villages (1 = yes, 0 = no)	Dummy	Population census 2011
WCR	Work completion rate for 2017–18 (WCR = Ratio number of works completed/number of works started)		NREGA portal (www.nrega.nic.in)

Source: authors' construction.

Table 3: Summary statistics of variables

Variables	Number of observations	Mean	Std dev.	Min.	Max.
WP	1,261	38.32	22.81	5	150
DELAY	1,261	44.45	37.97	1	360
WD	1,261	–120.26	80.39	–850	77
LOAN	333	9.16	1.15	5.70	13.30
Worker-specific variables					
AGE	1,261	43.94	12.95	18	85
MALE	1,261	0.71	0.46	0	1
FAMSIZE	1,261	4.34	1.66	1	12
EDNL	1,261	2.61	1.51	1	19
FINLIT	1,261	0.15	0.36	0	1
OWNLAND	1,261	1.90	2.27	0	19
SHOCK	1,261	0.18	0.39	0	1
CASTE	1,261	2.77	0.96	1	4
Village-specific variables					
INFRASTRUCTURE	1,261	2.95	0.98	0	5
WATERSOURCE	1,261	0.62	0.80	0	2
DISTOWN	1,261	20.73	14.54	1	100
Instruments					
POSTOFF	1,244	0.11	0.32	0	1
DISTANCE	1,244	9.72	10.30	0	60

Source: authors' construction.

5.4 Empirical results

Table 4 reports the results from the estimation of Equation (22) using OLS. We estimated the model in Equation (22) with five specifications. Three specifications are estimated for the full sample and two specifications for a sub-sample of NREGA participants. In model 1, we include only DELAY and WD variables. Worker- and village-specific control variables are also included in model 2. We introduce district fixed effects in model 3. We bring in the LOAN variable in specifications 4 and 5, which are estimated for a sub-sample of participants as not all NREGA participants had outstanding loan commitments at the time of the survey.

Table 4: Payment delay and worker participation: regression results (dependent variable: WP)

Variables	OLS results					IV results
	(1)	(2)	(3)	(4)	(5)	(6)
DELAY	0.057** (0.022)	0.044** (0.023)	0.074* (0.039)	0.112*** (0.045)	0.129** (0.056)	0.130* (0.077)
WD	0.026*** (0.008)	0.003 (0.008)	–0.009 (0.010)	–0.005 (0.014)	–0.018 (0.013)	–0.009 (0.010)
LOAN				2.090** (1.041)	0.911 (0.965)	
AGE		–3.796* (2.348)	–4.291* (2.419)	–8.338 (5.767)	0.238 (5.966)	–4.316* (2.429)
MALE		–0.887 (1.310)	–0.021 (1.594)	2.756 (2.949)	0.002 (2.943)	0.003 (1.578)
FAMSIZE		0.740* (0.418)	0.806** (0.365)	1.147 (0.865)	0.959 (0.788)	0.730* (0.391)
EDNL		–0.412 (0.450)	0.556 (0.473)	–1.551 (1.254)	1.325 (1.240)	0.557 (0.487)
FINLIT		4.187** (1.894)	3.098 (3.092)	18.987*** (5.088)	10.655** (4.216)	2.964 (3.137)
OWNLAND		2.324*** (0.239)	0.690** (0.312)	2.256*** (0.553)	0.259 (0.658)	0.634* (0.338)
SHOCK		4.779*** (1.564)	3.062* (1.719)	3.764 (2.859)	1.380 (2.498)	2.936* (1.709)
INFRASTRUCTURE		0.819 (0.572)	–0.342 (1.411)	–0.897 (1.729)	–2.451 (1.750)	–0.405 (1.359)
WATERSOURCE		–4.991*** (0.728)	–4.377** (1.878)	–6.480*** (2.415)	–5.829** (2.605)	–4.463*** (1.910)
DISTOWN		–0.194*** (0.043)	–0.254* (0.155)	–0.370*** (0.138)	–0.298* (0.177)	–0.285* (0.1652
CASTE						
OBC		–8.863*** (1.991)	–2.700 (2.351)	–5.972 (5.801)	1.837 (6.202)	–2.286 (2.380)

