Having it at Hand: How Small Search Frictions Impact Bureaucratic Efficiency

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Abstract

Can small search costs that constrain information acquisition and monitoring across the administrative hierarchy provide a substantive explanation for poor bureaucratic performance in the developing world? In collaboration with the Indian Ministry of Rural Development and two major states, we conducted a field experiment in which a random sample of bureaucrats were given access to an internet- and mobile-based management and monitoring platform for wage payments associated with the world's largest workfare program. The platform did not make new information available, but lowered costs of accessing information about the status of pending payments and helped identify subordinate employees who needed to take action. Our experiment also randomly varied which level of the administrative hierarchy had e-platform access - senior and/or immediate managers. Overall, we find delays are 29% lower in areas where search costs are reduced for intermediate management alone. Across all treatment arms, areas with above-median pre-period delays see delay reductions. While supervisor-only information provision is most impactful, we find evidence that app usage by intermediate supervisors reduces delays, and this usage is higher when senior officials also have e-platform access, suggesting complementarities across the administrative hierarchy are non-trivial. The extent of delay reductions

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achieved through minimal usage of the tool point to important service delivery improvements enabled by technology now widely available in capacity-constrained settings.

1 Introduction

While a variety of constraints can hamper public service delivery, particularly in resource-constrained settings, some of these challenges may relate to the design of the implementation structure itself. A defining feature of government bureaucratic structures is that they are hierarchical, with clearly ordered levels of management, where lower levels are subordinate and answerable to higher levels. The top bureaucrat often holds the purse strings, but relies on a local administrator to implement a program. As a result, bureaucrats at intermediate levels of the hierarchy are often both information intermediaries and monitors for local administrators.

Economists typically model such bureaucracies as networks of overlapping principal-agent relationships – the simplest vertical structure would have three layers: principal/supervisor/agent. The principal or supervisor's inability to directly observe the agent's actions creates opportunities for shirking by the agent. If, as is typically the case, the supervisor has a better technology than the principal to obtain information on agents' actions, then there is the possibility that the supervisor may choose to either collude with the agent or simply shirk and not collect information on agents' actions.

While these problems of asymmetric information in bureaucratic hierarchies have been widely modeled (Tirole 1986, Dixit 2002), we have limited empirical evidence on the relative importance of asymmetric information at different levels of the hierarchy in affecting bureaucratic performance. As the costs of information acquisition can potentially be reduced through new data and technology, those asymmetries may be more easily addressable than in the past, and examining the effects of such innovations may allow us to learn how service delivery relates both to the bureaucratic structure and costs of monitoring within that structure. In this paper, we exploit the randomized rollout of a mobile app that reduced search costs for identifying which agent is delaying the

processing of wages for a workfare program. We experimentally varied whether search costs were lowered for just the principal, just the supervisor, or both. We find evidence of complementarities in reduction of search costs – specifically, improved monitoring by the principal is important but effective only when the supervisor faces lowered search costs - but only over the short-term. Only lowering search costs for the supervisor presents benefits in terms of reduced delays over the longer-term. These findings raise multiple questions about bureaucratic inputs and efficiency and the mechanisms driving improvements in service delivery that are important both theoretically and practically.

The costs of bureaucratic inefficiency are particularly salient in poor areas, where information acquisition may be more costly, resources more constrained, and the poor more reliant on the delivery of benefits from government safety net systems. We examine an important example here in India's workfare program, based on the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), which provides up to 100 days of annual unskilled labor employment per rural household. In 2016-17, nearly 49 million rural households benefited from the program, and multiple studies document MGNREGA's positive impact on rural households' well-being (Deininger and Liu 2013, Imbert and Papp 2014, Klonner and Oldiges 2014).

Average time to payment for beneficiaries, however, was 23 days after completing work in 2016-2017 in our study states, despite government stipulations that these participants be paid within 15 days, and a supervisory system dedicated to monitoring and decreasing payment delays. These delays reduce poor rural households' ability to manage economic uncertainty (Basu and Sen 2015), and are recognized both at the highest levels of government and in the national press as a critical challenge for the program (Anand 2016). While MGNREGA has recently transitioned to electronic payment systems, the evidence of how e-governance reduces payment delays is mixed - the transition to e-payment-based smart cards in a state with high implementing capacity resulted in

reduced delays, whereas streamlining funds flow at a higher level in a low-capacity state resulted in higher delays, likely due to decreased returns to payment processing (i.e., funds extraction) by local leaders (Banerjee et al. 2016, Muralidharan 2016). In this paper, we take a more theoretically motivated approach to the question of bureaucratic efficiency.

Our research contributes to the growing body of evidence on how the inner workings of government administration can influence quality of public service delivery (Finan, Olken, and Pande 2015), and highlights the role of convenience (lowering the cost of information acquisition) on outcomes of importance to program beneficiaries. While several studies have considered the impacts of increasing information and monitoring, to the best of our knowledge this project is the first to experimentally examine the potential for multiplier effects across the bureaucratic hierarchy. Further, despite evidence from the private sector that poor management hinders productivity in India (Bloom et al. 2013), evidence on the impacts of tools that may facilitate better management is lacking for public sector settings.

The remainder of the paper is organized as follows. Section 2 provides background and describes our conceptual framework. The PayDash intervention and its randomized provision are detailed in Section 3, while Section 4 describes the data and identification strategy and performs randomization checks. Section 5 presents the results and Section 6 concludes.

2 MGNREGA payment delivery background and conceptual framework

We conceptualize the administration of MGNREGA as a vertical three-tier hierarchy. The principals (district officers) wish to ensure that villagers have access to paid work. The majority of payments process substeps are carried out by local-level MGNREGA officials and engineers – these are the agents. These agents may shirk or be involved in the theft of funds allocated for wage payments. The second tier of hierarchy - block officials - are the supervisors. They are responsible for monitoring the agents and releasing wage payments. They also report on their performance to the principal.

Multiple steps precede transfer of funds to MGNREGA workers. First, local-level officials enter MGNREGA worker names on attendance lists and government leaders at the local, Gram Panchayat (GP), level approve the lists once filled. Second, engineers travel to each project site and verify work completed. Third, project details and funds requests are uploaded to the online management information system (MIS) by local-level officials; and fourth, following two approvals from block officials, banks release payment. The district official (principal) and block official (supervisor) are therefore the key government actors overseeing two sets of agents – local-level officials and engineers – who must take specific steps to process each payroll, known as a muster roll. The principal (district officer) has an overarching administrative role and is a step removed from the funds flow process. As shown in Figure 1, block officers, in addition to managing field-level workers, evaluate and provide approvals for funds requests. Approved funds transfer orders are submitted directly from the block office to the government-approved bank controlling state-level funds. Payments are then transferred directly to beneficiary accounts. We focus in our subsequent analysis on the time taken to complete the steps in the payment delivery process within the purview of district- and block-level MGNREGA

officials, as opposed to falling to GP-level elected leaders or banks.

We assume that both district and block officers incur search costs to identify whether the agents have done their job in a timely manner (which requires exerting effort). Search costs potentially cause the supervisor and principal to underinvest in information acquisition. Consider first a benchmark non-corrupt setting. We hypothesize that in a multi-tiered administrative environment such as MGNREGA, weak information flows worsen program management and thereby contribute to payment delays. Specifically, officers are unable to correctly identify the sources of problems and determine which subordinates to hold accountable. In this case, the provision of a technology that reduces the cost of information acquisition for block officers could improve management and reduce payment delays. A potential barrier, however, may be that block officers of certain types (e.g. low intrinsic motivation) are not incentivized strongly enough to take costly action even when provided management-relevant information. In such cases, additionally facilitating monitoring through information provision to district officers, who have influence over the extrinsic incentives of block officials, may be necessary to improve outcomes. At the other extreme, giving block officers higher powered incentives to reduce delays through strengthened monitoring may be insufficient if they lack the information needed to do so. Therefore, important complementarities may exist in strengthening the flow of information at multiple points in the bureaucratic hierarchy.

