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Cellfare:

Delivering Self-Targeted Welfare Using Mobile Phones*

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Abstract

This paper proposes a new form of social welfare: beneficiaries carry out a series of small tasks on their mobile phones, each linked to a small payment. Key advantages over traditional public works, or workfare, are large potential reductions in leakage as well in administrative costs and delays. A basic implementation of the scheme was tested in the field, and participants with experience from a large Indian public-works programme favourably compared the proposed scheme to the existing one. There are potential challenges related to automation.

1 Introduction

A key problem in social welfare design is targeting, that is, how to ensure benefits reach the intended beneficiaries.¹ Targeting often relies on screening — defining a set of eligibility criteria and assessing potential beneficiaries against them. But in developing countries, the information required to assess the eligibility of potential beneficiaries can be costly to obtain and prone to error and fraud.

An alternative to screening is to make benefits self-targeting, i.e., to make them unattractive to those who do not need them. For example, in order to target those close to starvation, one could subsidise food items that are nutritious but unappetising. But

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¹Making benefits universal — available to everybody — avoids the problem of targeting, but is costly if the aim is to help the neediest. See Besley (1990) for a discussion of this trade-off.

the leading example of self-targeting welfare is public works:² the provision of benefits in return for labour. Public works differ from standard employment in that the primary aim of the employer (usually the government) is to transfer resources to workers who would otherwise be unemployed, rather than to use the labour as a productive input, although the latter is typically a secondary objective. Public works amount to a self-targeting welfare scheme if anyone can sign up, but the conditions and pay on offer are unattractive to those who can find alternative employment.

Traditional public-works programmes have several disadvantages. First, administration costs can be large. The physical projects need to be scoped out, planned and managed, and there are significant costs related to worker enrolment and payroll management. Second, non-labour operating costs, such as transport, materials, machinery and site supervision and facilities can consume a large proportion of the budget. Third, public works have been associated with leakage due to fraud on the part of officials and managers as well as workers. Within the worker pay budget item alone, such fraud can take the form of over-reporting of work done (theft from the government) or under-payment of work done (theft from the workers). Fourth, there can be substantial delays in work provision, since it is difficult to plan and locate projects to coincide with fluctuating demand. Fifth, there can be delays or errors in payment. Sixth, while in principle available to all, traditional public works often involve outdoor manual labour, and is typically best suited for those who are physically fit and, in some cultural contexts, male.

The core idea presented here is that by offering and rewarding micro-tasks via mobile phones, many of the disadvantages of traditional public works can be mitigated. Administration of the programme would be centralised and largely automated. Operating costs would be transparent and almost exclusively derive from mobile network charges and disbursement fees. The scope for at least some forms of fraud would be reduced by eliminating intermediate layers of administration and by making all reporting automatic, accurate and immediate. The scheme could be made entirely on-demand — available at all times and for any duration — or it could be made available, instantly, at times or in regions of need. Each submitted micro-task could be automatically verified and instantly rewarded by mobile transfer directly to the worker. While some categories of disabled people (e.g., the blind) may still be excluded, the proposed scheme is likely to be accessible to a broader set of beneficiaries.

As far as we know, this is the first paper to propose a self-targeting welfare scheme based on mobile-device micro-tasks. There have been previous attempts at making commercial work available to low-income workers in developing countries using mobile phones. But the perspective of a welfare scheme means that the tasks offered need not have any commercial or social value. One can instead focus on designing tasks that are instantly verifiable, available to all — including those without qualifications and the illiterate —

²The term ‘workfare’ is sometimes used synonymously.

yet paid at a low enough rate to be attractive only to those who need it. Still, productive work is not ruled out.