SC		–9.677*** (1.827)	–3.202 (3.356)	–2.005 (6.330)	–1.717 (6.963)	–2.892 (3.280)
ST		–2.596 (1.933)	–2.547 (2.995)	–2.162 (5.886)	0.192 (6.498)	–2.459 (2.957)
District Effect?	No	No	Yes	No	Yes	Yes
Constant	38.976*** (1.375)	54.637*** (9.200)	59.286*** (11.079)	58.405** (25.024)	37.321 (24.514)	58.848*** (11.229)
Rsquared	0.020	0.154	0.315	0.297	0.408	–
F	9.64	25.71	24.18	13.16	22.99	21.29
N	1261	1261	1261	333	333	1244
Coefficient value of Instruments						
POSTOFF						–1.420 (2.026)
DISTANCE						1.983*** (0.246)
Tests for validity of the Instrument						
Under identification test						
Kleibergen–Paap rk LM statistic (Chi2 *p*-value)						11.268 (0.004)
Weak identification test						
Kleibergen–Paap rk Wald F statistic						32.737
Stock–Yogo Weak ID test critical values:						
10% maximal IV size						19.93
15% maximal IV size						11.59
20% maximal IV size						8.75
25% maximal IV size						7.25
Overidentification of all instruments						

Hansen J Statistic (Chi^2 *p*- value)	0.075 (0.785)

Source: authors' construction.

Our results clearly suggest that wage payment delay and NREGA participation are positively related. The DELAY variable exhibits statistically significant coefficients in all specifications, estimated for the full sample as well as the sub-sample of participants with outstanding loan commitments, suggesting that wage payment delay encourages worker participation in the NREGA programme. The coefficient value of the DELAY variable in the full sample with controls and district fixed effects suggests that the average days of participation increases by about 0.074 man-days for each day that wages are delayed (column 3 of Table 4). To be more specific, assuming an eight-hour workday, for every additional day that wage payments are delayed, the participation in the programme increases by more than half an hour (approximately 36 minutes).

Barring a few exceptions, our control variables have the expected signs and some of them are significant. Age has a negative impact on participation while family size has a positive impact. Older participants are less likely to offer their labour for NREGA work; larger family size compels a household to actively participate in NREGA-related activities. We also find that the participation is higher among households who are financially more aware, live in more accessible villages, and those with comparatively large land holdings. These results are somewhat puzzling as one would expect higher participation from households living in remote villages, with less financial awareness, and smaller land holdings. The result is possibly indicative of programme capture by elites in the states of Sikkim and Tripura. Studies have found similar instances of programme capture by the non-poor in other states (Gaiha 2000; Jha et al. 2009). These studies argue that high levels of land inequality, distribution of political power in a village, geographical remoteness of a village, and informational constraints are possible reasons for this elite capture of the NREGA programme. As expected, the households that have experienced any earlier income shocks are more likely to demand NREGA work. Confirming our conjecture, the results also show that NREGA participation is lower in villages that have agricultural activities throughout the year, as evident from the negative and significant coefficient of WATERSOURCE.

Our theoretical prediction that a larger loan size leads to greater participation of workers in NREGA activities is also confirmed by the regression results. Our estimates based on a sub-sample of participants— only one-quarter of NREGA participants had outstanding loan commitments—show that the coefficient of LOAN is positively related to NREGA participation (column 4 in Table 4), endorsing the hypothesis that outstanding loans are driving people to participate more in NREGA-related activities.[11] But there is not enough empirical evidence to confirm that higher market wage relative to NREGA wage discourages or encourages NREGA participation. The coefficient of WD, although positive and significant in column 1 of Table 4, is insignificant in all other specifications.