Moving away from the benchmark setting, it may also be that the supervisor colludes with the agent in order to engage in corrupt behavior that extracts funds from the prorgram. In this case, improved information flows to the intermediate level supervisor decrease the cost of that extraction without directly affecting the probability that the extraction will be detected. If the probability of detection of collusive behavior is

sufficiently low (alternatively, potential returns to collusion sufficiently high), improved information to the supervisor may decrease delays even as the supervisor extracts rents from the payment process. Such a scenario is most likely in a setting where information costs for supervisors, but not for principals, have declined. In an environment with corrupt supervisors, we would expect declines when information is provided to the intermediate level only. The extent to which declines would occur in areas with information provision to both principles and supervisors would depend on how information to principles affects the probability of detection of collusive behavior of supervisors.

3 PayDash intervention and randomization

Our intervention, PayDash, is a mobile- and web-based application for district and block MGNREGA officers. PayDash relies on timestamped data noting when each sub-step occurs in the payment process to help officials more quickly process pending wage payments. Importantly, this process is automated and not prone to tampering. It is built on APIs that feed real-time information on details of delayed payments, with linked information on employees responsible for each administrative step at GP and block levels, to MGNREGA administrators. The login page for the online version of PayDash is shown in Figure 2a, and illustrations of the mobile phone version of PayDash (also known as PayDroid) are shown in Figures 2b and 2c. As we observe that officers nearly always use the mobile version of PayDash, we focus on mobile-related usage characteristics in our subsequent analysis.

PayDash decreases the cost (in staff time and effort) of information acquisition to help administrators identify and monitor poorly performing localities and employees. While information relevant to payment delays is accessible to program officials through

the MGNREGA website, it is not provided in a format tailored to the needs of these officers. For example, pending muster rolls can be viewed online, but they are displayed on a different page for each GP, the lowest locality delineation. Therefore, an officer navigate to many (e.g., 20 or more) individual web pages to understand which muster rolls are pending in his/her block. PayDash packages this information on a single screen, making information actionable by grouping pending muster rolls according to the employee responsible for the pending step.

PayDash clearly identifies where and at what payment steps delays are originating and who could help address the delay. For each step in the payment process, the block officers' version of Paydash provides real-time lists of pending documents along with contact information of responsible employees, allowing block officials to easily send information on delayed documents to field staff via WhatsApp or follow up with a direct phone call. A "contact" button next to the employee's name serves to nudge the officer to take immediate action on the delayed documents by either calling or sending a message via WhatsApp that is pre-filled with details of the relevant documents. The version of PayDash provided to district officials is similar to the version provided to block officials, but focuses on providing block-level summaries on time to payment and number of documents delayed at each step along with a "contact" function that allows district officials to get in touch with the appropriate block official via phone or WhatsApp message.

Access to PayDash is randomized at the district level; log-ins are user-specific so officers can only log into the platform using their own credentials, and they view summary information on payment delays for areas under their jurisdiction. Treatment arms are designed as follows: (1) Control – District and block-level MGNREGA administrators do not have access to PayDash; (2) TD – PayDash provided to district-level MGNREGA administrators only; (3) TB – PayDash provided to block-level MGNREGA administrators only; (4) TDB – PayDash provided to both district and block-level MGNREGA

administrators. The four treatment categories were randomly assigned across 73 districts (which excludes one pilot district per state) in the states of Madhya Pradesh and Jharkhand, which account for 7.7 million beneficiaries. Treatment is assigned to allow for better detection of effects at the TDB level, since our prior is that complementarities in bureaucratic management hold promise to reduce delays and we have limited districts with which to work. As a result, we have 20 control districts, 20 TDB districts, 16 District only districts, and 17 Block Only districts. We stratify by above/below the district-level median values across the state for average monthly person days worked and average monthly days to payment over the period April 2015 to April 2016.

Within each level of the hierarchy, PayDash was provided to two officers. The first of these officials is the Chief Executive Officer (CEO), the highest ranking bureaucrat at the District or Block level, who is responsible for overseeing a number of other schemes in addition to MGNREGA. The second is the Program Officer (PO), who is the highest ranking officer solely responsible for oversight of MGNREGA and reports to the CEO[1].

PayDash was rolled out across the large central Indian state of Madhya Pradesh during February and March 2017. The introduction of the tool required individual app installations and small group-based trainings for all treatment officials, while a parallel training session (without an introduction to PayDash) was conducted with control officers at a separate time. Control and treatment officials all underwent a basic training on MGNREGA MIS tools; treatment officials received the same training in addition to the introduction and training on PayDash. In our second study state of Jharkhand, east of Madhya Pradesh, officers underwent the same training and received the same support for PayDash installation and usage in October 2018. These trainings are described in

[1]The official titles described here and used throughout the paper are those used in Madhya Pradesh, the larger of our two study states, with 51 districts. In Jharkhand, bureaucratic titles are that of the District Development Commissioner (parallel to the District CEO in Madhya Pradesh), Block Development Officer (parallel to the Block CEO). The District Assistant Program Officer and Block Program Officer are analagous to the Madhya Pradesh District and (Assistant) Block Program Officers.

more detail in the appendix.

4 Data and identification check

4.1 Data sources

We use data on the time to completion for each step in the MGNREGA administrative payments process and the overall payment process time for each payment process under MGNREGA. The data is pulled at the date of payment completion, so we cannot see pending payments. We also have data on the standard deviation in time to complete each payment substep and number of transactions processed, which we will employ further in future analysis. As each step is completed at the block or (lowest level) gram panchayat office, an electronic timestamp is registered in the centralized MGNREGA management information system (MIS); we use this timestamped data and so are able to ensure that the data has not been tampered with or adjusted in any way. Data APIs allow us to access aggregated cuts of this transaction data. The analysis presented in this paper uses data for the states of Madhya Pradesh and Jharkhand beginning in April 2016, the start of the 2016-2017 fiscal year, through March 2018, which we aggregate up to the level of the administrative block on a monthly basis.

To understand how officials are using the platform, we make use of real-time Google Analytics data for the mobile (Android) and web applications. This usage data shows how many sessions (grouping of individual pageviews within a specific timeframe) each user had on each date, the duration of each session, how many "cards" related to specific subordinate employees users viewed on the mobile app on each date and whose card they viewed, when users used the call or direct WhatsApp message functions on the mobile app, the duration of the call, and who they called. The usage data contains a unique

identifier that we use to link with data on each trained official.

We also take month-wise MGNREGA outcome data on the number of person-days worked in the program and wage expenditures in the program at the level of the administrative block from the MGNREGA public website. In addition, we track which officials are posted in different locations around the state by completing a series of calls to a contact person within each district on a regular basis. Newly inducted officials are identified and given in-person or remote PayDash training, depending on logistical feasibility, and are administered a shortened version of the baseline survey. (Logistical constraints precluded us from conducting longer surveys with bureaucrats outside of the original training sessions). Officials who are transferred out of a treatment arm have their login information deactivated, and the region information shown on the app is updated for officials who are transferred to a different treated region; transferred officials are notified via phone call and text message of the change to their PayDash content.