The economic analysis of self-targeting welfare schemes goes back at least to Nichols and Zeckhauser (1982), who argue that targeting can be achieved by the imposition of pure deadweight costs ('ordeals') on beneficiaries. Ravallion (1991) discusses self-targeting in the context of the Maharashtra Employment Guarantee, a precursor to the National Rural Employment Guarantee. Besley and Kanbur (1991) discuss workfare and transfers in kind as two forms of social welfare that may incorporate elements of self-targeting. Besley and Coate (1992) analyse welfare programmes with work requirements and distinguish between the screening (targeting) and the deterrent argument for workfare, where the latter stems from the notion that ordeals may be required in order to incentivise agents to exert effort. There are also a small number of empirical papers looking at the extent to which schemes are, or can be made, self-targeting. Jacoby (1997) provides evidence of self-targeting by finding that poorer households were more likely to enrol in a programme that distributed a bland snack to students in Jamaica. Alatas et al. (2012) find that increasing the cost of applying for a welfare scheme can make it self-targeting by discouraging richer applicants who are less likely to be accepted.

2 Digging (digital) holes and filling them in

In order to function as a self-targeting welfare scheme, the work offered must be suitable for unskilled labourers. The tasks should be designed in such a way that virtually anyone can complete them, and in particular, literacy, schooling or professional qualifications cannot be required. At the same time, the work should command a beneficiary's full attention, so as to screen out those who are employed elsewhere.

By contrast, from a welfare design point of view, the quantity and quality of goods produced under the scheme are of secondary importance. Indeed, in the basic implementation described next, the work is completely unproductive. While the possibility of offering productive work will be discussed below, the unproductive scheme serves as a useful benchmark.

To fix ideas, consider a social planner operating a traditional public-works programme. The allocated budget per worker per day, y , must cover the transfer to the worker, W , as well as a programme cost C per worker per day that includes administrative costs, non-salary operating costs and leakage due to corruption and embezzlement.

The planner values the private utility of the worker, proxied by the transfer W , as well as the social value G of the goods produced under the programme, according to the welfare function

$$U = W + G = y - C + G.$$

Contrast this with the possibility of allocating the same budget y to a scheme of the kind proposed here. Denote the costs of this scheme per worker per day by c and assume it produces goods of value g . Then the planner should prefer the mobile-phone scheme over the traditional scheme if

$$y - c + g > y - C + G$$

or

$$C - c > G - g.$$

Thus, even if the mobile-phone scheme is entirely unproductive ($g = 0$), it should be preferred if the cost savings relative to the traditional scheme exceed the value of the goods produced by the traditional scheme. While estimates of the productivity of public works in developing countries are hard to come by, the evidence on efficiency is not encouraging.³ This, combined with the potentially large cost savings, could make even an entirely unproductive version of the proposed scheme worth considering.

3 A basic implementation and field test

The aim of this section is to fix ideas by providing details of a specific basic implementation of the proposed scheme. The implementation described here should be thought of as a prototype, as several aspects would need to be modified if it were to be scaled up into policy. The section also aims to provide an initial idea of how the proposed scheme would be perceived among potential beneficiaries. A small number of workers with experience of a large Indian public-works scheme were invited to test the basic implementation of the scheme and compare their experience and perception of the two.

3.1 The work

A new user would initiate a work session by sending an SMS (for example, ‘Start’) to the server’s mobile phone number. This triggered a response with the first task:

Welcome! Your balance is 0 rupees. To earn 1 rupee, reply with the reverse of this number: 4321

(The actual number task was randomly generated.) If the beneficiary responds with the *correct* answer (‘1234’ in this case), the service would respond with:

³India’s National Rural Employment Guarantee, the largest public-works scheme in the world, is notorious for corruption. Over-reporting of days worked, and pocketing the associated budget, is one of the most common forms of embezzlement by involved officials. Imbert and Papp (2011) estimate that across India, only between 42% and 56% of reported person-days of employment under the scheme represent actual work.

Correct. Your balance is 1 rupee. To earn 1 rupee, reply with the reverse of this number: 8765

On the other hand, if the answer was *incorrect*, the reply from the service would be:

Incorrect. Your balance is 0 rupees. To earn 1 rupee, reply with the reverse of this number: 4321

Thus each reply, whether correct or incorrect, would trigger an automated reply with the updated balance and a new or repeated task.