We also confirm the robustness of our results by estimating an IV model using two instruments. To be specific, we address the possible endogeneity issues associated with the DELAY variable—the positive relationship between DELAY and number of days of participation may be driven by administrative inefficiency due to greater demand for NREGA work and subsequent congestion in the payment process. To address this concern, we employ two-stage least squares (2SLS) with POSTOFF and DISTANCE as instruments for DELAY, and estimate the full specification—district dummies, control variables for individual- and household-specific characteristics, and controls for village-level characteristics. We present the IV results in column 6 of Table 4, with the first-stage results and tests for validity of the instruments in the lower panels of the table. The first-stage results show that DISTANCE has a positive and significant relationship to DELAY while the coefficient of POSTOFF yields

[11] The coefficient of LOAN yields a positive sign in the specification where we introduce district fixed effects but is insignificant (column 5 of Table 4).

an expected sign but is insignificant. The various test statistics show that the IV procedure works well for our estimations. The instruments pass the test for weak instruments, implying they are strongly correlated with our DELAY variable. This is indeed important since weak instruments can produce severely biased estimates. Further, the Hansen J statistic for overidentification is insignificant for all the models, confirming that the IVs are indeed exogenous and correctly excluded from the performance equation.

The IV 2SLS estimates reinforce the main findings based on OLS estimates. The coefficient of DELAY is positive and significant at the 10 per cent level, suggesting that delay in wage payment is positively related to higher demand for NREGA work. Our results are thus robust to concerns arising from endogeneity of wage payment delay, and these results unequivocally highlight the positive role of payment delays in NREGA participation. Overall, both the OLS and IV results support the prediction from the 'labour as a credit good' theoretical mechanism that a longer delay in the payment of wages to NREGA beneficiaries may actually lead them to offer more labour for NREGA work.

6 Conclusion

There is no dispute that an employment guarantee programme such as NREGA is a potentially useful anti-poverty measure to ameliorate the frictional unemployment arising from private labour markets. What is less obvious is how it helps the poor when such an employment guarantee programme has frictions of its own. In this paper we focus on one such friction: wage payment delay. Using a stylized life cycle model, we demonstrate that an asset-poor household participates more in the programme in response to a deferred wage payment. This happens because a payment delay makes labour a credit good and the value of labour as an asset declines due to a longer payment lag. In addition, the steady-state financial net worth of the household also declines in response to such wage payment delay. Both of these adverse effects on the human and non-human net worth make the household members participate more in the NREGA programme in the short run to pay off the existing debt obligations. The increased disutility of work and the implicit consumption tax due to longer payment lag make the household worker worse off in terms of welfare.

Using rich primary survey data, we find strong support for the key prediction of our model that NREGA participation responds positively to a wage payment lag. We also find that household consumption responds negatively to the wage payment delay, indicating that there is a welfare loss for households participating in the NREGA programme through delayed consumption and higher workload. Our paper has wider implications for the efficacy of a labour-intensive public works programme such as NREGA. The welfare improvement of the poor from such programmes is often questionable if the programme itself has endemic frictions of this nature. A longer payment delay by reducing the bargaining power of the poor in the private labour market could give rise to interlinkage between labour and the credit markets along the lines of Bardhan (1983). This could be a subject for future research.

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Appendix

Proof of Proposition 1

The Lagrangian of the problem (assuming an interior solution) is given by:

$$L^p = \sum_{t=0}^{\infty} \beta^t \left[\ln\left(c_t^i - \bar{c}\right) - A l_t^i\right] + \sum_{t=0}^{\infty} \lambda_t \left[w l_{t-k+1}^i + b_{t+1}^i - c_t^i - b_t^i(1+r)\right] \text{ (A1)}$$

where $\{\lambda_t\}$ is the sequence of Lagrange multipliers associated with the flow budget constraints. The first-order conditions are given by:

$$\frac{\partial L^p}{\partial c_t^i} = \frac{\beta^t}{c_t^i - \bar{c}} - \lambda_t = 0 \text{ (A2)}$$

$$\frac{\partial L^p}{\partial l_t^i} = -A\beta^t + \lambda_{t+k-1} w = 0 \quad \text{(A3)}$$

$$\frac{\partial L^p}{\partial b_{t+1}^i} = \lambda_t - \lambda_{t+1}(1+r) = 0 \text{ (A4)}$$