As mentioned above, we conducted surveys of the two main district-level (senior) bureaucrats, and the two primary block-level (intermediate) officials tasked with MGNREGA oversight in localities. These were self-administered, paper-and-pencil surveys conducted with officials prior to conducting training for all officials and introducing treatment officials to PayDash. The surveys covered basic demographics, details related to bureaucrats' typical work and management practices, their understanding of MGNREGA and its major challenges, information on officials they supervised (number of vacancies, frequency of contact, etc.), and baseline knowledge of payment delays in areas under their jurisdiction. They also included questions to elicit information on bureaucrats' tendency toward reciprocity, propensity toward corruption, motivation to work in government and public service, Big 5 personality traits, Raven's tests of intelligence, and a module to understand their typical communication and networks with officials at multiple levels of the bureaucratic hierarchy. While the analysis of this survey data

is ongoing, we report on experimental balance across bureaucrats' basic demographic characteristics. Additional analysis incorporating the survey data will be included in later versions of the paper.

4.2 Experimental balance

As a check of experimental validity, in Table 1a we examine a set pre-treatment characteristics related to MGNREGA administration (average and standard deviation of person days worked and days to payment over the previous fiscal year) and district composition (percent rural population and number of blocks) to understand whether significant differences exist across districts assigned to different treatment arms. Column (1) presents the means and standard deviations of each variable for districts receiving District PayDash. Column (2) gives this information for districts assigned Block PayDash, while Column (3) does so for districts receiving District+Block PayDash and Column (4) for control districts. Columns (5) through (7) present the coefficients and standard errors from a single district-level regression of each variable on separate indicators for assignment to each PayDash treatment arm, controlling for treatment strata and state. Standard errors are clustered at the district level. Of the 18 differences considered, none are statistically significant.

We additionally consider characteristics of the district and block officers working at the time of intervention roll-out in treatment and control districts in Tables 1b and 1c, as collected in the baseline official surveys. Our variables of interest for these individuals are years of age, gender, college graduation, SC/ST status, number of months at their current rank of office (topcoded at the 99th percentile), whether the officer was an Indian Administrative Services or state-level officer, and an indicator for whether they reported being comfortable or extremely comfortable with IT tools. Officers in each position tend

to be in their late 30s or early 40s and the majority are male. Most are college graduates, and sizeable proportions of officers fall into the SC/ST categories, particularly at the block level. The more senior CEOs are largely All-India/state-level service officers, while the POs tend not to hold these titles. District CEOs have had the shortest tenure in their current rank, whereas the majority of officials report being comfortable using IT tools, with those at the Block CEO level reporting slightly comfort lower levels overall. Across the four officer types and four program arms, we observe no systematic patterns of differences in characteristics. Of 84 differences considered, only 6 are statistically significant at the 10 percent level, similar to the approximately 8 differences we would expect to see by chance.

4.3 Identification

Given the random assignment of treatments to district, our empirical strategy is straightforward. We use the following basic empirical specification:

$$Y_{bdt} = \theta_b + \theta_t + \beta_1 TD_{dt} + \beta_2 TB_{dt} + \beta_3 TBD_{dt} + \varepsilon_{bdt} \quad (1)$$

where b is a block in district d in month t, θ_b and θ_t are block- and month-level fixed effects, and Y is an outcome of interest. TD is an indicator variable equal to 1 if only District PayDash has been provided to the district in which block b falls and 0 if the block falls in a control district, TB is an indicator taking a value of 1 if only Block PayDash is provided to all blocks in district d, and TBD is an indicator taking a value of 1 if both District and Block PayDash have been provided to district d. Standard errors are clustered by district, the level of treatment assignment, and regressions are weighted by the number of payments made at the locality level. This design allows us to evaluate the impacts of district- and block-level provision of PayDash separately, as well

as complementarities that may exist between them. In Section 5.1.2, we also examine how effects evolve over time using an event study framework.

5 Results

5.1 Impacts on time to payment

5.1.1 Reduced-form effects of PayDash provision

We start by considering the impacts of providing access to PayDash at the district, block, or both levels of the MGNREGA administrative hierarchy. The specification in column 1 of Table 2 controls for treatment status, block fixed effects, and month fixed effects. While the coefficient for all three treatment arms is negative, it is only statistically distinguishable from zero for Block Only Paydash areas. The Block Only areas also have significantly lower payment processing times than the District Only Paydash areas, and nearly so when compared to the District + Block PayDash areas. Impacts in the District only and District + Block arms are indistinguishable from zero. The Block Only PayDash provision decreases delays by 2.285 days, or 29% the size of the control mean.[2] Column 2 of the same table pools the treatment arms. While the pooled coefficient is negative, it is not significant at standard levels.

We also examine treatment effects separately by districts with above and below within-state median payment delays, defined over the April 2015-March 2016 range prior to the time range of analysis. The results, found in Table 3, highlight that PayDash provision for areas with better initial performance see no significant impact of PayDash in any treatment arm in time to payment. However, information provision has proven to

[2]We focus on the payment steps under the purview of the block and district level officials, so the mean of our outcome in control areas is lower than the mean payment processing time for the entire payment process mentioned in the introduction.

be useful in all areas with above-median pre-period time to payment: The Block Only PayDash coefficient is negative, large, and statistically different from zero, and in this case the District Only PayDash and District + Block PayDash both similarly decrease time to payment. The estimates here suggest PayDash decreased time to payment from 23 to 44 percent of the control mean.

In the pooled treatment version in column 2, a similar pattern is observed: overall, PayDash did not decrease delays in areas with below-median baseline delays, but the impact of access to PayDash on delays in areas with above-median pre-period delays is large and negative. In sum, impacts are driven by relatively worse performing areas. Figure 4 shows this result graphically, where all the areas with below median time to payment (on the left of the figure) have coefficients statistically indistinguishable from zero, whereas the treatment arms - District Only, Block Only, District & Block, and pooled treatment, all show lower time to payment in the areas with above-median pre-period processing times.

5.1.2 Event-study analysis

To examine time-to-completion patterns in the months leading up to and following PayDash rollout, we estimate the following equation:

$$Y_{bdt} = \theta_b + \theta_t + \sum_{\tau=-6}^{2} [\beta_{1,\tau} TD_{\tau,dt} + \beta_{2,\tau} TB_{\tau,dt} + \beta_{3,\tau} TDB_{\tau,dt}] + \varepsilon_{bdt} \tag{2}$$

where, as before, Y_{bdt} is an outcome of interest in block b in district d at month t, and θ_b and θ_t are block and month fixed effects. $TD_{\tau,dt}$ is a vector of indicator variables for whether month t in district d falls τ months relative to District PayDash provision. $TB_{\tau,dt}$ and $TDB_{\tau,dt}$ are the analogous vectors for Block and District+Block PayDash provision. Observations which fall in the month prior to PayDash provision serve as the

reference category.

Figure 4 plots the period-specific estimated coefficients and 95 percent confidence intervals from Equation 2. Examining first the pre-treatment periods, reassuringly, for none of the three PayDash treatments are significant pre-trends observed. In line with the results from Table 2, a downward shift in average time to completion is observed for Block Only PayDash provision. The District+Block PayDash provision is associated with lower time to payment initially but has tempered over time.

5.2 Variation in usage by officer type and treatment arm

We next take advantage of our unique ability, given the online/mobile nature of the intervention, to examine not just whether but also how officers of each type (Block CEO, Block PO, District CEO, District PO) use the PayDash platform, and if this differs significantly by whether treatment is provided to that level of the hierarchy alone or at both the district and block levels concurrently. In Table 4 we consider the following officer-month-level metrics of platform usage: (i) any use of the platform; (ii) total user sessions on the platform; (iii) total minutes of platform usage; (iv) number of pending document/responsible employee "cards" viewed; (iv) number of calls to subordinate responsible employees made using the in-app direct contact feature and Whatsapp messages sent to these employees (or groups of these employees with a single message).

