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Integrating Biometric Authentication in India's Welfare Programs: Lessons from a Decade of Reforms§

ABSTRACT India's biometric unique ID Aadhaar has been at the forefront of the global revolution in digital identification, and India's most significant investment in state capacity over the past decade. Yet, its application to social protection programs has been controversial. Proponents claim that the use of Aadhaar to identify and authenticate beneficiaries in these programs has led to considerable fiscal savings, while critics claim that it has led to denial of benefits to the marginalized and caused substantial harm. We review research on the use and impact of Aadhaar in social programs in India over the last decade. Our main takeaway from the review is that biometric authentication has reduced leakage in multiple settings, but its impact on beneficiaries depends crucially on the protocols and details of implementation. We conclude with a list of policy suggestions for obtaining the benefits of Aadhaar while minimizing the risk of harm to beneficiaries.

Keywords: Aadhaar, India, Service Delivery, Biometric Authentication

JEL Classification: D73, H53, O30, O31, Q18

1. Introduction

The United Nations Sustainable Development Target 16.9 states: "By 2030, provide legal identity for all, including birth registration."¹ Meanwhile, the World Bank's ID4D initiative estimates that a billion people globally, or

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1. <https://sdgs.un.org/goals/goal16>, accessed June 30, 2021.

40 percent of people in low-income countries, do not have official proof of identity. Moreover, this lack of access is especially concentrated amongst the poor and the marginalized. Having an ID helps individuals obtain government transfers and services, access the legal system, and gain economic opportunities, amongst many other benefits. ID4D notes that “trusted and inclusive identification (ID) systems can serve as a powerful tool for development, accelerating progress in a number of areas, such as women’s empowerment and gender equality, financial inclusion, and health.”²

Around the world, developing countries have been heavily investing in ID systems. Overall, 161 countries have ID systems using digital technologies.³ Of course, IDs do not need to be digital: the United States, for example, has unique Social Security Numbers for individuals. But digital, and especially biometric IDs, can provide considerable advantages in security as well as ease of use, given the lack of literacy and numeracy in developing countries. Recognizing these, the Global ID4D initiative helps “countries realise the transformational potential of digital identification systems.”

India has been at the forefront of the digital identification revolution, starting with the 2010 roll out of its Unique ID, Aadhaar. At the time of writing, over 1.296 billion Aadhaar cards have been issued. The use of Aadhaar has been integrated into numerous government-provided services. For 8 percent of individuals, Aadhaar was their first ID ever, and further, 49 percent of respondents in a large national survey noted that they had used Aadhaar to access a service for the first time (Totapally et al. 2019).

The growing requirement to use Aadhaar to avail of a number of government and even privately-provided services has been controversial, to say the least. The argument reached the Supreme Court, which in 2018 set out specific criteria for its usage. While providing clarity, the judgment does not resolve controversy over the costs and benefits of using Aadhaar in delivering public programs. Proponents claim that the use of Aadhaar to identify and authenticate beneficiaries in these programs has led to enormous fiscal savings, while critics claim that it has led to denial of benefits to the marginalized and caused substantial harm.

In this article, we first provide a generic framework for thinking about the challenges that a government faces when trying to transfer value to remote beneficiaries, and how biometric authentication might plausibly affect these. We next describe Aadhaar use cases in Indian social protection programming, using our framework to categorize whether the use is *a priori* reasonable. We then review evidence on the impact of Aadhaar integration on leakage and exclusion, including causal evaluations as well as high-quality descriptive work. We summarize two of our own studies: the use of biometric Smartcards to make payments to the

2. <https://documents1.worldbank.org/curated/en/953621531854471275/Global-ID-Coverage-Barriers-and-Use-by-the-Numbers-Insights-from-the-ID4D-Findex-Survey.pdf>, accessed June 30, 2021.

3. <https://id4d.worldbank.org/global-dataset>, accessed June 30, 2021.

Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS or NREGS) workers and pensioners in Andhra Pradesh, and the integration of Aadhaar in the Public Distribution System (PDS) in Jharkhand.

We conclude with five policy suggestions based on over a decade of research on the use of biometric authentication in social programs in India. These are: (i) build in safeguards against exclusion, including offline fallback options; (ii) focus on using Aadhaar-based authentication to improve the beneficiary experience rather than prioritizing fiscal savings; (iii) implement solutions for real-time measurement of beneficiary experiences to quickly detect problems of exclusion and address them promptly; (iv) incorporate questions about Aadhaar in representative household surveys like the National Sample Survey (NSS) [as well as private surveys like that of the Centre for Monitoring Indian Economy (CMIE)]; and (v) build trust between the government and civil society in order to manage the trade-off between benefits from fiscal savings and the costs from increased exclusion.

2. Framework

The Supreme Court's 2018 judgment allows the government to mandate the use of Aadhaar for transactions that involve the transfer of resources between governments and citizens (reflecting the legacy of the enabling legislation for Aadhaar being introduced in Parliament as a "money bill"). These include obtaining welfare benefits, as well as filing income taxes and obtaining a Permanent Account Number, or PAN (tax ID) card. The judgment makes exceptions for children accessing benefits, and also explicitly prohibits private companies from requiring the use of Aadhaar for providing services such as bank accounts (though this has not prevented some cases of "Aadhaar-creep," where either public or private sector entities require Aadhaar in contravention of the SC judgment).⁴

Where it is legal, is mandatory Aadhaar also desirable? In order to organize our thinking about the potential benefits, we begin with a simple conceptual framework. We focus on situations in which the government wishes to transfer something of value to people who meet certain criteria. For example, it wishes to transfer PDS rations to households that meet a certain definition of poverty, or issue caste certificates to people from specified castes. The government manages these processes through its agents, the front-line bureaucrats who interact directly with citizens. Broadly speaking, the main steps in processes like these usually involve the following:

- (a) Testing the *eligibility* of the applicant—whether a household is poor, whether a person is from a given caste, and so on;

4. See, for example, this article in the *Huffington Post*: https://www.huffpost.com/archive/in/entry/a-year-after-supreme-court-aadhaar-verdict-its-business-as-usual_in_5d8c69a8e4b0ac3cdda340cc.

- (b) Testing the *identity* of the applicant (i.e., authentication)—whether the person who appears before the agent is in fact who they claim to be.
- (c) Authorizing the agent to issue transfers. This authorization happens in real time in some cases, but can also happen asynchronously as, for example, when the government advances money or food to an agent and then subsequently *reconciles* his balances with records of transactions.

Notice that authentication, such as using Aadhaar, can play two logically distinct roles in these processes. The first is to create a reliable link across interactions. For example, in order to ensure that PDS benefits go to priority households, it is important to confirm that the person showing up to claim PDS rations today is from a household that was classified as a Priority Household last year. In order to ensure that people do not collect the same benefit twice, it is important to check whether the person claiming a benefit today did not claim the same one somewhere else yesterday. This role for authentication is *not* relevant, on the other hand, in one-shot interactions where the government can test eligibility and authorize transfers in the same interaction. For example, if the goal is to provide medical care to people sick with COVID, the government can simply immediately admit anyone who tests positive.

The second function of authentication is to ensure that the people with whom the agent interacts are real, and not “ghosts.” For example, Barnwal (2019) suggests that diversion of Liquefied Petroleum Gas (LPG) to the commercial black market arises chiefly through the creation of fake accounts, which was substantially reduced (by 15 to 19 percent) after the introduction of authenticated direct transfers.

Notice that there are also aspects of the transfer process that authentication does *not* improve. It does not, *per se*, improve the quality of eligibility tests. If the government conducts a survey to determine which households are Priority Households, for example, this determination does not become more accurate if it also collects their Aadhaar numbers. This is counter to the casual rhetoric about Aadhaar preventing the leakage of benefits to the non-poor. Where authentication *can* improve eligibility tests is by making it easier to link multiple records, as for example, by cross-referencing household surveys with government payroll records to ensure that government employees are not enrolled in programs they are not entitled to.

Authentication also does not *per se* prevent government agents responsible for delivering transfers from taking some of these transfers, or charging bribes for them. The PDS is a good example of this: PDS dealers may well keep part of the beneficiaries’ rations for themselves, regardless of whether or not the beneficiaries scan their fingerprints in a Point of Sale (PoS) device. (In other words, authentication may help to reduce “identity fraud” but does not obviously prevent “quantity fraud.”) Authentication might in theory help indirectly by improving the beneficiaries’ negotiation position, as they can threaten to

withhold authentication, but whether this is the case in practice is an open question (more on this below).

In short, authentication can plausibly help to address some forms of fraud and leakage from transfer programs, but not others. To understand the potential benefits of mandating an authentication technology such as Aadhaar in a transfer scheme, a central question is thus:

(1) *Are there substantial issues facing the scheme that Aadhaar is well-suited to solve?*

For example, if most of the leakage from the PDS in a State takes the form of “ghost” ration cards, there is a strong case that requiring Aadhaar (at least for enrollment, if not for transactions) will help reduce it. If, on the other hand, most of the leakage takes the form of under-delivery of benefits to the enrolled households, it is not clear whether authentication will help. And if the main issue is simply that non-poor households have been classified as Priority Households (or poor households have not been able to obtain ration cards), then authenticating them more strictly will not help at all.