Assuming an interior solution, use of Equations (A2) and (A3) yields

$$A\beta^t = \frac{w\beta^{t+k-1}}{c_{t+k-1} - \bar{c}}$$

which solves

$$c_{t+k-1}^i = \bar{c} + \frac{w\beta^{k-1}}{A} \quad \text{(A5)}$$

Given $\beta(1+r) = 1$, use of Equations (A2) and (A4) yields $c_t^i = c_{t+1}^i$ for all t which, after plugging into Equation (A5), yields the following stationary consumption policy:

$$c^i(k) = \bar{c} + \frac{w\beta^{k-1}}{A} \text{ (A6)}$$

In other words, the consumption is stationary because it does not depend on time but only on the payment lag k. Using the flow budget constraint (Equation (2)) recursively forward from date t onward and using the optimal stationary consumption function (Equation (3)), one gets (assuming a no-Ponzi game condition):

$$-b_t^i \beta^{-1} + \frac{y^i}{1-\beta} + \beta^{k-1} w l_t^i(k)[1 + \beta^k + \beta^{2k} + \beta^{3k} + \cdots \infty] = \left[\bar{c} + \frac{\beta^{k-1} w}{A}\right]\left[\frac{1}{1-\beta}\right]$$

which can be further simplified as

$$-b_t^i \beta^{-1} + \frac{\beta^{k-1} w l_t^i(k)}{1-\beta^k} = \left[\bar{c} + \frac{\beta^{k-1} w}{A}\right]\left[\frac{1}{1-\beta}\right] \quad \text{(A7)}$$

to get Equation (4).

Proof of Equations (20) and (21)

The Lagrangian of the problem (focusing only on an interior solution) is given by:

$$L_2^p = \sum_{t=0}^{\infty} \beta^t \left[\ln\left(c_t^i - \bar{c}\right) - A\left(l_t^i + n_t^i\right)\right] + \sum_{t=0}^{\infty} \varsigma_t \left[\widetilde{w_t} n_t^i + w l_{t-k+1}^i + b_{t+1}^i - c_t^i - b_t^i(1+r)\right] \text{ (A8)}$$

where $\{\varsigma_t\}$ is the sequence of Lagrange multipliers associated with the flow budget constraints.

The first-order conditions are given by:

$$\frac{\partial L_2^p}{\partial c_t^i} = \frac{\beta^t}{c_t^i - \bar{c}} - \varsigma_t = 0 \text{ (A9)}$$

$$\frac{\partial L_2^p}{\partial l_{t+k-1}^i} = -A\beta^t + \varsigma_{t+k-1} w = 0 \text{ (A10)}$$

(A11)

$$\frac{\partial L_2^p}{\partial n_t^i} = -A\beta^t + \varsigma_t \widetilde{w_t} = 0$$

$$\frac{\partial L_2^p}{\partial b_{t+1}^i} = -\varsigma_t + \varsigma_{t+1}(1+r) = 0 \quad \text{(A12)}$$

Using Equations (A9), (A10), and (A12), we can verify that the stationary solution for consumption is the same as Equation (17). Next, using Equations (A10) and (A11), one gets the arbitrage condition $w^i = \theta^{k-1} w$, which after equating to the marginal product of labour in the non-NREGA sector solves for n_t^i in Equation (20). Using the same line of reasoning as in the proof of Proposition 1, one can verify that the expression of $l^i(k)$ is as in Equation (21).

Supplementary Material

District-Level Analysis

In this section, we provide a district level analysis of the relationship between NREGA participation and wage payment delay using nationally representative administrative data form 2014/5 – 2017/8 for 657 districts in India. We first discuss the empirical strategy, followed by a discussion of the sources of the data, and then present the results.

A.1 Empirical Strategy

The generic form of the regression model that we estimate using the district level data takes the following form:

$$WP_{it} = \beta_0 + \beta_1 DELAY_{it} + \sum_{k>1} \gamma_k X_{it} + \prod_{m>1} \alpha_m Z_i + \theta_j + \varepsilon_i \qquad (1)$$

where *WP* is the proportion of households seeking NREGA work among total households registered for the scheme. *DELAY* is the delay in NREGA wage payments. As discussed previously, the sign of the coefficient of *DELAY* (β_1) is indeterminate. If there is a "discouraged worker" effect, then the coefficient would be negative – that is, a higher wage payment delay will lead to lower NREGA participation. On the other hand, if the wage payment delay leads to a lower present value of labour earnings, and a lower value of labour as an asset, the coefficient is expected to be positive. In this case, a higher wage payment delay will lead to higher NREGA participation.