The messages were spaced so as to cap maximal earnings at approximately the level of NREG pay. At the time of the field test, the regulated pay for NREG work in Karnataka was 243 rupees (USD 3.74) per day. Assuming an effective working day of six hours, this rate corresponds to about 40 rupees per hour or 1 rupee every 90 seconds. The system would, therefore, reply to workers' messages immediately if the previous task was sent more than 90 seconds earlier, but otherwise wait until 90 seconds had passed.⁴

3.2 Recruitment, workers and payment

The basic implementation described above was tested in April 2017 in Karnataka, India. In four villages in Kolar district, households were randomly selected and contacted. They were asked whether any of the household members had experience in working for NREG. Potential participants also needed to be able to access a mobile phone — they could use their own or borrow somebody else's.⁵ We required some experience in using mobile phones for making and receiving calls, but not experience with SMS. Those satisfying these criteria were invited to attend a work session held in the same village a few days later at a specified time and location. They were told that they would be paid 100 rupees for a session lasting 2–3 hours, plus their earnings from the work. In addition, participants were given mobile phone credit to cover their SMS expenses.

Of the 100 people invited across the four villages, fewer than half turned up. There may have been an issue of trust, as our field workers were not known to the villagers and the latter may have been sceptical of whether there really would be money to be

⁴There were minor variations in the scheme between the four sessions. The changes were introduced partly to make the work easier and more fair. The 'task' was 5 digits long in the first and second sessions, 4 digits long in the third session and 3 digits in the fourth session. In the first session, tasks were remunerated at 0.70 rupees and the maximum rate was one task every 60 seconds, whereas in later sessions tasks were remunerated at 1 rupee and sent at a maximum rate of one every 90 seconds. Initially, new tasks were sent whether the worker's response was correct or not, but in later sessions the same task would be repeated until it was 'solved' correctly by the worker. Finally, in the first sessions the system would space out responses to both correct and incorrect messages, whereas in the later sessions responses to incorrect answers were sent immediately and the minimum spacing only applied to responses to correctly solved tasks.

⁵In the 2011 Census, 47.9% of rural households and 63.4% of urban households in India owned at least one mobile phone. Mobile ownership will have expanded significantly since then. Anecdotally, many of the households who still do not have their own mobile phone are able to borrow one when needed.

made. They may also have lacked confidence in their own ability to do the work. (They did not know the details of the work at the time of recruitment, but they were told that they would be paid for an SMS-related task.) For these reasons, our data may not be representative of the population of NREG workers, but they should suffice to give an initial idea of some potential beneficiaries' first impression of the scheme.

Nearly all participants had a basic (non-smart) mobile phone and would use a pen and paper (provided by us) to note down the task and solution before keying in their response.

As the focus of the field test was on the work itself rather than the disbursement system, participants were paid their earnings in cash at the end of the session rather than by mobile transfer. Payment by mobile would also have been impractical because some participants had borrowed a mobile phone for the session.

3.3 Findings

Forty-two participants with NREG experience took part and are included in the analysis.⁶

There were four sessions. In each session, after a general introduction explaining the purpose of the research and the nature of the tasks, enumerators would re-confirm consent orally, field a pre-session survey and then help participants get started by sending the initial message to the server. Since not all participants arrived at the same time, and since they required individual enumerator attention for the survey and to launch the first task, the effective starting time for the work varied within a session. At the end of the session, some participants would keep working while others were fielded the post-session survey. A few participants chose to leave before the end of the session, and these would be fielded the surveys and paid in the same manner as the others.

Summary statistics are presented in Table 1. 43% of participants self-identify as belonging to a scheduled caste or tribe. 29% are women. The age range is from 18 to 73 with a mean of 45. 38% are illiterate. The number of years of schooling varied between 0 and 15 (there was one university graduate in the sample), with an average of about five years. 79% are married. The principal occupation of the household is 'agricultural labourer' in 55% of cases, and 'cultivator' (meaning they primarily work on their own land) in another 31%. 14% of participants used smart phones. The number of days of NREG work undertaken over the past 12 months ranged from 5 to 180 with an average of 36.⁷

The duration of the work session, as measured by the gap between the first and the last

⁶In one additional case, the participant did not actually have NREG experience, and in two cases we were unable to match the phone number provided in the survey with the number recorded by the server.