Two clear patterns emerge upon examination of the results. First, as might be expected, within each level of the hierarchy (district level or block level), usage is systematically higher by the lower-ranking official (program officer – PO) tasked full-time to MGNREGA versus the higher-ranking official (CEO) who is responsible for overseeing a number of additional government schemes in addition to MGNREGA. POs are the heaviest users of PayDash, with an average of roughly 3 sessions per month total-

ing approximately 20 - 25 minutes duration in total. Lower-level Block POs view the most "cards" on the app, which provide information linking pending payment steps to accountable lower-level officials, with approximately 50 cards viewed each month.

Second, the usage patterns within a given officer type vary across treatment arms in a manner suggesting District+Block treatment is associated with usage complementatires at some user levels; we show in the next subsection that such usage induces lower time to payment. For each officer type, column (4) reports the results of a regression of a usage outcome on an indicator for District + Block PayDash availability, where the comparison group is officers of that same type in areas receiving either District or Block PayDash treatment only, and month fixed effects. Panel A shows that monthly usage sessions and usage duration increase for District CEOs in District+Block PayDash areas as compared to those in District Only PayDash areas. Differences in usage for block officers also exist, seen in Panels C and D: Block CEOs are 7 percentage points (28 percent), and Block POs are 8 percentage points (21 percent), more likely to use PayDash in a given month when district level officials also have access to PayDash. Interestingly, the District PO does not appear more likely to use PayDash when the lower-level block officials have access to PayDash, where coefficients on usage are largely negative but far from significant.

A final important point from this table links to our broader results: total minutes of PayDash usage are quite low, and yet delays declined markedly under the PayDash regime. Taken together, this suggests the targeted information provided through PayDash is an important input to payment delay reduction and major improvements in service delivery overall. The next section investigates causal links between usage and time to payment.

5.3 Impacts of platform usage on time to completion

The previous results demonstrate that concurrently providing PayDash access to both district and block MGNREGA officials significantly reduces average days taken to complete the steps under their purview related to payment delivery in areas with relatively worse pre-period delays. Evidence above also suggests platform usage by officials at both levels of the administrative hierarchy - but particularly for District CEOs and block officials - is significantly higher in such areas. In addition, Block Only access to PayDash significantly decreases time to payment, and junior block-level officials are some of the heaviest users of PayDash. In this section, to improve our understanding of the channels through which PayDash is impacting the MGNREGA payments administration process, we directly examine whether higher usage of PayDash is associated with reductions in average time to payment.

Columns (1) through (5) of Table 5 present the results of regressions of block-month-level average days to completion on each of the five usage metrics considered previously, together with month and block fixed effects. In Panel A, we include usage measures summed across officers within each level of the administrative hierarchy, while Panel B further disaggregates the usage measures to the officer-type level. We observe at both levels of the hierarchy that sending of messages is associated with significant reductions in time to completion. Looking at specific officer types in Panel B, any usage by District CEOs and Block POs is associated with lower delays; while higher numbers of sessions, session duration, cards viewed, and messages sent or calls made by POs at the district and block level are all associated with lower payment processing time. Usage duration and cards viewed by Block CEOs is also associated with lower time to payment. While the estimates in this table do not have a causal interpretation, they provide suggestive evidence that usage of the PayDash application is at least in part responsible for the

observed reductions in time to completion driven by access to the platform.

We examine the causal impact of usage on time to payment in Table 6, where we present results of instrumental variables regression. Here we regress block-month level average days to payment on block and district officer PayDash usage. Usage is summed at the block and district level, and the first stage variation is induced through the random assignment to PayDash at the district, block, or district + block levels. The table highlights that although the correlation between usage and time to payment is negative, block-level officers' usage alone reduces time to payment, whereas district officers' app usage does not directly reduce time to payment. That said, the potential usage complementarities that exist when both block and district level officers have access to the tool suggest provision at both levels could be beneficial.

6 Conclusion

Poor delivery of government services, notably payments, is endemic in developing country settings. We examine here two potential constraints to effective service delivery outside of more frequently discussed issues such as low human resource capacity, inadequate infrastructure, or insufficient financing: implementation by a multi-tiered bureaucratic structure and small inconvenience costs that hamper effective monitoring by supervisory officials within that system.

Our field experiment, conducted in collaboration with the Indian Ministry of Rural Development and the government of the states of Madhya Pradesh and Jharkhand, provided a random sample of bureaucrats access to an internet and mobile-based management and monitoring platform to track and more easily monitor wage payments associated with the world's largest workfare program. The platform lowered the costs of accessing information about the status of wage payment processing and helped super-

visors easily identify subordinate officials who needed to take action to address pending payments. We also randomly varied the level of the administrative hierarchy that received access to the e-platform to ensure that only principals, only supervisors, and then both principals and direct supervisors of implementing agents, received this information useful to program monitoring.

We find that lower costs of information acquisition reduced payment processing time by up to 29 percent the size of the control mean in the most effective treatment arm, which provided the information only to supervisors, overall. Looking at impacts by areas with below and above baseline median time to payment, we also document that lowered information costs reduced time to payment in all treatment arms: those with access by the principals only, those with access by the supervisors only, and those where both the principals and supervisors had low-cost access to this information.

Using detailed platform usage data, we find indication that usage complementarities across the hierarchy exist. Usage rates at the intermediate management level—a proxy for efforts to improve the speed of wage payments—increase when senior-level officials also have access to the e-platform. Reduced form estimates highlight a prominent association with platform usage and reduced time to payment, and IV estimates indicate the supervisor-level usage, but not that of the more senior principals, decreases time to payment. Taken together, the results suggest lower information costs for those charged with direct programmatic responsibility are a primary driver of the results seen here, but higher-level monitoring can encourage such usage - and even low levels of usage translate into statistically and practically significant impacts on service delivery.

The results of this study point to the practical importance of both reducing small costs of information acquisition to monitor program performance, and of ensuring this information is handed to those best poised to act on that information to improve service delivery. In future extensions of this work, we will examine the longer term impacts of

PayDash on both payment processing time and variation in time to payment, as well as outcomes indicative of the overall performance of the workfare program. We will also examine how the impacts of the platform may be mediated by officer-level personality characteristics, and the relevance of potential collusive behavior, as motivated by the conceptual framework described here.