We also control for the variables that are likely to influence NREGA participation at the district level. Our control variables include both time-variant and time-invariant variables. The time variant control variables are represented by the vector X_i in equation (1). The most important among them would be rural poverty. Districts with higher levels of rural poverty would see a

higher number of households seeking NREGA work. Further, not controlling for rural poverty could lead to omitted variable bias in our estimates as poorer districts may have less capable state administrations to implement the NREGA, leading to payment delays. As reliable district level data on rural poverty is not available for India, we use district-level agricultural wages (*AWAGE*) for manual labour as a proxy for rural poverty (Datt and Ravallion 1998) as well as a measure of the outside option for agricultural labourer in the private rural labour market. In addition to agricultural wages, we also control for the impact of rainfall variation (*RAINFALL*) across districts on the NREGA participation. The NREGA participation is likely to be higher in rainfall-deficit districts of India where agricultural activities are not profitable, leading to low private demand for agricultural labour (Dasgupta 2014).

Z_i represents the vector of time-invariant control variables constructed at the district-level and captures the level of village infrastructure and social backwardness that would be correlated with district level economic activity and local demand as well as the ease by which poor agricultural households may be able to find outside work in the private labour market. These time-invariant variables are the proportion of villages in total inhabited villages on a bus route (*TRANSPORT*), villages with electricity (*POWER*), villages with a post and telegraph office (*POST*), villages with paved approach roads (*ROAD*), and villages with a primary school (*SCHOOL*). Social backwardness variables are the proportion of households which are Scheduled Castes (*SC*) and the proportion of households which are Scheduled Tribes (*ST*). Scheduled Castes and Scheduled Tribes are among the poorest in India (Gang et al. 2008), and the Government of India specifically targeted these households for NREGA work (GoI, 2013; Vij, 2013; Breitkreuz et al. 2017). Finally, we include year dummies (θ_j) to control for the impact of economy-wide macro shocks on NREGA participation.

A.2 Data

For the district level analysis, we focus on the period 2014/5 – 2017/8, for which we have annual data. We have data for 657 districts in India. Data for district level analysis are drawn from different sources. Data on NREGA demand and wage payment delay come from the MGNREGA data portal of Government of India. For NREGA demand, we use household's willingness to participate in NREGA work (which is equivalent to household notional labour supply for the NREGA) rather than the actual number of households receiving NREGA work. To be specific, our dependent variable is the ratio of households demanding NREGA work to total jobcard holders and not the ratio of households receiving NREGA work to total jobcard holders. The actual number of households receiving NREGA work is determined by the short side of the market depending on the availability of NREGA work by local governments.[12] In any case, our results do not change if we use the number of households receiving actual NREGA work rather than total households demanding NREGA work. For each district, the MGNREGA data portal provides the number of transactions delayed by days of delay, in the interval classes: delay in payment between 15 to 30 days, 30 to 45 days, 45 to 60 days, 60 to 90 days and over 90 days. We compute the average expected delay in payment by taking the average of the midpoints of the interval classes, weighted by the proportion of transactions in each interval class in total NREGA transactions in the district.[13]

Data on Agricultural wages (AGRWAGE) come from the report "Agricultural Wages in India" published by the Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India. The report presents the data on wages for different types of rural manual labourers -- ploughman, reaper/harvester, sower and weeder -- by centre, which

[12] As Dutta et al (2014) find, using primary data from the state of Bihar, there is significant unmet demand for NREGA. Therefore, while in principle, NREGA is a demand determined scheme, so there should no systematic unmet demand for NREGA, However, in practice, due to several institutional rigidities and supply side bottlenecks, there is widespread rationing of NREGA work, especially in states with weaker state capacity (Himanshu et al. 2015).