Understanding the details of leakage and fraud is important for deciding not only *whether* to use Aadhaar but also *how* to use it—in particular, what form and frequency authentication should take. For example, if the main issue is “ghost” beneficiaries, then it may be enough to require beneficiaries to link (“seed”) their accounts to Aadhaar once, or to re-verify their identity every few years. If, on the other hand, the long-run goal is to enable beneficiaries to access their benefits from anywhere, then it is important that each transaction be authenticated so that the government can check what remaining balance the person requesting rations is entitled to, “linking” the current request with any other related transactions conducted earlier.

Note that in some cases schemes do transfer benefits to the “wrong” people, but this is not particularly consequential for the scheme’s overall goals. In certain types of vaccinations, for example, it may be critical to simply get as many “shots in arms” as possible, without being concerned about the specific identity of the individual. It is worthwhile to distinguish cases like these from those where the identity of the recipient is critically important—*who* receives a caste certificate, for example, or payment for a particular MGNREGS work spell.

The benefits of limiting fraud also depend on the nature of the benefit being provided, and in particular, whether or not it is “rival,” in the sense that one person’s consumption of it precludes another’s. Individually consumed goods and services such as rations provided via the PDS are rival in this sense, which is why it is important to prevent them from falling into the wrong hands. But some other benefits, such as slots in adult education classes or agricultural clinics, are less so. For this latter category, preventing the “wrong” people from benefiting has little value *per se*; the question is rather whether there is value in obtaining

an accurate count of the number of people benefiting, as for example, when instructors are compensated on this basis.

The information needed to assess these issues empirically—how much of various types of leakage and fraud exists in the status quo—generally cannot be found in administrative records alone. Records of the amount of grain sent to a Fair Price Shop (FPS), for example, do not tell us how much was diverted, how much of this was due to “ghost” ration cards, and so on. The key is to *match* the administrative data to independent, representative data on what is actually happening on the ground, as for example, in an audit study. The quality and availability of administrative data on India’s major social programs has been increasing substantially, as for example, the detailed records of payments issued to workers through the MGNREGS. But comparable ground-truth data have, if anything, become harder to obtain, particularly now that the National Sample Survey Office (NSSO) has stopped conducting rounds of the National Sample Survey (NSS) (and chosen not to release data from the 2017–2018 Round). We return to the importance of better ground-truth data in discussing policy implications below

(2) ***How serious are the risks of exclusion, and of higher transaction costs, to the population being served?***

Understanding how much scope exists for Aadhaar authentication to improve a scheme is important because requiring authentication will usually come at some cost.

The first category of cost is exclusion: some people may be eligible, but unable to establish their identity at some step in the process, and so lose access to benefits. This may occur for a number of reasons—because they do not have an Aadhaar number, because they are not able to link one to other government records, because authentication at the point of interaction fails, and so on. The potential costs of exclusion have been graphically illustrated by the press coverage of starvation deaths in households that lost access to PDS rations because they were unable to seed an Aadhaar number to their ration card.

The second is transaction costs: some people may successfully obtain benefits, but incur much higher costs in terms of time, money, and frustration to get them. The authentication process can be costly and/or time-consuming; for example, authentication failures might necessitate multiple trips to collect benefits. For example, in Jharkhand, both our own work and that of Dreze et al. (2017) suggests that beneficiaries needed multiple trips to collect PDS rations after the introduction of online Aadhaar authentication.

The severity of these risks depends both on how *likely* they are and on how *harmful* they would be.

In order to assess likelihood, it is useful to examine the usual information about the share of the target population that already has an Aadhaar number, as well as determine how difficult obtaining an Aadhaar number (and, where relevant, seeding it) would be for those that do not. Knowing the population

being served can also give us a decent sense of the potential costs. The costs for obtaining and seeding Aadhaar are known to be high for remote and more marginalized populations (Totapally et al. 2019); cases where these populations make up a high proportion of beneficiaries might, therefore, see higher costs. The age of the beneficiary population can be an easy predictor of costs. It is clear that obtaining Aadhaar cards and being present for transaction authentication might pose particular challenges for the very young or the very old. Yet while being useful, this information cannot tell us how much exclusion will, in fact, take place *as a result of* Aadhaar, as that requires knowing what rates of exclusion would be like under the alternative—a point we return to below.

In order to assess harm, it is important to consider the type of benefit being transferred and its value from the point of view of the beneficiaries. Some benefits, such as food for vulnerable populations, can be matters of life or death. Other types of subsidies, for example, technological and quality upgradation subsidies for Micro, Small and Medium Enterprises (MSMEs) are less essential in comparison.

(3) *What mechanisms are or can be put in place to mitigate these risks?*

The Supreme Court judgment explicitly recognized that making Aadhaar mandatory involved real risks of exclusion, and that it would be important to have fallback mechanisms in place to mitigate this risk. Yet such mechanisms are not always existent, or easy to access. In the case of the PDS, for example, a fallback option to Aadhaar authentication was supposed to exist in the form of one-time passwords (OTPs) sent to beneficiary cell phone numbers. But few PDS beneficiaries have consistently available phone numbers that are accurately linked to their Aadhaar accounts. For making MGNREGS payments in Andhra Pradesh, on the other hand, the use of simple offline fallback mechanisms—collecting fingerprints on paper, rather than scanning them, or having trusted local officials verify transfers—appears to have significantly reduced exclusion (Aadil et al. 2019; Muralidharan et al. 2016).

3. Aadhaar in Action

We next review and discuss the ways in which Aadhaar is being used by the government in practice.

We take as our point of departure the catalogue of government schemes making use of Aadhaar contained in the State of Aadhaar Report 2016–2017 (Abraham et al. 2017). At that point, 1.14 billion people (85 percent of the population) had an Aadhaar card and 139 million used it to authenticate themselves every month on average. Aadhaar was used for payments in Pratyaksh Hanstantrit Labh (PAHAL) Scheme (LPG), MGNREGS, PDS, and pensions (with 82 percent, 79 percent, 72 percent, and 51 percent seeded, respectively). Since this dataset is now several years old, and in particular was created before

the 2018 Supreme Court judgment on Aadhaar, we have also updated it. We first verified for each scheme in the original report whether Aadhaar is still required in the wake of the court judgment. We then augmented the list by examining the websites of all 51 Central Government ministries to identify additional Central Sector or Centrally Sponsored Schemes that request Aadhaar numbers from beneficiaries. We also examined all official State government websites to determine State-level schemes that request Aadhaar numbers. In doing so, we referred to the operational guidelines of various schemes and, in some cases, to application forms available online. Table A1 reports the use cases we identified, noting the specific scheme, whether it is national or particular to a State, what government or private agency is responsible, the sector, and a brief description. (For Table A1, see: https://www.ncaer.org/Events/IPF-2021/Paper/IPF_2021_Paper4_TableA1_Aadhaar_Use_Cases_in_Various_States.pdf.)

The first fact that stands out is a simple one: Aadhaar usage is ubiquitous. By usage, we mean the employment of Aadhaar in one or more of the following ways: linking to beneficiary rolls (“seeding”) for de-duplication, authenticating transactions, or making Direct Benefit Transfers (DBTs) using the Aadhaar Payment Bridge. We document usage by governments in all States, and across more than twenty Central Government ministries and departments. Aadhaar is used in schemes ranging from flagship anti-poverty programs such as the MGNREGS, PDS, and the Integrated Child Development Services Scheme (ICDS), to extremely specialized schemes related to horticulture or homeopathy.

Overall, we document 183 Central-level schemes that use Aadhaar. In addition, we document 301 State-level use cases, spanning financial assistance in various schemes, requirements for permits, licenses, and certificates, as well as a number of additional identity cards (for example, family ID cards). One special case is that of online citizen service portals, such as *MeeSeva* in Andhra Pradesh, *Jharsewa* in Jharkhand, and *Seva Sindhu* in Karnataka, which provide a single window for accessing welfare schemes, citizen services, grievance redressal, and even business registration.

Usage is widespread in terms of not only the number of schemes, but also the number of beneficiaries affected. The State of Aadhaar Report 2019 (Totapally et al. 2019) reveals that of the 1.2 billion people who have Aadhaar (including 95 percent of adults and 75 percent of children), 330 million use it regularly for rations, 145 million have used it at least once for LPG subsidy, 102 million have used it for MGNREGS wages, 96 million farmers have used it to receive fertilizer subsidies, and 9 million older adults use it to receive pensions. In addition, 609 million have linked it to their bank accounts, 125 million children have enrolled in school using theirs or their parents’ Aadhaar, and 345 million people used Aadhaar to get a SIM card.⁵

5. Note that the State of Aadhaar Report 2019, though more up-to-date and with a much larger survey sample, does not have a comprehensive treatment of use cases; hence, we rely on the 2016–2017 report and our own updates to describe use cases.

Second, there is some evidence that the prevalence of Aadhaar usage has risen since the Supreme Court judgment. Of the 117 schemes documented in the State of Aadhaar Report 2016–2017 (Abraham et al. 2017), we document a total of 97 cases that are still actively using Aadhaar, 5 cases which are no longer active or use Aadhaar, and 15 cases that we cannot verify; meanwhile, we found 86 *new* Aadhaar use cases, for a net increase of at least 66. In relative terms, the State of Aadhaar Report estimated that 77 percent of social protection spending (\$36B out of \$47B per year) passed through schemes that used Aadhaar; while we do not have budgetary figures for all schemes, that number seems likely to have increased as well.