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Figures and tables

Figure 1: MGNREGA payment process

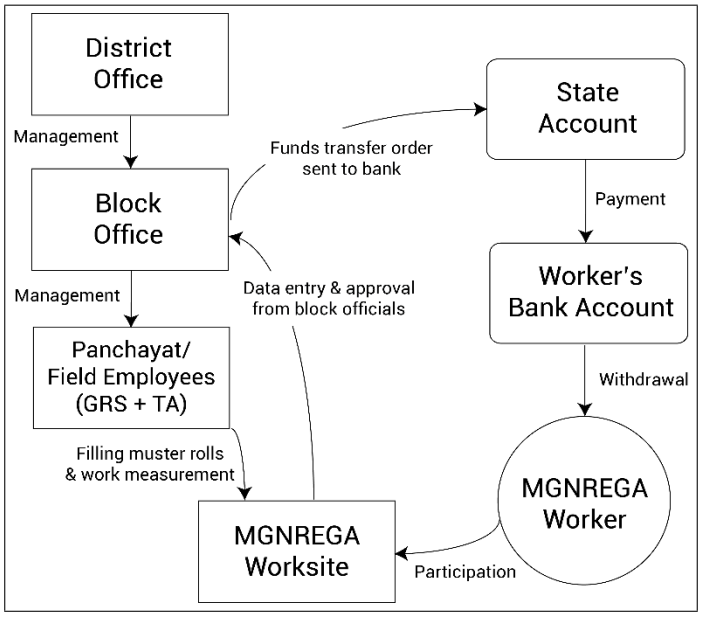
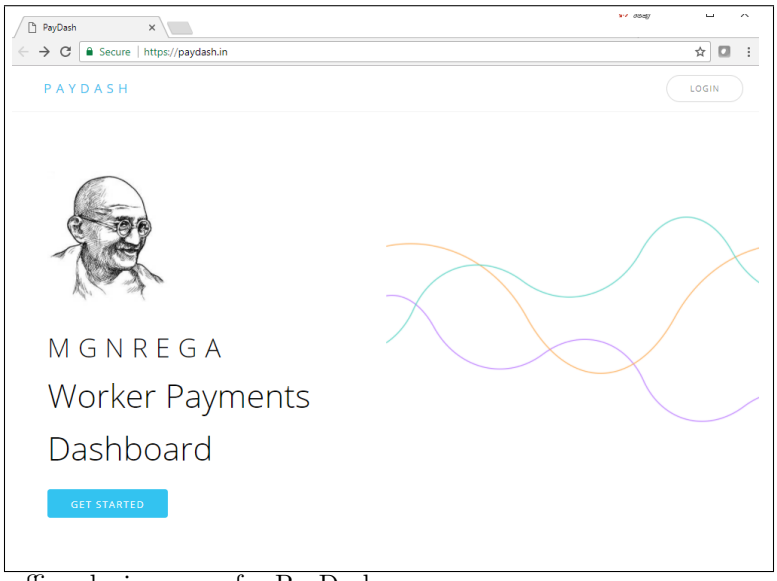
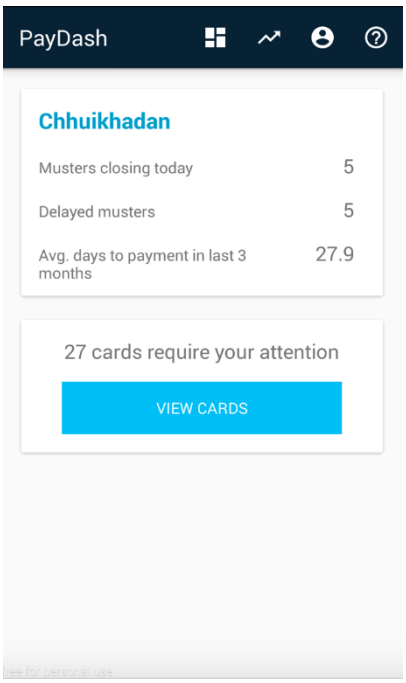


Figure 2a: PayDash screenshot example 1



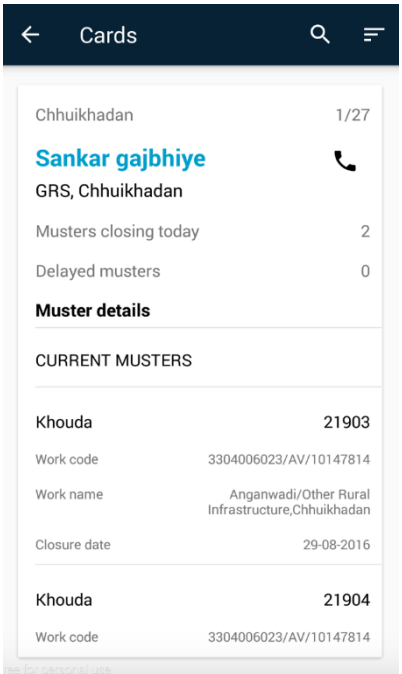
Notes: The online officer login screen for PayDash.

Figure 2b: PayDash screenshot example 2



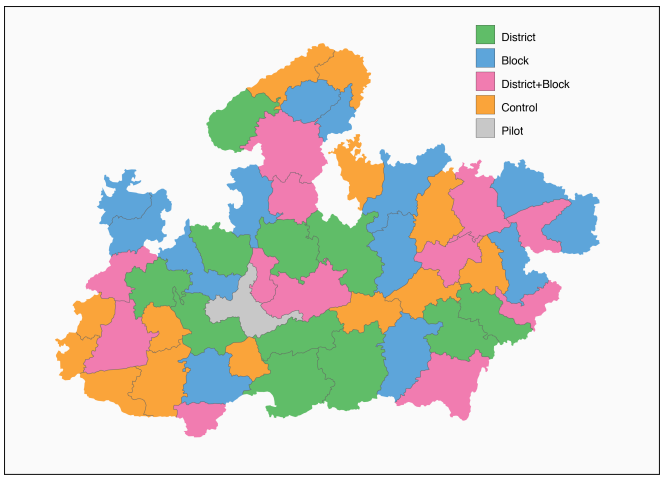
Notes: The mobile landing screen of Block PayDash provides an overview of block performance.

Figure 2c: PayDash screenshot example 3



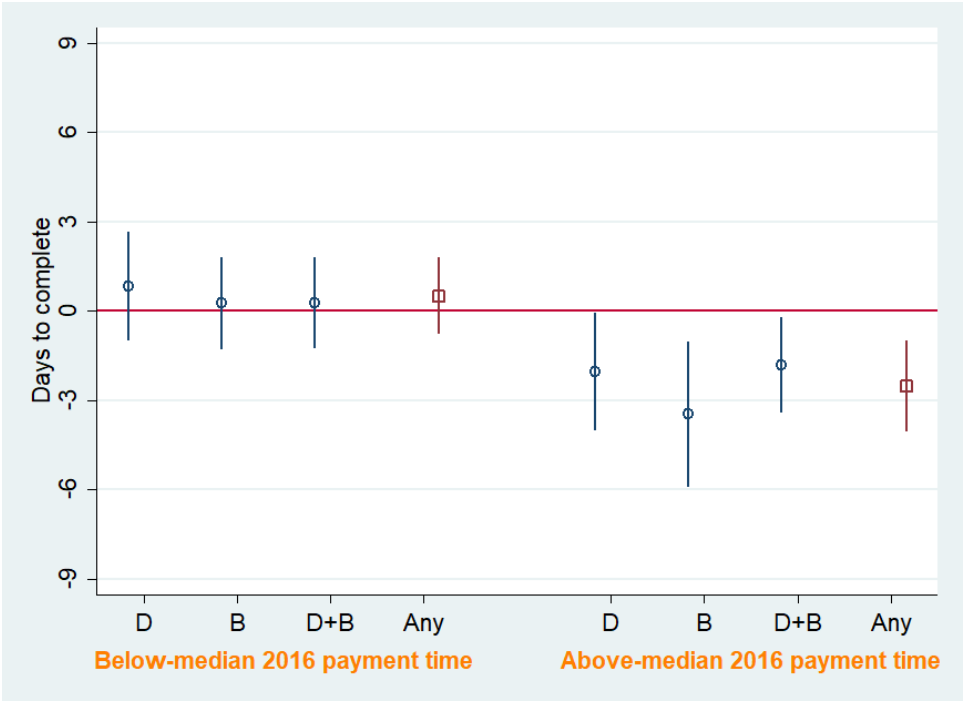
Notes: "Cards" show documents pending and offers the option of directly contacting the employee responsible for processing the document.

Figure 3: District-level treatment assignments



Notes: Figure shows randomized assignment of PayDash variants across districts in the state of Madhya Pradesh.