[13] We also use value of transactions in each interval class instead of number of transactions as the weights to calculate expected delay in payment and get no difference in our results.

could be one or more in a district. The data in each centre is also separate for male and female labourers. We have averaged the wages across types of labour, gender and centres (in case of more than one centre in a district) to arrive at an average for each district. The data on RAINFALL are taken from the *Rainfall Statistics of India* published by the India Meteorological Department of the Ministry of Earth Sciences, Government of India. This report prepares rainfall statistics for various administrative zones including districts on seasonal and annual basis. We compute average monthly rainfall for each district from this report and use it in the empirical analysis. Our time invariant district level controls -- TRANSPORT, POWER, POST, ROAD and SCHOOL -- are obtained from the 2001 Census of India while the social backwardness variables (SC and ST) are obtained from the 2011 Census of India. For data on the variable capturing rural bank density in the district (RBANK), which we use as an instrument for DELAY in IV estimations, we rely on the Reserve Bank of India (RBI) publication, Basic Statistical Returns of Scheduled Commercial Banks in India. These reports provide comprehensive data on distribution of branch offices, number of deposits and amount deposited and out-standing credit of scheduled commercial banks by location (rural/urban) for all districts of India. Data on district-wise rural population figures are drawn from the Census of India 2011. The construction of the variables used in the analysis is presented in Table AI:1.

Table: AI.1: Variables and their Construction

Variable	Definition	Type	Source
Dependent Variable			
WP	Ratio of households demanding NREGA work to total jobcard holders	Ratio	NREGA Portal
Independent Variables			
DELAY	Average expected delay in wage payment weighted using number of transactions in each interval class of delay	Continuous	NREGA Portal
AGRWAGE	Agricultural wages for manual labour	Continuous	Agricultural Wages in India
RAINFALL	Average monthly rainfall	Continuous	Rainfall Statistics of India
TRANSPORT	Proportion of villages in total inhabited villages on a bus route	Ratio	Census of India 2001
POWER	Proportion of villages with electricity in total inhabited villages	Ratio	Census of India 2001
POST	Proportion of villages with a post and telegraph office in total inhabited villages	Ratio	Census of India 2001
ROAD	Proportion of villages with paved approach road in total inhabited villages	Ratio	Census of India 2001
SCHOOL	Proportion of villages with a primary school in total inhabited villages	Ratio	Census of India 2001
SC	Proportion of Scheduled Caste households in total households	Ratio	Census of India 2011
ST	Proportion of Scheduled Tribe households in total households	Ratio	Census of India 2011
Instruments			
RBANK	Ratio of rural bank offices to total offices in a district	Ratio	Basic Statistical Returns of Scheduled Commercial Banks in India

Source: Authors´ estimates.

Table AI.2 reports the summary statistics of the district level variables included in our analysis. Our dependent variable is the ratio of households demanding NREGA work to total registered households. We find that only less than half of the registered households (45 percent) sought work under NREGA. With regard to our main variable of interest, DELAY, we find that about 28 per cent of the wage payments are delayed by 15 days or more. Table AI.2 also reports the summary statistics for the control variables and instruments used in our estimations. On average, Indian districts received a monthly rainfall of 98 millimeters. Our computations reveal that the average daily wage rate for a rural manual labour stood at Rs. 236 per day. Scheduled Cates (SCs) and Scheduled Tribes (STs) constituted 28 per cent of the total population at the district level. Our average estimates at the district level also show that 86 percent of the villages had a primary school, nearly half of the villages had better road connectivity, 85 percent of the villages had electricity, 53 percent had a post and telegraph office and around 60 percent had a paved approach road.

Table AI. 2: Summary Statistics of Variables: District-Level Analysis

Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
WP	2460	0.450	0.234	0.01	1
DELAY	2460	28.334	23.100	0.0019	91
Control Variables					
RAINFALL	2460	98.594	70.180	1.733	658.225
AWAGE	798	235.875	93.474	88.875	765.84
SC	657	14.972	6.352	0.49	32.35
ST	657	13.162	18.428	0	93.76
SCHOOL	657	0.864	0.123	0.369	1
TRANSPORT	657	0.499	0.459	0.051	1
POWER	657	0.852	0.213	0.102	1

POST	657	0.536	0.280	0.104	1
ROAD	657	0.598	0.262	0.191	1
Instruments					
RBANK	657	0.059	0.033	0.0004	0.272

Source: Authors' estimates based on field survey data.

Empirical Results

We present the results based on the district-level data in Table AI.3. Five specifications of equation (1) are estimated using OLS. In Col. (1), we report the OLS estimates of equation (1) with just the DELAY variable. We introduce RAINFALL in Col. (2). Year effects are controlled for in Col. (3). In Col. (4), we also introduce AWAGE. We present the OLS estimates of equation (1) with DELAY, the control variables (both time-variant and time-invariant) and year effects in Col. (5). In all regressions, standard errors are corrected for clustering at the district level.