⁷These numbers are self-reported. While it is possible that someone has worked 180 days in NREG over 12 months, it would be uncommon. The NREG entitlement is for up to 100 days per year, and the second-highest observation in the sample is 100.

server message, varied from about half an hour to more than six hours. However, nobody actually worked for more than about three hours, and the longest duration observations are due to some SMS messages being delayed by the mobile network. The average work session was about 105 minutes long, and only three work sessions were recorded as lasting more than three hours. The number of tasks completed correctly in this time varied between 0 and 65, with an average of 17. Two respondents did not complete any tasks correctly, and the minimum number of completed tasks among the remaining participants was three.

From the duration, the number of tasks completed and the piece rate, it is possible to work out an effective hourly wage. This ranged from 0 to 34 rupees, with a mean of about 9. (This excludes the 100 rupees show-up fee paid to all participants.) If the two participants with zero completed tasks are excluded, the mean hourly wage is about 10 rupees. These figures are far below the NREG rate of about 40 rupees per hour. To get closer to the NREG rate, the tasks could be made easier, for example by using tasks with two digits rather than three, four or five. It is also possible that the rates would have picked up over time as the participants became more comfortable with the tasks and the technology.

At the end of the session, participants were asked a series of questions contrasting ‘SMS work’ to ‘NREG work’. The purpose of these questions was to get an initial sense of how this form of welfare scheme might be perceived among potential beneficiaries who have personal experience with NREG. For each of these questions, the answer options were ‘SMS work’, ‘NREG work’, ‘No difference’ or ‘Can’t say’.⁸

The results of this poll are presented in Table 2. A majority of participants found SMS work less difficult, more comfortable, more convenient, less physically tiring, less demeaning, better for building self-confidence, better for building experience to get other work and more likely to teach them something new. On the other hand, SMS work was perceived to be more mentally tiring than NREG work.

A little over half the participants thought NREG work was more suitable for healthy, working-age men and women, and 83% thought NREG work was more suitable for the illiterate. However, a large majority of participants thought SMS work would be more suitable than NREG work for women who are pregnant⁹ or who have small children, the elderly, those in poor health and the disabled.

Only 10% thought SMS work was better for the overall development of the village. This is probably because many NREG projects relate to local infrastructure, while the proposed scheme, at least in the implemented form, is unproductive. However, it may

⁸Very few chose the latter two options (a maximum of three respondents per question), so the focus will be on the proportion who responded ‘SMS work’ out of those who stated a preference, that is, out of those who responded either ‘SMS work’ or ‘NREG work’.

⁹However, one female participant felt that NREG work is more suitable for pregnant women as physical labour would facilitate normal delivery.

not have been clear to the participants (and it was not explained to them) that the savings from reduced administration costs and leakage could be spent on developing local infrastructure in a more efficient manner.

Finally, participants were asked which type of work they would personally prefer, if that had to choose only one. 51% responded that they preferred SMS work. Recall that the respondents were experienced NREG workers; if we had asked the population at large, the proportion preferring SMS work may well have been larger. This is consistent with Alik-Lagrange and Ravallion (2012), who argue that the disutility of working in NREG is considerable and should be taken into account when evaluating its effects.

These results are based on a small and probably selected sample of rural workers who tested the prototype scheme only for a fraction of a day. Still, by and large, it would be fair to say that the idea of ‘SMS work’ was not rejected outright by these potential beneficiaries. A majority of workers found SMS work preferable in many respects, and about half would prefer it over NREG work if they could choose only one or the other.

4 Extensions and further considerations

The basic implementation described above is intended as a proof of concept and would need to be modified in several ways in order to be scaled up to a policy. This section covers some issues to be considered in undertaking further research.

4.1 The possibility of productive work

Operating an unproductive scheme has advantages of its own, since it makes it possible to generate tasks with known ‘solutions’ that can be automatically and reliably verified. Still, being able to offer productive tasks would have several advantages. One is the possibility of partly or fully financing the scheme by offering the services of the workers to paying clients. Basic image recognition would be an example, though this would probably require more than just a basic mobile phone. Even if the work is not commercially viable, it might contribute to a public or social good. Productive tasks may also be more likely to develop the skills of the workers, so as to make them more attractive to other employers, and they might provide greater job satisfaction.