Third, a majority of use cases involve authentication to receive a material benefit. These include both in-kind transfers (for example, PDS grains) and cash transfers (for example, DBT payments of various subsidies), and include subsidy and scholarship programs in addition to the familiar social welfare schemes. Because these use cases involve the transfer of material benefits from governments to beneficiaries, it is *a priori* reasonable to worry about duplicate or “ghost” beneficiaries, or about fraud by non-beneficiaries. Yet the costs of exclusion can also be very high (in the PDS, for example) and the burden of transaction costs substantial, especially for transfers that are repeated. It is generally thus best to examine these on a case-by-case basis, considering for each the questions posed above.

That said, there are also a number of examples where Aadhaar authentication is required to access benefits that are likely non-rival.⁶ These include, for example, coaching classes for underprivileged students or agricultural clinics for farmers that are administered at the group level. As mentioned above, the case for Aadhaar use in these cases may not be as strong, since allowing an additional person to participate does not preclude participation by anyone else. There seems little downside to having unexpected guests at agricultural clinics, for example. The main argument for authentication here is likely to accurately track the number of people who benefit, as for example, when instructors are paid on that basis. The open questions are whether Aadhaar authentication does this more effectively than other simpler methods of tracking participation, and how susceptible it is to obvious scams such as registering passers-by as participants.

There are also cases in which the government issues documents to specific people—such as caste, residence, or education certificates—that are of value only to the person named on them. Here there is some risk of identity theft, as for example, if person A obtains person B’s residence certificate and then uses it to pose as B, and also some risk of fraud, as for example, if A obtains a residence certificate specifying an address at which he does not live. Aadhaar authentication can help prevent identity theft if A is required to authenticate when he

6. At least five schemes, as per Table A1.

obtains or uses a certificate. It is less clear how it can help prevent fraud, except as a means of cross-referencing claims across administrative data sources.

In short, there are regularities in the ways Aadhaar has been deployed (despite the enormous number of use cases) that we can use to form some *a priori* sense of the likely benefits and costs of Aadhaar authentication in each. Yet what the *actual* benefits and costs are is almost always an empirical question. In addition to understanding the specific mechanisms, risks of exclusion, and so forth, one needs to match administrative data to a source of “ground-truth” in order to quantify leakage and exclusion, and to do this in representative samples to ensure that isolated anecdotes are not given undue prominence. We next turn to a review of the available evidence on these points.

4. Descriptive Evidence on Aadhaar

For a technology that now plays such a pervasive role in the life of the nation, it is striking how little rigorous research on Aadhaar is available. For instance, a Google scholar search of the terms NREGS or MGNREGS yields several times as many hits as a search for the term Aadhaar, despite MGNREGS being just a single welfare program whereas Aadhaar affects the delivery of *hundreds* of government services. One reason for the relative lack of evidence is that primary data has been difficult to obtain over the last decade, with the NSS either not releasing collected data or not conducting scheduled rounds.⁷ It is critical that the NSS resume and that it should include questions that capture the impact Aadhaar is having on people’s lives—a point to which we return in the conclusion.

Given the shortage of data it is not possible to paint a comprehensive picture of Aadhaar’s impacts—yet several individual studies do give us useful insights. We begin in this section with insights from studies that are *descriptive* in nature, meaning that they capture what is happening but do not attempt to compare this to what *would have* happened in the absence of Aadhaar, at least not using methods of causal inference generally accepted in social science research. We then proceed in the following section to studies that conduct credible causal inference to try to assess how outcomes are *different* as a result of Aadhaar’s use. We restrict ourselves, throughout, to studies that collected and analyzed primary data and that made some attempt to do so in samples that are representative of

7. Many authors have written about recent problems with data collection in India, including Pronab Sen, India’s first Chief Statistician (<https://www.indiatoday.in/magazine/up-front/story/20200323-the-unfolding-tragedy-of-indian-data-statistics-1654709-2020-03-13>), Abhijit Banerjee, Pranab Bardhan, Rohini Somanathan, and T.N. Srinivasan (<https://economictimes.indiatimes.com/blogs/et-commentary/from-being-world-leader-in-surveys-india-is-now-facing-a-serious-data-problem>), and Pramit Bhattacharya (<https://www.livemint.com/news/india/how-india-s-statistical-system-was-crippled-1557250292753.html>).

a broader population of interest. Based on these criteria, we focus here on the following five studies:

- Two State of Aadhaar reports: The 2017–2018 report (Abraham et al. 2018) is based on individual surveys with 3,000 households across Andhra Pradesh, Rajasthan, and West Bengal; and the 2019 report, which has broad coverage, with a quick survey with 145,000 households across 28 States, and an in-depth survey with 19,000 households in 16 States and one Union Territory.
- Two distinct studies conducted by the Center for Global Development. The first (Gelb et al. 2018) examines the case of introducing *Bhamashah*, a digital platform for service delivery, in Rajasthan in 2018. It relies on surveys with 633 households across 7 districts of Rajasthan. *Bhamashah*, introduced in 2014, gives households a card and a unique *Bhamashah* family number; each household member’s Aadhaar number is linked to the card, and it is needed to avail of any of the 150 schemes either wholly or partially funded by the State government. The second (Aadil et al. 2019) was conducted in Krishna district of Andhra Pradesh in 2018–2019, with surveys of 556 beneficiaries of one of three welfare programs, 53 FPS owners, and 45 business correspondents.⁸
- Dreze et al. (2017), who examine the use of Aadhaar in the PDS in Jharkhand. They surveyed 890 households attached to 32 FPSs across eight districts, with 18 of these FPSs using online Aadhaar authentication, 7 using offline Aadhaar authentication, and the remaining not using Aadhaar authentication.⁹

In examining these studies, we focus on outcomes that we described in Sections 2 and 3 as important for judging the appropriateness of Aadhaar integration: fiscal savings and leakage, exclusion, transactions costs, and beneficiary preferences.

4.1. Fiscal Savings and Leakage

Measuring leakage in transfer programs requires both administrative records on the amounts disbursed and a source of “ground truth” on the amounts received by beneficiaries. Claims about leakage reduction due to Aadhaar have often ignored this point, citing reductions in fiscal outlay as if they were *per se* evidence of reduced leakage. For example, the State of Aadhaar 2016–2017 report

8. Krishna is the richest district in Andhra Pradesh, so the results must be viewed in this light.

9. Three types of PDS outlets were discarded from the sample: (i) those serving more than one village; (ii) those with more than 250 ration cards on their list; and (iii) those operating under the “partial online” mode. The sample should thus be viewed as skewed towards smaller and more rural villages.

(Abraham et al. 2017) cites the DBT website in claiming that \$2.1 billion in food subsidies and \$3.9 billion in LPG subsidies were saved by removing 23 million and 35 million duplicates, respectively. However, without matched data on actual beneficiaries, it is difficult to know whether the removal also mistakenly included genuine beneficiaries. Of the studies we review in this section, only Dreze et al. make a more concerted effort to examine leakage: they report that the average PDS purchase-entitlement ratio was the same in online and offline FPSs at approximately 93 percent, suggesting that online Aadhaar usage did not change leakage. This is correct to the extent that the ratio of entitlements to actual disbursements was also the same across these types of shops, but the analysis is incomplete because the authors do not have data on disbursements from the government to PDS shops to verify this.

4.2. Exclusion

Most of the studies do have something to say about exclusion. The State of Aadhaar Report 2017–2018 notes that 0.8 percent of the respondents in Andhra Pradesh and West Bengal and 2.2 percent in Rajasthan reported exclusion in the case of PDS (which they estimate as being equal to 2 million people every month). However, they also note that in the latter two states, non-Aadhaar related problems contributed substantially more to exclusion than Aadhaar-related problems (0.3 percent, 6.5 percent, and 5.2 percent, respectively).

The 2019 report notes that individuals from minority religions (Muslims and Christians), historically disadvantaged castes, and homeless and third gender people are less likely to have Aadhaar than the national average. Turning to exclusion, 2.5 percent of the respondents experienced exclusion from a key welfare service because of Aadhaar (which disproportionately affects the homeless and third gender people), and 0.5 percent of children could not enroll in school because of Aadhaar-related problems. However, for the major social programs, the rate of exclusion because of Aadhaar-related errors is lower than exclusion because of non-Aadhaar related errors (1 percent versus 31 percent in NREGA, 0.5 percent versus 5.7 percent in pensions, and 1.5 percent versus 3.2 percent in PDS). The general picture that emerges is that Aadhaar authentication is one among several hurdles that disadvantaged people face when trying to access public benefits, but not necessarily the most common.¹⁰

In Krishna district, 2 percent of the beneficiaries reported being denied rations because of technology failure, though the authors report that these issues were resolved quickly. In addition, 5 percent of the pensions were temporarily stopped during the transition. The study notes that Andhra Pradesh officials did

10. With respect to private programs, it is notable that 3.3 percent of the people were denied bank accounts and 0.8 percent were denied SIM cards because of Aadhaar-related problems. Along with denial of access to education, these are denials that are illegal under the 2018 Supreme Court judgment.

not seek to remove bogus beneficiaries at the time of digitization. Further, they implemented strong fail-safes to deal with technological failures. For example, the State has entrusted village revenue officers (VROs) with the authority to authenticate transactions in cases of technology failure.