Figure 4: Heterogeneity by pre-period performance



Notes: Figure plots the coefficients and associated 95% confidence intervals corresponding to the estimates of Equations 1.

Figure 5a: Event study: District Only PayDash

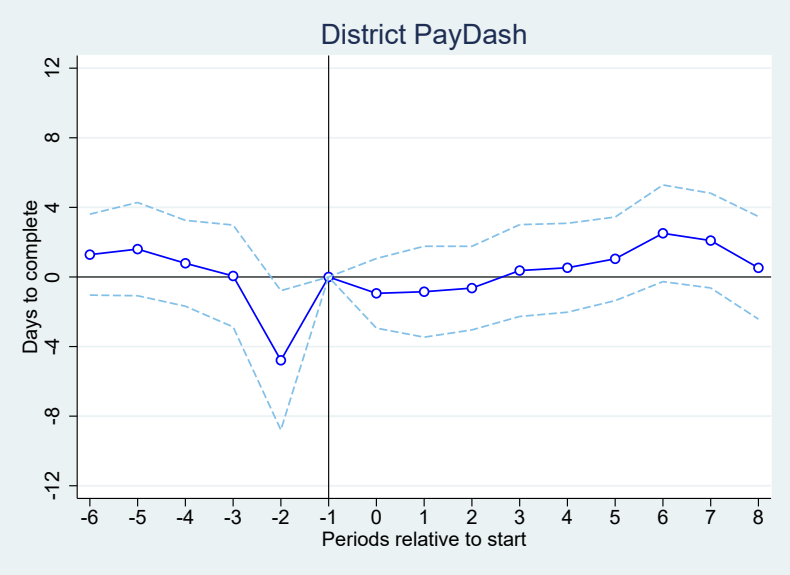


Figure 5b: Block Only PayDash

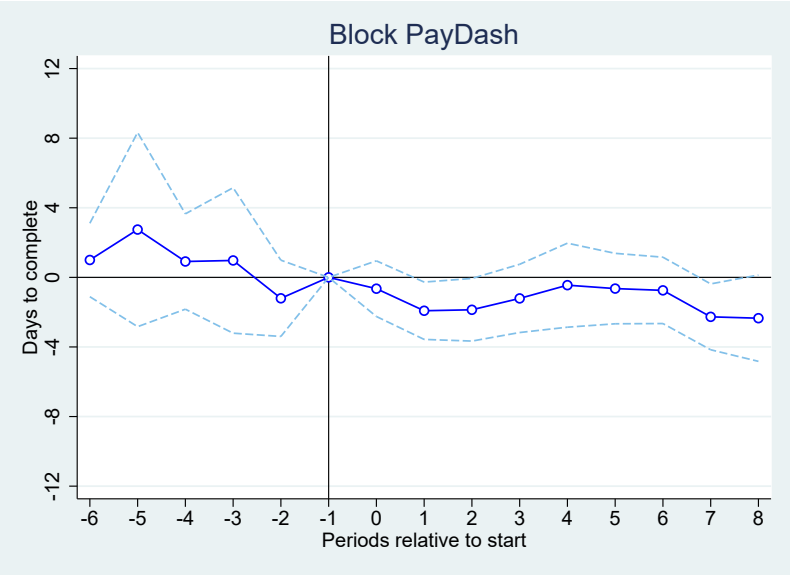
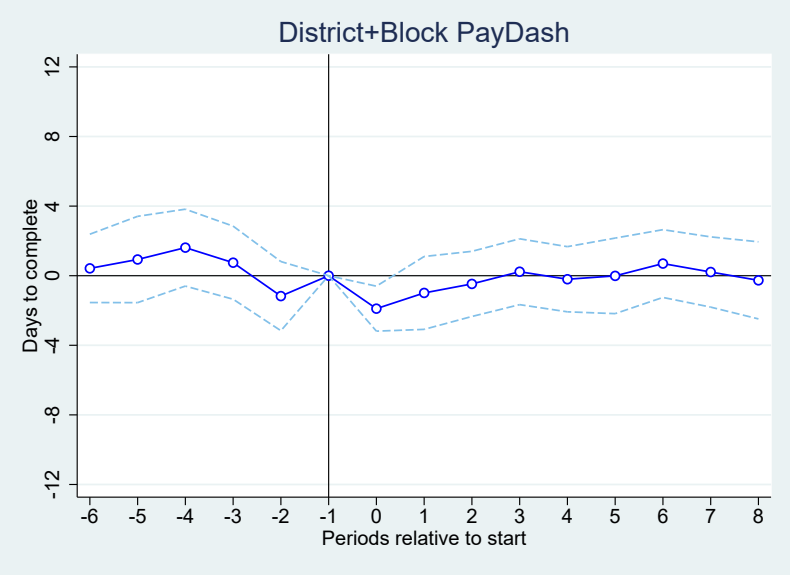


Figure 5c: District + Block PayDash



Notes: Each panel plots the coefficients and associated 95% confidence intervals corresponding to the estimates of Equation 2.

Table 1a: Balance - district characteristics

	District PayDash (1)	Block PayDash (2)	District + Block PayDash (3)	Control (4)	Diff. (1-4) (5)	Diff. (2-4) (6)	Diff. (3-4) (7)	Obs. (8)
Average person days	27.33	24.89	27.89	24.65	2.68	0.24	3.24	73
worked (x1000)	[15.61]	[12.72]	[11.06]	[9.27]	(4.41)	(3.71)	(3.23)	
Std. dev person days	20.03	19.26	23.03	19.15	0.88	0.11	3.88	73
worked (x1000)	[10.49]	[12.26]	[12.14]	[9.93]	(3.43)	(3.71)	(3.52)	
Average days	24.28	28.10	25.88	26.31	-2.03	1.78	-0.43	73
to payment	[6.31]	[6.03]	[6.50]	[7.66]	(2.33)	(2.53)	(2.25)	
Std. dev days	26.35	27.89	27.76	26.86	-0.51	1.03	0.90	73
to payment	[7.16]	[7.65]	[6.76]	[9.05]	(2.70)	(2.75)	(2.53)	
Percent rural	79.82	77.20	74.45	78.09	1.73	-0.89	-3.64	73
population	[9.43]	[15.33]	[17.74]	[18.92]	(4.85)	(5.63)	(5.81)	
Total blocks	8.31	6.65	8.25	7.55	0.76	-0.90	0.70	73
	[4.08]	[2.91]	[4.72]	[4.01]	(1.36)	(1.14)	(1.39)	

Notes: Column (1) presents the means and standard deviations of each variable for districts receiving District PayDash. Column (2) gives this information for districts assigned Block PayDash, while Column (3) does so for districts receiving District+Block PayDash and Column (4) for control districts. Columns (5) through (7) present the coefficients and standard errors from a single district-level regression of each variable on separate indicators for assignment to each PayDash treatment arm.