Our district-level results too confirm the existence of a positive relationship between payment delay and worker participation. The coefficient on the expected delay in wage payment is positive and significant at the 1 per cent level in all specifications. Among the control variables, the measures of social backwardness of the district - the proportion of SC households in total households (SC) and the proportion of ST households in total households (ST) – are significant at the 1 per cent level and have the right sign suggesting that households in socially backward regions are more likely to demand NREGA work. On the other hand, we obtain positive and significant coefficients for RAINFALL, POWER and POST indicating that participation is higher among households who live in largely rainfed districts and districts with better village infrastructure. These results are contrary to our expectations as one would expect higher demand for NREGA work from rainfall-deficit districts and districts with low level of village

infrastructure. These findings possibly reinforcing our earlier claim of programme-capture by the elite groups.

One limitation of the agricultural wage data that we use in our regressions as an important control variable is that it is only available for three years and for 266 of the 615 districts for which we have NREGA demand and wage payment delay data. To see whether our results change if we use the entire sample for which we have data, we estimate equation (1) for all 498 districts without the agricultural wage variable. We do not find any difference in our key finding that higher delay of wage payments leads to greater demand for NREGA work.[14]

A key limitation of the district level analysis is that we are unable to address reverse causality from WP to the wage payment delay, in contrast to the instrumental variable strategy we used in the household level analysis. This is because we are unable to identify credible instruments for the wage payment delay variable that vary both over across districts and over time. Further, the lack of time variation in our key variable of interest – wage payment delay – does not allow us to use district fixed effects to control for unobserved district level factors that may affect both wage payment delay and household labour supply. For these reasons, we interpret the positive relationship between wage payment delay and the proportion of households demanding NREGA work as correlational, rather than causal.

[14] Due to paucity of space, we do not present these results here. However, they are available from authors upon request.

Table AI.3: Payment Delay and Worker Participation: District-Level Results

Variables	(1)	(2)	(3)	(4)	(5)
DELAY	0.0013***	0.0011***	0.002***	0.001***	0.002***
	(0.0002)	(0.0002)	(0.0004)	(0.0004)	(0.0005)
Control Variables					
RAINFALL		0.0008***	0.001***	0.0003	0.0005***
		(0.0001)	(0.0001)	(0.0002)	(0.0002)
AWAGE				0.026	0.040
				(0.026)	(0.035)
SC					0.012***
					(0.002)
ST					0.004***
					(0.0008)
SCHOOL					0.019
					(0.111)
TRANSPORT					0.0003
					(0.015)
POWER					0.142**
					(0.058)
POST					0.173**
					(0.075)
ROAD					0.042
					(0.083)
Constant	0.414***	0.341***	0.238***	0.180	-0.487***
	(0.008)	(0.009)	(0.017)	(0.136)	(0.188)
Year Effect?	No	No	Yes	Yes	Yes
F	28.41	74.63	146.47	71.46	43.35

N	2460	2460	2460	798	657
Regression	OLS	OLS	OLS	OLS	OLS
R square	0.016	0.07	0.124	0.059	0.278

Notes: (a) Our dependent variable in all estimations is the proportion of households demanding NREGA work in total registered households; (b) District is the unit of analysis; (c) Our dataset corresponds to the four-year period, 2014-15 – 2017-18; (c) Control Variables: RAINFALL: average monthly rainfall; AGRWAGE: annual average agricultural wage for respective years; SC: proportion of SC households in total households; ST: proportion of households who are STs; SCHOOL: proportion of villages with a primary school in total inhabited villages; TRANSPORT: proportion of villages with bus connection in total inhabited villages; POWER: proportion of villages with electricity in total inhabited villages; POST: proportion of villages with post and telegraph offices in total inhabited villages; ROAD: proportion of villages with paved roads in total inhabited villages; (d) ***, ** and * indicates significance at 1%, 5% and 10% levels respectively; and (e) Figures in parentheses are standard errors, corrected for clustering at the district level.
Source: Authors' estimates.