In Jharkhand, Dreze et al. report that 7 percent of the households did not have a single member with Aadhaar, including mainly small households with elderly couples or widows living alone. This would make it near impossible for them to obtain rations in the online-only system with no fallbacks, but there is no comparison with exclusion in villages that do not have Aadhaar.

4.3. Transactions Costs

Many reports point out the existence of authentication failures, although serious attempts at quantifying transactions costs in Rupee terms are lacking. In Rajasthan, less than a quarter of all program beneficiaries could authenticate in the first attempt (~96 percent could authenticate in four attempts or fewer). Meanwhile, 70 percent of those who were denied PDS rations because of authentication failures had to return the next day (sometimes with another family member) to reattempt authentication. Dreze et al. (2017) note that transaction costs were significantly higher in online villages (1.5 trips per month compared to 1.1 in offline villages), although they do not report whether these numbers are statistically distinguishable.

4.4. Preferences

All reports elicit beneficiary opinions on the integration of Aadhaar. The SOA 2017–2018 report notes that a large number of schemes (252) required beneficiaries to authenticate themselves to receive benefits, but that nevertheless 87 percent of respondents approved of the government’s mandatory use of Aadhaar (and 77 percent approved of the private sector’s use of mandatory Aadhaar). This may be related to the fact that, for example, over 60 percent of people preferred Aadhaar enabled PDS as they believed it reduced fraud. This number had increased further by SOA 2019: 92 percent of people say they are very or somewhat satisfied with Aadhaar. Strikingly, even among those who have been excluded from a service because of Aadhaar, 67 percent still say that they are satisfied with it.

In Krishna, which has a strong grievance redress mechanism to deal with exceptions or cases of technology failure, 70 percent of PDS beneficiaries viewed the new system (with Aadhaar) as better and 28 percent as worse, with few differences across gender, age, and other demographics. Interestingly, 80 percent of those who thought the new system was better, and 46 percent of those who thought it was not, believed that rations were no longer diverted. Conversely, 100 percent of those who thought the new system was not better, and 42 percent of those who thought it was better, agreed that authentication failures were frequent. Meanwhile, pensioners strongly favored the panchayat

office system of payment delivery using Aadhaar. Very few report skimming by officials, which was quite common in the manual system before Aadhaar. Note that all comparisons are simply with the system as it existed prior to Aadhaar; there is no contemporaneous counterfactual.

In Rajasthan, 40 percent of PDS beneficiaries found the new system to be better and 12 percent found it to be worse, with the rest remaining neutral between the two. The main reason for approval of the new system was that people felt their entitlement could no longer be diverted. Those who disliked the new system cited authentication failures as their main reason. In the case of pensions, nearly two-thirds of pensioners said they preferred the new system. Among respondents who were not below the poverty line about 45 percent said they preferred the new system, but among below poverty line respondents, over 75 percent did, indicating that the reforms benefited those who are most reliant on pensions. The most important reason seems to be that pensions had become more regular under the new system.

The picture was worse in Jharkhand. In online villages, 64 percent of transacting households said the ePoS should be discontinued, while only four out of eighteen dealers in online villages said the ePoS system should continue. Surprisingly, 70 percent of transacting households in offline villages—more than those in online villages—said that the ePoS should be discontinued, but again it is not clear if these numbers are statistically distinguishable.

We summarize the available descriptive evidence as follows. There is no credible data on leakage at all, a serious lacuna given that one of the main arguments for integrating Aadhaar into transfer programs in the first place was to reduce leakage. Exclusion risk may be small but it is real, and appears to disproportionately affect the most vulnerable. However, non-Aadhaar exclusion risk is also significant, in most cases higher than that attributable to Aadhaar. Transactions costs are again small but non-trivial, coming largely from authentication failures that result in beneficiaries having to make additional trips to obtain ration. In most cases, it seems reasonable to attribute these to Aadhaar. Opinions seem positive overall, but depend on context. Aadhaar seems like something that most people seem willing to accept even when it has caused them problems. The picture is of a population that is used to having a hard time getting things out of government that they are entitled to, and doesn't see Aadhaar as a major change-maker in that regard.

We next review studies that conduct causal analysis of the impact of using biometric authentication to deliver welfare programs.

5. Evidence of Impact of Biometric Authentication and Aadhaar

In addition to the descriptive work above, there are three studies on the impact of using biometric identification to deliver welfare programs that also have

a credible comparison group against which to assess impacts. These include Barnwal (2019) who studies the impact of Aadhaar-based DBT on leakage in LPG subsidies (using a natural experiment), and two of our own studies spanning MGNREGS, pensions, and the PDS (with randomised experiments). We summarize the findings and insights from each of these studies below.

5.1. Aadhaar-based DBT in LPG Subsidies

Barnwal (2019) uses the fact that DBT was rolled out across 89 districts in six phases, and then unexpectedly terminated, as a natural experiment. The paper has two main findings. First, it finds that the reform led to a significant reduction in LPG sales to households, and a corresponding reduction in the distributor-level sales data (using administrative data on distribution of LPG cylinders). It also finds that these reductions were reversed when the reform was rolled back. Second, the paper finds compelling evidence of diversion of subsidized LPG into the (illegal) private “black” market through an innovative approach of measuring black market prices during the reform and after the reform was repealed, which finds a significant reduction in these black market prices when the reform was stopped.

Quantitatively, the paper finds that after DBT is introduced in the treated districts, LPG purchases by eligible households go down by 11–14 percent, then converge back to the level in untreated districts once DBT is withdrawn. After DBT is removed, fuel prices in the black market go down by 13–19 percent (consistent with the supply of LPG cylinders and the resulting ability to divert to the open market having gone up again), while firms’ purchases in the formal market go down by 9 percent. The evidence suggests that there is significant divergence of LPG from households to firms that buy in black in the old system (before Aadhaar). Finally, the paper analyzes the heterogeneity of impacts by the pre-program incidence of usage, and finds that the reductions in LPG purchase are concentrated among larger buyers, suggesting that the fiscal savings were less likely to be driven by the exclusion of genuine beneficiaries and more by reductions in “ghost” beneficiaries.

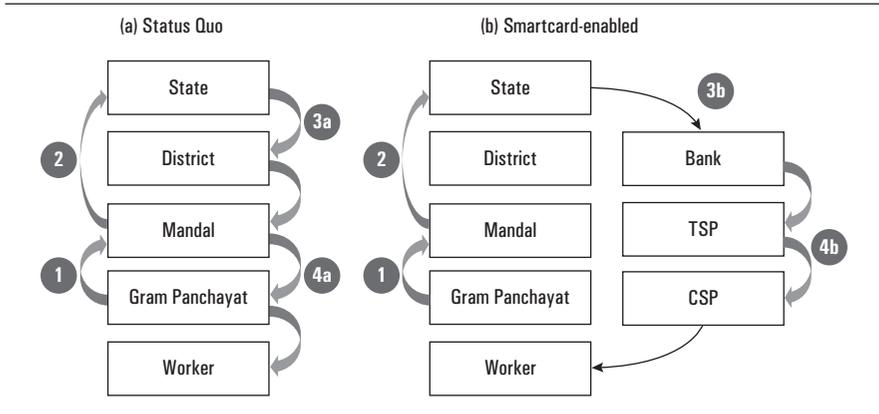
Put together, Barnwal (2019) provides compelling evidence that the use of Aadhaar to reform the way in which LPG subsidies were delivered led to meaningful reductions in leakage. However, there are two limitations in the study. The first is the lack of a contemporaneous control group (the study used a natural as opposed to a randomized experiment). Second, and more important, is the lack of matched data between administrative records of disbursement and household records of receipts. Thus, while there is compelling evidence of reduction in government spending and indirectly of reduced leakage (through the effects on black market prices), it is difficult to rule out the possibility that some part of this reduction may have come at the cost of increased exclusion error of households, especially those with low frequencies of purchases.

5.2. Biometric Smartcard-based Payments in MGNREGS and Pensions in (unified) Andhra Pradesh

The next two studies are based on our own work. Both feature: (i) large-scale randomized experiments of the rollout of linking biometric authentication to welfare payments, and (ii) *matched* data between disbursements and receipts to measure the extent to which these reforms affected *both* of these items of interest.

The first one studied the impact of biometric authentication and payments through local Customer Service Providers (CSPs) in MGNREGS and social security pensions across 8 districts in (unified) Andhra Pradesh between 2010 and 2012. This reform opened no-frills bank accounts for beneficiaries, which were accessed through biometric Smartcards. CSPs partnered with banks to make last-mile cash disbursements; accounts could only be accessed through the local CSP because they were offline and there was no portability, after biometric authentication through local PoS machines. Figure 1 describes the Andhra Pradesh Smartcards (APSC) reform for the case of MGNREGS payments; while the flow of information from the field to the State did not change, payments now

FIGURE 1. Status Quo versus Smartcard-enabled Payment Systems in Andhra Pradesh



Source: Reproduced from Muralidharan et al. (2016).