Table 1b: Balance - district officer characteristics

	District PayDash (1)	Block PayDash (2)	District + Block PayDash (3)	Control (4)	Diff. (1-4) (5)	Diff. (2-4) (6)	Diff. (3-4) (7)	Obs. (8)
Panel A. District CEO								
Age	42.333	46.067	41.286	42.353	-1.000	-2.838	1.080	73
	(13.140)	(11.776)	(12.388)	(11.569)	(4.591)	(3.960)	(4.230)	
Female	0.133	0.000	0.214	0.235	0.163	0.238**	0.039	73
	(0.364)	0	(0.510)	(0.474)	(0.147)	(0.112)	(0.167)	
College graduate	1.000	1.000	1.000	1.000	0.000	0.000	0.000	73
	0	0	0	0	(0.000)	(0.000)	(0.000)	
SC/ST	0.188	0.235	0.100	0.150	-0.094	-0.087	0.066	73
	(0.404)	(0.437)	(0.309)	(0.367)	(0.155)	(0.133)	(0.119)	
Months current rank	24.778	26.733	13.923	35.563	7.578	13.525	22.936	73
	(5.700)	(5.336)	(2.804)	(15.873)	(18.540)	(17.060)	(17.300)	
All-India/state service officer	1.000	1.000	1.000	1.000	0.000	0.000	0.000	73
	0	0	0	0	(0.000)	(0.000)	(0.000)	
Comfortable with IT tools	0.875	0.588	0.700	0.900	0.040	0.281**	0.186	73
	(0.340)	(0.507)	(0.470)	(0.309)	(0.130)	(0.131)	(0.135)	
Panel B. District PO								
Age	42.714	40.412	41.850	43.632	2.554	4.352*	1.686	73
	(8.036)	(7.706)	(8.108)	(8.985)	(2.622)	(2.428)	(2.267)	
Female	0.143	0.118	0.053	0.263	0.097	0.119	0.197*	73
	(0.388)	(0.334)	(0.237)	(0.465)	(0.138)	(0.138)	(0.106)	
College graduate	1.000	1.000	0.850	0.895	-0.139	-0.105	0.061	73
	0	0	(0.367)	(0.322)	(0.093)	(0.072)	(0.111)	
SC/ST	0.375	0.059	0.200	0.150	-0.222	0.057	-0.048	73
	(0.500)	(0.243)	(0.411)	(0.367)	(0.144)	(0.098)	(0.132)	
Months current rank	81.800	82.438	63.444	61.412	-18.940	-19.670	-1.515	73
	(8.138)	(9.165)	(8.461)	(9.588)	(14.164)	(13.658)	(13.087)	
All-India/state service officer	0.133	0.188	0.105	0.316	0.231	0.176	0.168	73
	(0.364)	(0.416)	(0.322)	(0.492)	(0.139)	(0.140)	(0.124)	
Comfortable with IT tools	0.813	0.882	0.850	0.750	-0.027	-0.126	-0.101	73
	(0.404)	(0.334)	(0.367)	(0.443)	(0.166)	(0.141)	(0.134)	

Notes: Column (1) presents the means and standard deviations of each variable for district officials in districts receiving District PayDash. Column (2) gives this information for districts assigned Block PayDash, while Column (3) does so for districts receiving District+Block PayDash and Column (4) for control districts. Columns (5) through (7) present the coefficients and standard errors from a single district-level regression of each variable on separate indicators for assignment to each PayDash treatment arm including controls for randomization strata - state and pre-intervention days to payment and person-days participated in MGNREGA at the district level. Standard errors in these regressions are clustered at the district level.

Table 1c: Balance - block officer characteristics

	District PayDash (1)	Block PayDash (2)	District + Block PayDash (3)	Control (4)	Diff. (1-4) (5)	Diff. (2-4) (6)	Diff. (3-4) (7)	Obs. (8)
Panel A. Block CEO								
Age	46.513	44.308	44.608	43.468	-1.586	0.621	-1.516*	561
	(21.739)	(12.937)	(17.662)	(15.824)	(0.966)	(1.123)	(0.803)	
Female	0.092	0.103	0.113	0.165	0.085	0.051	0.052	561
	(0.369)	(0.330)	(0.321)	(0.514)	(0.052)	(0.051)	(0.050)	
College graduate	0.642	0.594	0.695	0.722	0.098*	0.168***	0.012	561
	(0.438)	(0.404)	(0.437)	(0.600)	(0.052)	(0.045)	(0.047)	
SC/ST	0.316	0.336	0.291	0.320	0.003	-0.014	0.027	561
	(0.750)	(0.595)	(0.437)	(0.514)	(0.062)	(0.068)	(0.049)	
Months current rank	113.516	104.112	97.533	91.286	-5.253	3.954	-10.684	561
	(16.209)	(13.359)	(13.760)	(13.144)	(7.061)	(6.785)	(6.597)	
All-India/state service officer	0.975	0.991	0.993	1.000	0.021	0.011	0.008	561
	(0.208)	(0.106)	(0.090)	0	(0.013)	(0.011)	(0.007)	
Comfortable with IT tools	0.571	0.558	0.691	0.607	0.006	0.038	-0.082	561
	(0.807)	(0.500)	(0.501)	(0.576)	(0.070)	(0.069)	(0.059)	
Panel B. Block PO								
Age	38.535	39.349	38.388	38.271	0.551	-0.160	-0.085	561
	(11.533)	(8.260)	(7.964)	(10.863)	(0.778)	(0.898)	(0.794)	
Female	0.200	0.219	0.159	0.190	0.021	-0.046	0.026	561
	(0.577)	(0.542)	(0.681)	(0.404)	(0.050)	(0.062)	(0.057)	
College graduate	0.865	0.896	0.864	0.888	0.037	0.007	0.019	561
	(0.473)	(0.244)	(0.411)	(0.429)	(0.056)	(0.036)	(0.046)	
SC/ST	0.331	0.327	0.297	0.333	0.023	-0.014	0.042	561
	(0.669)	(0.755)	(0.501)	(0.698)	(0.072)	(0.085)	(0.069)	
Months current rank	98.115	100.762	98.946	93.574	0.918	-2.848	-6.927	561
	(4.478)	(3.660)	(4.528)	(7.274)	(5.932)	(6.154)	(7.525)	
All-India/state service officer	0.135	0.058	0.068	0.080	-0.035	0.050	0.013	561
	(0.588)	(0.319)	(0.257)	(0.355)	(0.050)	(0.037)	(0.027)	
Comfortable with IT tools	0.759	0.788	0.764	0.813	0.077	0.019	0.046	561
	(0.507)	(0.457)	(0.681)	(0.416)	(0.050)	(0.041)	(0.057)	

Notes: Column (1) presents the means and standard deviations of each variable for block officials in districts receiving District PayDash. Column (2) gives this information for districts assigned Block PayDash, while Column (3) does so for districts receiving District+Block PayDash and Column (4) for control districts. Columns (5) through (7) present the coefficients and standard errors from a single block-level regression of each variable on separate indicators for assignment to each PayDash treatment arm including controls for randomization strata - state and pre-intervention days to payment and person-days participated in MGNREGA at the district level. Standard errors in these regressions are clustered at the district level.

Table 2: Reduced-form impacts of PayDash provision

	Average days to complete	
	(1)	(2)
District PayDash	-0.095	
	(0.847)	
Block PayDash	-2.285**	
	(1.049)	
District+Block PayDash	–0.671	
	(0.578)	
Any PayDash		-0.935°
		(0.581)
Test for equality of coeffs., p-value:		
District = Block	0.058	
District = District + Block	0.489	
Block = District + Block	0.128	
Observations	13,061	13,061
Control outcome mean [SD]	7.881	7.881
	[8.261]	[8.261]

Notes: All columns report OLS estimates from block-month-level regressions of the listed variable on indicators for PayDash treatment availability, weighted by the total number of transactions. Additionally included are block and month fixed effects. Standard errors clustered at the district level in parentheses. Significant at *10 percent, **5 percent,***1 percent. °p-value =0.112.