Crowdsourcing refers to the outsourcing of tasks to an anonymous ‘crowd’ of remote workers. The work is typically divided into very small tasks, called micro-tasks, each associated with a small payment. Amazon Mechanical Turk is a pioneer in this area and the most well-known platform. Several systems have been developed by academics with the idea of bringing crowdsourced work to poor people in developing countries as a form of livelihood, using only basic mobile phones. A system called txteagle (Eagle, 2009) was perhaps the earliest, and relied on SMS alone. The tasks included translation

and transcription. However, the founders of txteagle have moved away from the original business model, possibly because of limited commercial supply of tasks suitable for basic voice-and-SMS phones.

MicroWorks (Narula et al., 2011) intended to bring another type of microwork to the poor — optical character recognition. While a smart phone was not required, the workers needed to have phones with a basic browser function and internet connection. The pilot was never scaled, and the founders have reformulated their platform to outsource more complicated work to highly qualified, though still relatively poor, people in developing countries.

Another system called mClerk was trialled in Karnataka (Gupta et al., 2012). It used a little-known protocol to send small images by normal SMS, thereby obviating the need for workers to have a data plan with their subscription. But because the task was to transliterate handwritten text in the local language (Kannada) using Latin characters, a high level of Kannada literacy as well as basic knowledge of English were required.

All of these systems were aimed at generating gainful employment rather than providing self-targeting welfare. This tends to limit both the availability (there is a limited supply of useful tasks and clients willing to pay for them) and accessibility (literacy is required by most) of work. As far as we know, none of these pilots have been scaled beyond the initial trial in the original form that required only basic phones.

It may also be possible to partly or fully finance the system by exposing the beneficiaries to advertising or market surveys, but the wider consequences need to be considered.

Systems requiring smart phones would be much more flexible in the types of tasks that could be offered, but such phones are not yet ubiquitous.

One possibility would be to make the tasks educational. A system in which the payments can be viewed as investment in human capital could be socially beneficial and possibly more politically palatable. Unlike some types of commercial work, it would also permit automatic generation and checking of work. Ksoll et al. (2015) study a literacy training system delivered via basic mobile phones, aimed at Latino immigrants in California, but there were no monetary transfers involved.

4.2 Captchas and the threat of automation

Because of the investment required, automation is unlikely to be a problem in a pilot implementation. But if scaled, it is a real concern that a system could be developed to ‘milk’ the scheme by automating task completion.

Probably the only fully satisfying solution to this threat is to design each task so that only humans can solve them effectively. Such tasks are already in common use on the internet. ‘Captchas’ (‘Completely Automated Public Turing tests to tell Computers and Humans Apart’) are used in contexts where a web application needs to verify that a

user is human as opposed to a computer programme. There are many implementations, but an ideal captcha is a task that is easy for humans but difficult or impossible for computers. For this reason, many captchas look similar to crowdsourcing micro-tasks: image recognition is a feature common to many systems.

But some captcha systems also do useful work. reCaptcha is a freely available system that combines its human-detection function with an effort to digitise print books. A system based on captchas could therefore be socially productive, even if not commercially viable.

4.3 Other issues

A related concern might be human outsourcing — rather than doing the work him/herself, the mobile phone owner would employ someone else to do the work in return for part of the revenue. While some money would still reach the worker, this is wasteful from the planner’s of view. However, if the entry cost (the cost of the mobile phone) is sufficiently low, this is unlikely to be a serious concern, because it would be more profitable to work for oneself than for somebody else. It would be hard for a potential ‘entrepreneur’ to hire workers paid at a lower rate and keep the difference.

Another concern is that the work might be undertaken primarily by children or young people. This might be undesirable, especially if it comes at the expense of school attendance or effort. It may be possible to address this by making continued use of the system conditional on satisfactory school attendance by the household’s children.