Note: This figure shows the flow of information (1 and 2) and funds (3a, 3b, 4a and 4b) for MGNREGS payments, pre- and post-Smartcards. "TSP" is a Technology Service Provider, a firm contracted by the bank to handle details of electronic transfers. "CSP" is a Customer Service Provider, from whom beneficiaries receive cash payments after authentication. The upward flow of information about work done is the same in both systems: (1) Paper muster rolls are maintained by the Gram Panchayat and sent to the *mandal* computer center, and (2) the digitized muster roll data is sent to the state financial system. However, the downward flow of funds is different. In the status quo model (3a), the money is transferred electronically from the State to the district to the *mandal*, and (4a) the paper money is delivered to the Gram Panchayat (typically via the post office) and then to the workers. In the Smartcard-enabled system (3b), the money is transferred electronically from the State to the bank to the TSP, and (4b) the TSP transfers cash to the CSP, who delivers the cash and receipts to the beneficiaries (both with and without Smartcards). Beneficiaries with Smartcards were required to biometrically authenticate identity before getting paid. Beneficiaries without Smartcards were issued "manual payments" with status quo forms of authentication and acknowledgment of payment receipt.

flowed through the Bank and CSP, as opposed to flowing through the same agent (field assistant) who reported the amount of work done.

In order to evaluate the impact of rolling out Smartcards in MGNREGS and pension programs, we worked with the Government of (unified) Andhra Pradesh (GoAP) to conduct a staggered roll-out of the programs in three phases in eight districts with a total rural population of ~20 million. We used a randomized lottery to allocate *mandals* (blocks) to each phase between 2010 and 2012. Thus, Phase 1 *mandals*, which got the program first, were the treatment group and Phase 3 *mandals* (which only got the program two years later) served as the control group.¹¹ We conducted nearly 16,000 baseline and endline household surveys that allowed us to match administrative data on payments and disbursements to rich beneficiary-level data on receipts, time delays in getting paid, and wages and employment (on both NREGS and other work). The combination of randomization of the rollout of Smartcards and matched data between administrative records and household data (across treatment and control areas) allows us to estimate the causal impact of the Smartcards program.

We found strikingly large positive impacts of Smartcards on almost every dimension of beneficiary experience. First, the payments process improved sharply. The Smartcard system reduced the lag between working on an NREGS project and collecting payment by 29 percent, and reduced the unpredictability in this lag by 39 percent. Further, it reduced the time workers spent collecting MGNREGS payments by 19 percent. Second, leakage fell significantly. NREGS beneficiaries in the treated *mandals* reported a 24 percent increase in weekly earnings, while fiscal outlays did not change, resulting in a 41 percent reduction in leakage (a 12.7 percentage point reduction relative to the average leakage of 30.8 percent in the control areas). Similarly, reported earnings on pensions went up by 5 percent, while official disbursements did not, leading to a 49 percent decline in leakage (a 2.9 percentage point reduction relative to average leakage of 6 percent in the control areas).

The APSC program was a bundle of two components: using biometrics for authentication, and moving payments closer to beneficiaries by hiring business correspondents (BCs) to have a payment point (through local customer service providers or CSPs). We find using a non-experimental decomposition of effects that the use of local BCs/CSPs was the key to improving the payments process, whereas the biometrics were the key to reducing leakage. Specifically, the benefits of faster, more convenient, and more predictable payments were seen even for those who had not obtained a Smartcard, as long as the village had hit the threshold of enrollment (typically 40–50 percent of the beneficiaries) at which point *all* payments in the village were “converted” to going through the BC/CSP

11. We included a Phase 2 of “buffer” *mandals* so that the GoAP could continue rolling out Smartcards there after Phase 1 but before Phase 3. These buffer *mandals* were not included in the study and we did not collect survey data there.

(even for those without Smartcards). However, we only found leakage reduction in the cases of beneficiaries who had enrolled for Smartcards. This leakage reduction was driven mainly by reduced over-reporting of work by intermediaries, since the money went directly into beneficiary bank accounts and could not be siphoned away by intermediaries.

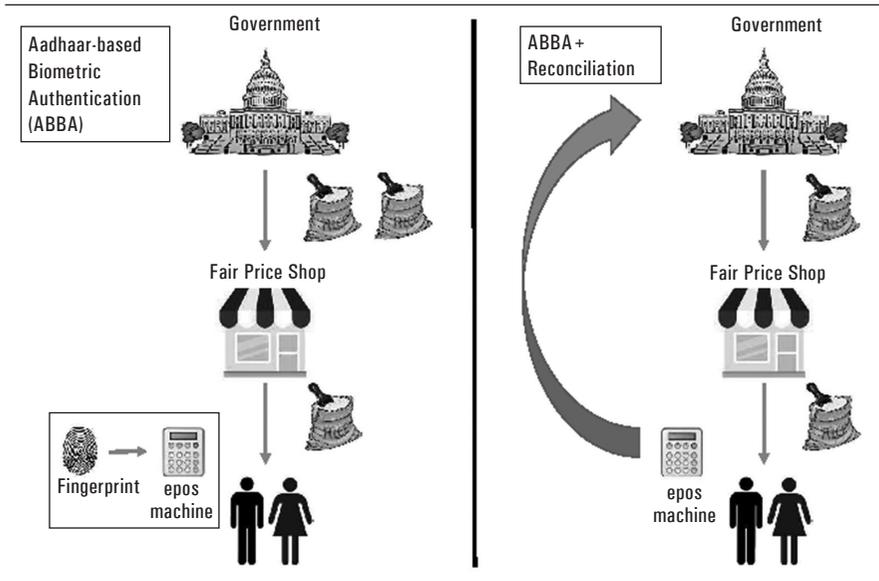
Finally, we find that Smartcards were very cost-effective. The monetized value of time savings to beneficiaries (₹26 crores) alone was greater than the cost of the new system (₹24 crores) for NREGS. The reduction in NREGS leakage was nine times the cost of the program. Put together the returns from time saving and leakage reduction were nearly ten times the cost of the program. All estimates are only for the eight study districts, and would be higher if extended to all of Andhra Pradesh. Overall, the evidence suggests that Smartcards improved beneficiary experiences in collecting payments, increased payments received by program participants, reduced corruption, broadened access to program benefits, and achieved all these benefits without substantially altering fiscal burdens on the State. Consistent with these results, we find that 90 percent of the NREGS beneficiaries and 93 percent of the Social Security Pensions (SSP) recipients who were exposed to the Smartcard initiative reported that they prefer the new system to the old. Combined with the evidence of high cost-effectiveness, this was clearly a reform that made sense all around.

5.3. Aadhaar-based Biometric Authentication in the PDS in Jharkhand

Our second study was in partnership with the Government of Jharkhand (GoJH) to evaluate the impact of introducing Aadhaar-based Biometric Authentication (ABBA) in the PDS starting in 2016. This allowed us to test the impacts of biometric authentication in a different context (Jharkhand), with a different program (PDS), using a different technology (Aadhaar versus Smartcards-based authentication), and in a setting of weaker State capacity than unified Andhra Pradesh, which had made strong investments in technology-driven governance over the years.

The evaluation was carried out using a similar design to the Andhra Pradesh Smartcard study and featured a large-scale randomized evaluation. The roll-out of the biometric ePoS machines was done in a phased manner across 132 blocks in 10 districts where the blocks were allocated to treatment (receiving ePoS machines first) and control (receiving them last) groups using a random lottery. In order to measure impacts, we conducted over 14,000 household surveys (matched to ration cards) and collected data on PDS commodities received (quality and quantity), transaction costs of collecting benefits (time, number of trips), and beneficiary opinions of the program.

The intervention was similar to APSC in that biometric authentication was required to obtain grains at the last mile from the PDS dealer. However, one important difference was that the reform was rolled out in two stages. The first

FIGURE 2. PDS Reforms in Jharkhand

Source: Reproduced from Muralidharan et al. (2021a).

Note: This figure shows the two phases of the reform studied in Muralidharan et al. (2021a). The left panel shows the first stage, ABBA, which requires beneficiaries to authenticate transactions at the FPS in order to receive rations. The right panel demonstrates that transaction records from the ePOS machine are used to provide information in the “reconciliation” phase to adjust future disbursements of grain from the Government to the FPSs.

stage, which was randomized, involved the rollout of ePoS machines which enabled ABBA of beneficiaries attempting to collect food. In the second stage (“reconciliation”),¹² GoJH used data from ePoS devices to determine monthly food distribution to the FPSs, by adjusting the amount of new grain disbursed based on electronic records of authenticated transactions. This was introduced in all blocks at the same time, so we evaluate this using a pre-specified event study framework, a placebo group of PDS commodities not subject to reconciliation, and experimental variation in the duration of exposure to ABBA prior to reconciliation. Figure 2 describes the two stages of reform.