Table 3: Heterogeneity by pre-period performance

	Average days to complete	
	(1)	(2)
Below-median pre-period avg.		
* District PayDash	0.839	
	(0.921)	
* Block PayDash	0.258	
	(0.779)	
* District+Block PayDash	0.279	
	(0.768)	
* Any PayDash		0.513
		(0.652)
Above-median pre-period avg.		
* District PayDash	-2.040**	
	(0.994)	
* Block PayDash	–3.456***	
	(1.226)	
* District+Block PayDash	–1.820**	
	(0.804)	
*Any PayDash		-2.520***
		(0.769)
Observations	13,061	13,061
Control outcome mean [SD]	7.881	7.881
	[8.261]	[8.261]

Notes: All columns report OLS estimates from block-month-level regressions of the listed variable on indicators for PayDash treatment availability, weighted by the total number of transactions. Additionally included are block and month fixed effects. Standard errors clustered at the district level in parentheses. Significant at *10 percent, **5 percent,***1 percent.

Table 4: Heterogeneity in officer PayDash usage

	District (1)	Block (2)	District+Block (3)	Difference (4)	Obs. (5)
Panel A. District CEO					
Any usage	0.15		0.23	0.08	401
	[0.36]		[0.43]	(0.07)	
Sessions	0.41		1.11	0.70*	401
	[1.90]		[3.45]	(0.41)	
Usage duration (min)	1.55		4.41	2.87*	401
	[8.87]		[19.2]	(1.72)	
Cards viewed	3.10		2.64	-0.46	401
	[13.11]		[12.52]	(1.63)	
Messages sent +	0.14		0.19	0.06	401
calls made	[1.41]		[1.61]	(0.21)	
Panel B. District PO					
Any usage	0.41		0.46	0.05	420
	[0.49]		[0.50]	(0.10)	
Sessions	3.64		3.34	-0.30	420
	[7.86]		[7.25]	(1.58)	
Usage duration (min)	20.14		12.98	-7.31	420
	[59.87]		[34.42]	(11.01)	
Cards viewed	22.12		16.16	-6.24	420
	[68.52]		[46.09]	(12.37)	
Messages sent +	13.08		3.26	-10.15	420
calls made	[60.78]		[13.97]	(11.19)	
Panel C. Block CEO					
Any usage		0.25	0.32	0.07*	2,973
		[0.43]	[0.47]	(0.04)	
Sessions		1.30	1.56	0.27	2,973
		[4.65]	[4.39]	(0.34)	
Usage duration (min)		5.11	5.51	0.49	2,973
		[27.13]	[21.16]	(1.25)	
Cards viewed		10.73	9.98	-0.33	2,973
		[76.13]	[52.19]	(3.05)	
Messages sent +		0.10	0.01	-0.09*	2,973
calls made		[1.29]	[0.21]	(0.05)	
Panel D. Block PO					
Any usage		0.38	0.47	0.08**	3,023
		[0.49]	[0.50]	(0.04)	
Sessions		2.80	3.77	0.93	3,023
		[7.12]	[9.21]	(0.73)	
Usage duration (min)		19.04	22.52	3.28	3,023
		[74.57]	[79.47]	(5.74)	
Cards viewed		49.5	58.5	8.41	3,023
		[217.0]	[213.7]	(15.05)	
Messages sent +		0.64	1.25	0.59	3,023
calls made		[8.24]	[18.37]	(0.82)	

Notes: Columns (1) through (3) report variable means with standard deviations in brackets for officers in each position within the listed treatment arm. Column (4) reports the coefficient from an OLS regression of the listed outcome on an indicator for District+Block PayDash. Also included are month fixed effects. Standard errors clustered at the district level in parentheses. Significant at *10 percent, **5 percent,***1 percent.

Table 5: Platform usage and time to completion - OLS

Usage measure:	Average days to complete				
	Any usage	Number of sessions	Usage duration (min)	Cards viewed	Messages sent + calls made
	(1)	(2)	(3)	(4)	(5)
A. Level-specific usage (sum across positions)					
District	-0.697*	-0.057**	-0.009***	-0.010***	-0.010***
	(0.352)	(0.025)	(0.003)	(0.002)	(0.002)
Block	-0.705*	-0.039***	-0.003**	-0.001***	-0.005***
	(0.357)	(0.013)	(0.001)	(0.000)	(0.001)
Observations	12,045	12,045	12,045	12,045	12,045
B. Position-specific usage					
District CEO	-0.782*	-0.079**	-0.010	-0.012	-0.146
	(0.434)	(0.036)	(0.010)	(0.015)	(0.142)
District PO	-0.156	-0.052*	-0.009***	-0.010***	-0.010***
	(0.419)	(0.031)	(0.003)	(0.002)	(0.002)
Block CEO	-0.207	-0.032	-0.008***	-0.003***	0.094
	(0.357)	(0.032)	(0.003)	(0.001)	(0.107)
Block PO	-0.837***	-0.041***	-0.003***	-0.001**	-0.005***
	(0.292)	(0.015)	(0.001)	(0.000)	(0.001)
Observations	12,045	12,045	12,045	12,045	12,045

Notes: All columns report OLS estimates from block-month-level regressions of the listed variable on variables reflecting PayDash usage by hierarchy level or specific position, weighted by the total number of transactions. Additionally included are block and month fixed effects. Standard errors clustered at the district level in parentheses. Significant at *10 percent, **5 percent,***1 percent.

Table 6: Platform usage and time to completion - IV

Usage measure:	Average days to complete				
	Any usage	Number of sessions	Usage duration (min)	Cards viewed	Messages sent + calls made
	(1)	(2)	(3)	(4)	(5)
District officers	0.735	0.130	0.019	0.014	0.020
	(0.938)	(0.157)	(0.032)	(0.028)	(0.053)
Block officers	-1.716**	-0.233*	–0.031*	–0.012*	–0.287
	(0.872)	(0.129)	(0.017)	(0.007)	(0.250)
Observations	12,045	12,045	12,045	12,045	12,045

Notes: All columns report IV estimates from block-month-level regressions of the listed variable on the indicated distict and block officer usage measures, instrumented by the randomized provision of district, block, and district+block PayDash and weighted by the total number of transactions. Additionally included are block and month fixed effects. Standard errors clustered at the district level in parentheses. Significant at *10 percent, **5 percent,***1 percent.

Appendix

PayDash training details

To introduce officers to PayDash, we invited all relevant government officials in the study area - typically a permanent district officer overseeing multiple development schemes in their district, the contract district worker specifically overseeing MGNREGA, a permanent block officer overseeing multiple development schemes in the block, and a contract block officer specifically overseeing only MGNREGA in the block - to a half-day session.

Both control and treatment officials go through the same roll-out process, with the exception that only treatment officials are introduced to and provided PayDash. First, we collect baseline survey data from all officials through a self-administered, paper survey.[3] Then we conduct a session outlining data-based management tools available to officials in the MGNREGA MIS and ask officials to share about their work and profes-

[3]For the most senior group of officials, we sometimes administer a shortened version of the baseline survey in-person, either because the official is too busy to fill out the entire survey or because s/he has a strong preference not to fill out the survey personally.

sional challenges they face. After this, control officials are dismissed. In sessions with treatment officers, the training continues with an additional 1.5 hour session where officers are introduced to PayDash and its mobile platform, and they download the app and conduct preliminary exercises on the platform to ensure it is functional and they understand how to use it.

To avoid treatment contamination, officers from treatment areas were trained on separate days and/or locations from those in control areas. To encourage survey response and PayDash coverage, we make extensive efforts (by calling up to 5 times, and the state sends a letter telling all officials to report for this official training) to ensure all officers are present at the training session during the state roll-out. For those officials that do not attend the group-based training, we conduct individual surveying and onboarding to PayDash (when relevant). To avoid sensitivities related to officials' seniority, we conducted sessions separately not simply for treatment and control officials, but also for block and district-level officials within these groups.