A system that makes unskilled work more profitable may also have detrimental effects on schooling outcomes in the long run, because it reduces the returns to education. Shah and Steinberg (2015) argue that NREG has had precisely this effect. On the other hand, Afridi, Mukhopadhyay and Sahoo (2016) argue that NREG has improved female empowerment and find that investment in children’s education has increased as a result.

5 Conclusion

This paper proposes a new form of social welfare: offering rewarded micro-tasks via mobile phones. The scheme could be made available to anyone with a mobile phone, at any time. If required, it could be made available at short notice, in a specific geographical area, and rescinded instantly. It can be accessed by beneficiaries as needed, at no notice. Because the work is divided into small, independent tasks, it can be undertaken for as short or long a duration as needed (from a few seconds to several years), and on a part-time or full-time basis. In the simplest version, virtually anyone can do it — literacy is not required, although it may be an advantage.

Unlike traditional public works, the tasks do not require beneficiaries to have the

physical capacity to undertake manual labour, and are therefore potentially available to the old, infirm and those with some types of disability, as well as those who are physically healthy. The work can be done from the relative comfort of home, in shade and shelter, or indeed from anywhere else with mobile reception. In contrast, traditional public works typically involve spending long hours doing physically demanding work outdoors, in sometimes inclement conditions.

The proposed scheme, in its basic form, would provide little scope for learning useful skills to improve prospects of market employment. The work would also be extremely monotonous. However, relative undesirability is a key requirement for the scheme to be self-targeting. Furthermore, it is not clear that these characteristics distinguish the proposed work from what is in practice offered under existing public-works schemes. More elaborate versions of the proposed scheme might provide more productive and satisfying work.

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Table 1: Summary statistics

| Variable | Mean | Median | Minimum | Maximum |
|-------------------------------------|-------|--------|---------|---------|
| Scheduled caste / scheduled tribe | 0.43 | . | . | . |
| Female | 0.29 | . | . | . |
| Age | 44.8 | 43.5 | 18 | 73 |
| Illiterate | 0.38 | . | . | . |
| Years of schooling | 4.7 | 5 | 0 | 15 |
| Married | 0.79 | . | . | . |
| Agricultural labourer | 0.55 | . | . | . |
| Cultivator | 0.31 | . | . | . |
| Smart phone | 0.14 | . | . | . |
| Days of NREG work last year | 35.8 | 30 | 5 | 180 |
| Duration of work session (minutes) | 107.9 | 103.2 | 31.9 | 258.9 |
| Number of tasks completed correctly | 17.0 | 14.5 | 0 | 65 |
| Implied hourly wage (rupees) | 9.44 | 8.02 | 0 | 34.3 |

Table 2: Comparing SMS work to NREG work: Participant responses

| Question | Proportion answering 'SMS work' |
|--|------------------------------------|
| Which type of work | |
| ... is more difficult? | 12% |
| ... is more physically comfortable? | 88% |
| ... is more convenient? | 63% |
| ... is more physically tiring? | 10% |
| ... is more mentally tiring? | 68% |
| ... is more dignified? | 60% |
| ... is better for building self-confidence? | 53% |
| ... provides better experience to take up other employment? | 60% |
| ... would help you to learn something new? | 83% |
| ... is more suitable for healthy, working-age men? | 44% |
| ... is more suitable for healthy, working-age women? | 45% |
| ... is more suitable for women who are pregnant? | 86% |
| ... is more suitable for women who have young children? | 95% |
| ... is more suitable for the elderly? | 90% |
| ... is more suitable for people in poor health? | 98% |
| ... is more suitable for the disabled? | 100% |
| ... is more suitable for the illiterate? | 17% |
| ... is better for the overall development of the village? | 10% |
| If you had to choose one of these two, which type of work would you prefer, personally? | 51% |

Note: The four answer options for all questions listed here were 'NREG work', 'SMS work', 'No difference' and 'Can't say'. The second column shows the proportion who responded 'SMS work' to the question, out of those who selected either 'NREG work' or 'SMS work'. Few selected the options 'No difference' or 'Can't say' — at most three respondents for any question.