The results in Jharkhand were different from those in Andhra Pradesh in important ways. We found that the first phase of the reform (requiring biometric authentication to collect PDS benefits) did not lead to any increase or decrease in either the value of benefits received or leakage. Further, there was a significant decline in the benefits received (of around 10 percent) for those beneficiaries who had not seeded their Aadhaar numbers into their ration cards. Finally, there

12. Note that in Andhra Pradesh, reconciliation was much more straightforward since bank accounts were automatically settled upon uploading of the transactions records from the electronic point of sale (ePoS) machine. Moreover, payments were sent out only upon receiving information of what was due based on the work done that was uploaded by the *mandal*.

was also an increase in transaction costs for beneficiaries in the treated areas with a significant increase in the number of unsuccessful trips made to the FPS for collecting rations. We also found that leakage (defined as the gap between the value a beneficiary was entitled to and the value they received) continued to be high, at around 20 percent in both the treatment and control areas. This was likely because Aadhaar only solves the problem of identity fraud and not the problem of quantity fraud, where the dealer takes beneficiary fingerprints but provides them with less than the value to which they were entitled. Overall, these results are consistent with the critique that biometrically authenticating transactions caused at least some “pain without gain” (Dreze et al. 2017).

Yet, there were reductions in leakage in the second phase of the reform, when the government started to reconcile its monthly shipments of grain to each FPS against transaction data for the previous month. Roughly speaking, this meant that a ration shop owner responsible for distributing 100 kg of grain each month who distributed 70 kg in July would receive only 70 kg from the government in August rather than the full 100 kg he would previously have received. Our data suggest that reconciliation had a meaningful impact on fiscal savings for the government.

In particular, the ABBA data from the electronic point of sale (ePoS) machines during the months prior to reconciliation allowed GoJH to see the undisbursed balance of grain for each dealer, and correspondingly reduce disbursements under reconciliation. When reconciliation started, we saw a 31 percent drop in the value of grains disbursed by the government for the reconciled commodities (rice and wheat) in the first month of reconciliation (July 2017). Combined with matched household survey data, we estimate that around 70 percent of this drop in value was a reduction in leakage. Another striking piece of evidence of lower leakage is that FPS dealers in treated areas reported a 72 percent lower expected future bribe price for FPS licenses, suggesting that they expected a substantial fall in the potential for making money from diverting PDS grains.

However, this reduction in leakage came at the cost of increased errors of exclusion: the remaining 30 percent of the reduction in value disbursed represents value lost by legitimate beneficiaries. The probability that a household received no rice or wheat increased by 10 percentage points after reconciliation. This sharp decline in benefits also had political costs and the government temporarily rescinded the reconciliation policy entirely, citing complaints from both dealers and beneficiaries. As we discuss further, the exclusion was likely exacerbated by GoJH’s decision to hold dealers responsible for undisbursed stock over several (8–10) months, corresponding to the period of ABBA but before the onset of reconciliation. In practice, some or much of this grain would have already been diverted (or spoiled). Thus, when GoJH sharply reduced disbursements in July 2017, many dealers likely did not have the grains in stock that they were supposed to have (based on ABBA records). The reduction in disbursement thus also led to a reduction in grain to beneficiaries.

Over time, GoJH has brought back the reconciliation process with improvements (such as reconciling stocks every 1–2 months as opposed to doing a one-shot cumulative reconciliation for several months). However, the discussion above highlights a deeper structural problem.

In an ideal world, the government would like to reduce leakage (by reducing dealer corruption) without increasing exclusion. However, the structural problem is that while the government can reduce disbursements by only replenishing stocks for authenticated transactions, it is much more difficult to prevent the dealers from passing on some of their pain (of having lower stocks) to the beneficiaries. These results highlight that efforts to control corruption can have negative consequences, too. Overall, the results from Jharkhand suggest that while there may have been reductions in leakage in the PDS due to ABBA, some of this reduction came at the cost of increased exclusion errors.

5.4. Discussion

Methodologically, the discussion above highlights the centrality of matched data (between administrative records and beneficiary receipts) and a credible control group for quantifying and understanding what is actually going on. In the Andhra Pradesh Smartcards case, it would have been easy to think that there was no impact on leakage because there was no change in government expenditure on MGNREGS and pensions. It was only with the matched data between administrative records and household surveys (and the existence of a control group) that we could see that leakage had fallen sharply and that more benefits were reaching people. Conversely, in the case of ABBA in Jharkhand, it would have been easy to interpret the reduction in disbursements as evidence of reduced leakage (and indeed, officials often claim this exact point). However, it was the matched data using household surveys which clarified that at least some of the reductions in disbursement were coming at the cost of exclusion errors.

Such visibility is also essential for political economy reasons. It is very difficult for senior policymakers to distinguish between genuine issues and vested interests. In the Andhra Pradesh case, despite the strong evidence of positive impact, the feedback on the program through political channels was often negative, to the extent that the political leadership of GoAP almost considered scrapping the Smartcard program. This is because the lower-level officials, who could no longer make money from MGNREGS as easily as before, would try to highlight cases of system malfunction and beneficiary inconvenience to get the program scrapped (since they could not publicly complain that “they were no longer able to make money”). Thus, in this case, the opposition to the program was being driven by vested interests that the political leaders almost listened to, nearly scrapping a highly effective program because they could not be sure that the beneficiaries were not genuinely worse off.

Conversely, in Jharkhand, Right-to-Food activists routinely highlighted the exclusion errors from imposing Aadhaar-based authentication. But many officials

believed that a few cases of adverse effects were being exaggerated by activists because of ideological opposition to Aadhaar and did not take these concerns as seriously as they perhaps should have. Ground-level data like the one we collected in our studies allows officials and citizens to have better visibility on multiple crucial aspects of the program and enable them to make better informed decisions.

Substantively, in understanding why the outcomes were different between the two studies, it might be helpful to consider the structural differences in the two contexts. The technology itself was, of course, different, with Andhra Pradesh relying on offline Smartcards, while the Jharkhand reform used (mostly) online authentication via Aadhaar. Another difference that *ex-ante* a lot of people thought was important was state capacity—Andhra Pradesh usually performs well on measures of governance (third out of 19 in one such indicator), while Jharkhand does not (17th out of 19).¹³ Indeed, understanding whether biometric technology would work in a context with low state capacity was one of our own motivations while undertaking the ABBA evaluation in Jharkhand.

However, neither of these factors appears to be the main reason for the differences in outcomes. For instance, in Jharkhand, we found no significant differences between FPSs that were fully online and fully offline (in contrast to the results of Dreze et al. 2017). In addition, Jharkhand ended up implementing the reform more comprehensively and faster, managing to converge to more than 90 percent implementation in less than six months, suggesting that the capacity to implement *per se* was not necessarily a constraint. Andhra Pradesh deployed Smartcards incrementally, having previously piloted them for four years in other districts, and also rolled them out slowly in treatment *mandals*.

Rather, our experience of evaluating the two programs suggests that the main reason for the differences in impacts was the *difference in political priorities* around the use of biometric authentication technology. Specifically, the Andhra Pradesh Smartcards program focused on improving the beneficiary experience, while ABBA in Jharkhand focused on fiscal savings.

A key point to note is that *both* programs (Smartcards in Andhra Pradesh and ABBA/reconciliation in Jharkhand) reduced leakage. However, in the case of the NREGS and pensions in Andhra Pradesh, the benefits of reduced leakage were passed on to the beneficiaries in terms of more money received (displaced from corrupt intermediaries), while there were no savings with the government. In contrast, in the case of Jharkhand, the reduced leakage in the PDS led to reduced disbursements from the government but did not improve the beneficiary experience in any way (and worsened it in some ways).

13. The index of governance was compiled by Mundle et al. (2012), and includes indicators of performance of the executive, judiciary, and legislature, with particular emphasis on the delivery of infrastructure, social services, fiscal performance, and maintenance of law and order by the executive branch.

In other words, the technology of biometric authentication “worked” in both settings, in terms of reducing leakage. But the question of how the benefits of this leakage reduction should be shared between the government and beneficiaries is ultimately a design question, as well as a political one. Thus, the biggest reason for the difference in results (in our assessment) was not because of the technology (Smartcards versus Aadhaar) or the context (Andhra Pradesh versus Jharkhand) but because of differences in program design and priorities. Andhra Pradesh focused on the beneficiary experience, while Jharkhand (implementing the policy decision of the Government of India) emphasized fiscal savings.

This difference in emphasis was also reflected in the speed of rollout, which itself may have mattered for outcomes. GoAP rolled out Smartcards gradually, over 3–5 years during which GoAP had a lot of time to learn, adjust, and improve field protocols. Importantly, at no point during this period did GoAP *mandate* the use of Smartcards to receive payments. Rather, GoAP aimed to encourage Smartcard adoption by making it more convenient to do so. On a related note, GoAP also provided liberal override mechanisms even for those who did have Smartcards and were not able to authenticate. The combination of gradual rollout, and generous override mechanisms all reflected the focus on beneficiary experience as opposed to fiscal savings, and likely led to lower exclusion.

In contrast, GoJH (reflecting the priorities and push from the Government of India) aimed to implement ABBA rapidly and did so, achieving over 90 percent coverage of ePoS devices within six months of the program rollout. While on one hand, this is a sign of “successful” implementation, the speed may have also contributed to the increased exclusion we find, including decisions such as mandating ABBA at a time when around 23 percent of the beneficiaries had not yet seeded their PDS ration cards with Aadhaar, and not having effective manual override systems to protect the most vulnerable. For instance, mechanisms like OTPs sent via text message were in place as a back-up against authentication failure, but were likely inaccessible to those without cell phones. More generally, relying on technology-based backup procedures for Aadhaar-related challenges may not work as well for the most marginalized and vulnerable members of society.¹⁴

Many of the challenges we documented with ABBA in Jharkhand were likely to be transitory and not permanent. For instance, Aadhaar-seeding rates are now over 98 percent as compared to 77 percent at the start of the ABBA rollout. Similarly, our estimates suggest that much of the exclusion at the onset of reconciliation can be attributed to GoJH’s decision to hold dealers

14. For a recent example, see this article which discusses how a poor widow in Bihar was unable to access her benefits because she had lost her Aadhaar card and could not easily recover her Aadhaar number because most of the procedures for retrieving her Aadhaar number required a registered e-mail or phone number, which she did not have: <https://indianexpress.com/article/opinion/columns/flaw-in-aadhaar-architecture-uidai-card-enrolment-7389133/>

accountable for *cumulative opening balances* of grains as recorded on the ePoS machine and sharply reducing disbursements in line with this. Since much of this grain may have been already diverted or spoiled, increased exclusion was much more likely since the dealers did not have the grains that the ePoS records suggested that they did. Our estimates suggest that starting with a “clean slate” zero opening balance and using ePoS and ABBA to reconcile stocks on a monthly basis would likely have reduced leakage (albeit by less) and also avoided the increased exclusion. Yet, our results also suggest that nearly two million beneficiaries were denied access to their PDS benefits at some point during ABBA and reconciliation in Jharkhand, and the discussion above suggests that *the focus on fiscal savings and speed of implementation may have contributed to the increase in exclusion.*

Note that the decision to focus on fiscal savings as opposed to beneficiary experience is a legitimate political choice. Consistent with political orientation around the world, the Centre-Left UPA Government (at the Centre and in Andhra Pradesh, in 2006–2012) chose to emphasize the beneficiary experiences, while the Centre-Right NDA Government (at the Centre and in Jharkhand, in 2015–2018) chose to emphasize the fiscal savings in both their policy choices and their public messaging regarding the benefits of the program. After all, fiscal savings to the “government” also belong to the people in that it frees up the budget for other programs that would also be implemented by a democratically elected government. Conversely, focusing only on the beneficiary experience without regard to fiscal costs is likely to limit the budget for other productive investments.

Citizen and voter support for this idea is seen in both our data and in the State of Aadhaar reports where respondents report favorable opinions on Aadhaar despite having been personally inconvenienced by it, reflecting their view that it is good for the government to curb fraud and leakage even if it comes at the cost of some inconvenience. Thus, going forward, a key question to ask is how can we as a society realize the benefits of Aadhaar, while minimizing the risk and damage from exclusion? In the conclusion below, we discuss practical steps for doing so.

6. Conclusion and Recommendations

While the use of Aadhaar in various welfare schemes has been controversial, in practice, all indications are that Aadhaar is here to stay. Its use is widespread and representative data from the State of Aadhaar reports suggest that the overall incidence of exclusion is low. At the same time, given the large population of India, even a 2 percent exclusion rate (as documented in the State of Aadhaar reports) affects over 20 million people. As a society, this number ought to be considered unacceptably high, especially since those excluded are disproportionately more

likely to be vulnerable and most in need of their welfare benefits. Further, even governments that focus on fiscal savings would not wish to impose harm on genuine beneficiaries, and officials we met in both Andhra Pradesh and Jharkhand were quite sensitive to wanting to avoid genuine exclusion errors. Based on our decade-long field research on the impact of biometric authentication in welfare programs in India, we have five broad recommendations for the way forward.¹⁵

First, it is essential to build in safeguards against exclusion in the cases of authentication failure, including providing options for offline authentication in the local POS machine. Such offline options were likely an important reason as to why we find no evidence of exclusion in our study of the impact of biometric Smartcards on NREGS and Pensions in (unified) Andhra Pradesh. In cases where beneficiaries do not expect to travel outside their assigned PDS shop (and opt to not avail of the portability of benefits), it may even be enough to conduct online authentication only once a year to verify the continued existence of beneficiaries, and allow offline authentication during the year with the dealer being required to upload records of offline authentication on a monthly basis. Finally, the burden of proof on the government for card deletions should be high and should ideally be conducted with a combination of field verification, as well as ABBA records of continuous non-use of a seeded card for at least 12 months in a row.

Second, the larger goal of improving the design and delivery of welfare programs in India will be better served by focusing on using ABBA to improve the beneficiary experience rather than fiscal savings *per se*. Examples of such ABBA-enabled reforms include portability of benefits across the country, and potentially even offering beneficiaries a *choice* between receiving subsidized PDS grains versus a direct transfer of the subsidy amount into their bank accounts. Such reforms can meaningfully empower beneficiaries by giving them additional options for holding dealers accountable and accommodate diversity of preferences better. However, this would not be possible without ABBA, because portability and choice of benefits require a connected technological backend combined with authentication to keep track of where and how benefits have been collected each month. Thus, it would be both politically and ethically prudent to focus on such empowerment instead of fiscal savings *per se*. The fiscal savings will come over time, but putting the beneficiary experience at the center of the design of reforms will provide sounder and more broad-based support for such reforms.

Third, it is essential to implement solutions for real-time measurement of beneficiary experiences to quickly detect problems of exclusion and address them promptly. One promising way of doing this may be to use outbound call

15. The discussion here draws on material and language used by Karthik Muralidharan in this interview in *The Indian Express*: <https://indianexpress.com/article/governance/karthik-muralidharan-to-an-extent-both-supporters-and-critics-of-aadhaar-for-service-delivery-are-correct-6283226/>.

centers to make thousands of short calls each day and directly measure beneficiary experiences in accessing their benefits. We tried this approach recently in Telangana and found that such improved measurement significantly raised the quality of service delivery (Muralidharan et al. 2021b). Regardless of whether such measurement is based on field surveys, phone surveys, or analysis of Management Information Systems (MIS) data, the government should invest in the technical capacity (in-house or through partnerships) to be able to do so.

Fourth, we recommend that representative household surveys like the NSS start including questions about Aadhaar use, in general and, also, regarding specific applications. In addition, given the non-release of NSS data from the 2017–2018 Round, and the risk of relying on a single source of representative data, we also recommend that alternative sources of regular data like the CMIE consumer pyramids survey consider including a few questions on Aadhaar. Of course, space is short in these surveys and choices have to be made; but the ubiquity of Aadhaar use across India and the importance of protecting the vulnerable from being excluded from their legally-entitled benefits makes it essential to track the incidence of exclusion in representative data and use both the aggregate data and case studies of exclusion to design protocols to minimize such risks.

Fifth, and more broadly, navigating the complex issue of trading-off the benefits from improving state capacity for program delivery and the resultant fiscal saving and the costs of the risk of increased exclusion requires more trust between the government and civil society. If critics are seen as wanting to shut down Aadhaar regardless of its benefits (including a meaningful reduction in leakage), the government may tune out legitimate concerns as being “motivated.” Critics need to recognize that reducing corruption and leakage is especially important, given India’s low tax/GDP ratio, and resource constraints make cost-effectiveness in service delivery as much a moral imperative as reducing exclusion. On the other hand, the government is ill-served by simply asserting that all reduction in program spending is leakage reduction, without recognizing the possibility of exclusion, which our data suggest is very real. Publicly acknowledging this concern and making consistent and visible efforts to mitigate exclusion can help bridge a trust deficit. Transparently collecting and reporting data on beneficiary experiences in representative samples, and acting on this data, is an important first step in this process.

More generally, the discussion above highlights that a lot of genuine disagreement regarding policies in India (and around the world) comes from people arguing from different parts of the distribution of outcomes. The same reform can have positive impacts on some and negative impacts on others, and it is impossible to assess the overall impact without understanding the magnitudes of these effects (and how different groups are affected). One promising way to improve public discourse and reduce disagreement is to ask: “What data do we need to narrow down the range of disagreement?” Having visibility into the beneficiary experiences with public programs and policies in a regular and transparent way

can thus play an important role, not just in policymaking but in improving public trust and “public reason” that is so essential to a well-functioning democracy.¹⁶

Finally, we note that the focus of this paper has been limited to the specific case of studying the impacts of integrating Aadhaar into welfare programs. This is by design, since the Aadhaar Act was passed by Parliament as a “money bill,” with the primary justification being that the use of Aadhaar would reduce leakage to the exchequer in the delivery of welfare programs. However, as we document in Section 3, the use cases of Aadhaar have increased dramatically and extend well beyond the delivery of welfare schemes. This increases the importance of additional and ongoing research and evaluations regarding the impacts of Aadhaar use in other use cases. It may also make sense to debate and modify the legislative framework for Aadhaar to reflect both the opportunities and risks from the increased use of Aadhaar in the daily lives of Indian citizens. We hope that the evidence and principles presented in this paper can contribute to this discussion.

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16. The importance of “public reason” for the health of a democracy has been highlighted on multiple occasions by Pratap Bhanu Mehta. See for example this op-ed: <https://indianexpress.com/article/opinion/columns/public-reason-indian-style/>.

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Comments and Discussion*

Chair: **Arvind Subramanian**

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Stuti Khemani

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The paper by Karthik Muralidharan, Paul Niehaus, and Sandip Sukhtankar deals with how to leverage India's remarkable achievement of providing a digital ID to more than one billion people, almost its entire population, to improve welfare programs. I am going to structure my comments around a series of questions about what Aadhaar means for welfare programs and beyond:

1. What is the potential of Aadhaar?
2. How can Aadhaar improve the design of welfare policies?
3. What does Aadhaar teach us about state capacity, which has come to the fore in recent times as critical for sustained economic development?
4. What is the danger of Aadhaar? The constitutional concerns about the Aadhaar Act, as a threat to freedom and privacy of citizens, requires attention.

On the first question: The potential of Aadhaar for inclusive growth is likely to be much larger than the specific application that MNS examine—of targeting beneficiaries of welfare programs. The developers of Aadhaar described it as: *“We answer the question, ‘Who am I?’ And then we expect innovations to be built on top of this... Hopefully in the next 5–10 years there will be a whole ecosystem of apps that will bring more and more benefits to people who don’t have an ID.”* (Nandan Nilekani, Chairman of UIDAI, April 24, 2013). This paper takes up one, rather narrow, application: how Aadhaar can be used to more accurately target welfare benefits to eligible beneficiaries, and save fiscal resources that “leak” to ineligible. However, Aadhaar's potential to enable poor people to participate in economic markets goes well beyond targeted welfare benefits. Lack of a credible ID can create large transactional costs for poor people to engage in economic activity—from accessing financing, healthcare, education, housing, to gainful employment. A broader approach is needed on the policy potential and research

* To preserve the sense of the discussions at the India Policy Forum, these discussants' comments reflect the views expressed at the IPF and do not necessarily take into account revisions to the conference version of the paper in response to these and other comments in preparing the final, revised version published in this volume. The original conference version of the paper is available on NCAER's website at the links provided at the end of this section.

around ID programs like Aadhaar. Future research could address questions like: now that Aadhaar exists, does it help poor people to better navigate migration to urban centers and labor markets; obtain housing; reduce credit constraints; and thus enable long-term investments, such as in their children's education?

On the second question: even within the scope of welfare programs, the focus of the paper on reviewing available research on the use of biometric authentication in existing programs like the PDS and MGNREGS, is too narrow. A policy paper on Aadhaar could say much more about the *design* of public policies, now that the Indian State has achieved the huge outcome of providing a digital ID to its people. For example, Aadhaar has likely made it more feasible to implement a new type of food security policy which could replace the old PDS system—delivering food coupons directly to households (and even within households, targeted to the women of the household, because of research evidence that intra-household bargaining would improve outcomes), which can be used to purchase food at any shop (Basu 2011).

Examining how Aadhaar was used in the Jharkhand PDS, as Aadhaar-Based Biometric Authentication (ABBA), the authors report “*a significant decline in benefits received (of around 10%) for those beneficiaries who had not seeded their Aadhaar numbers into their ration cards. Finally, there was also an increase in transaction costs for beneficiaries in treated areas with a significant increase in the number of unsuccessful trips made to the fair price shop (FPS) for collecting rations.*” MNS use this finding to offer the following policy advice: “*the larger goal of improving the design and delivery of welfare programs in India will be better served by focusing on using ABBA to improve the beneficiary experience rather than fiscal savings per se.*” It seems that this advice could have been offered to the policy-makers in Jharkhand at the outset of the researchers' engagement with the government, using the ideas laid out in Basu (2011), for example. One lesson that seems to emerge from this work in Jharkhand is a meta-lesson about how researchers might more fruitfully engage with policymakers, offering ideas on policy design rather than only seeking to evaluate impact of *any* policy through randomized experimental methodology. Of course, the decision to use economic-theory-based ideas in policy design is the government's, and researchers have no mandate or power to “force” anything. All I am suggesting is that in future engagement, some hypotheses be laid out about *a priori* expectations, given how the government has designed any program, and how these hypotheses would change if the policy design is changed in certain directions. It is within the scope of a policy piece recommending future research on Aadhaar to have some more discussion about how to guide such future research. I am suggesting that much more economic theory and mechanism design needs to be used.

On the third question: The achievement of Aadhaar shows (among other things, such as the successful administration of the largest elections in human history) that the Indian State has tremendous capacity. State capacity has come to

the fore in economics research as the necessary (and even sufficient!) condition for economic prosperity, as illustrated in the following quote attributed to Adam Smith: *“Little else is requisite to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes, and a tolerable administration of justice; all the rest being brought about by the natural course of things”* (Attributed to Adam Smith in Besley and Persson 2011). The “natural course of things”, which would presumably bring “all the rest” appear to be gainful economic exchange and entrepreneurship, which would be supported by a state which protects property rights, creates a level playing field for competition to thrive, and enables trustworthy contracts to be established and enforced.

However, despite its proven capacity to undertake some really difficult tasks, the Indian State appears to regularly fail to deliver basic services like health and education to its poorest citizens. This point is linked to the argument that the critics of Aadhaar make, which is taken up by the authors—the lack of trust in government to serve objectives of fairness and justice in a country with entrenched, debilitating poverty. The critics argue that the Government in India cannot be trusted to serve the poor, and therefore, there is a role for civil society to scrutinize policy initiatives and take action (launch protests, mobilize people, make demands on government) when it appears that policy changes are going to adversely affect poor people. The paper provides a response to these critics by emphasizing the need to build trust in government through more credible empirical research on how benefits can be provided to the poor along with fiscal savings, presumably through more precise targeting and reductions in “leakages.” This response treats too lightly and simplistically the role of trust, where and how it can or should be built, and where lack of trust might play an appropriate role of scrutiny and accountability, to strengthen incentives of governments.

A burgeoning economics literature on institutions is dealing with the concept of “trust” (reviews in Alesina and Giuliano 2015; Algan and Cahuc 2014; Khemani 2020; and application to Bihar in Khemani 2021). On the one hand, trust plays a role in enabling private economic transactions in markets, to which credible identification programs like Aadhaar can contribute. On the other hand, the role of trust in public sector organizations is more complicated. Economic theory suggests that there is a role for trust in professional norms of certain bureaucracies which are tasked with serving the public interest. However, building that trust, when it is missing to start with, requires reducing harmful political interference in the functioning of bureaucracies. The story of how social movements in the United States reduced the influence of “machine politics” and helped establish professional bureaucracies is a case in point (Khemani 2019).

This leads directly to my fourth question: Can the people of India trust a bureaucracy that is tasked with managing Aadhaar to use it in the public interest, and without political manipulation to serve ideological political objectives? The dissenting opinion of Justice D.Y. Chandrachud in Supreme Court decisions of 2021 and 2018 on the constitutionality of the Aadhaar Act focused on issues of

privacy and freedom of citizens because Aadhaar is a technology that can be misused. Questions were raised about whether the Aadhaar Act had been passed without appropriate legislative debate, by being characterized as a “money bill.” These are the larger issues of trust that matter in the context of Aadhaar which future research should address.

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In the public discourse, people talk past each other on Aadhaar—it causes exclusions (on the one hand) versus it makes savings (on the other). It can do both (as seen in Jharkhand) and so it is important to narrow down the disagreements with data (as is being done in Andhra Pradesh). The paper raises both these points. The paper should also play up this aspect of people talking past each other by bringing out these false binaries.

My point of departure is the very significant finding of the paper that Aadhaar should focus on citizen-centricity rather than fiscal savings. Perhaps the paper can unpack this in the following two ways:

- A. Aadhaar as a single sign-on for government-resident interaction:**
A live example of where citizen-centricity is being thought about but cannot be implemented owing to legal issues is in labor. The Supreme Court in the wake of the migrants’ crisis has instructed the government to set up a National Database of Unorganized Workers. No such centralized database exists. Now the Ministry of Labor has two options—first, do a fresh data

collection exercise which is both onerous and time-consuming for citizens; get the data from another database with significant overlap, adopt simple secondary eligibility criteria if necessary, and populate the database. But at this time, it cannot do the latter because sharing of Aadhaar numbers across databases is not permissible except for purposes originally indicated to the user. This is a major problem and defeats the purpose of Aadhaar to provide ease of access for residents in obtaining subsidies. If citizen-centricity is to be central and has to be complementary to savings, then every citizen should have to provide his basic demographic and biometric information to the government once and using Aadhaar as the common identifier one department should be able to migrate the information. This should only be for government welfare schemes based on individual consent. Although tangential to the argument of the paper, the authors may like to look into it.

- B. **Consensual use of Aadhaar:** The paper makes a very important recommendation that the use of Aadhaar should be consent-based with alternate offline options provided. This is critical because exclusion errors (at least of the biometric mismatch variety) are not a consequence of using Aadhaar but using Aadhaar exclusively. In fact, as long as it is voluntary, whether the use is by a government or a private sector body should not matter. In the Supreme Court, the main cleavage seemed to be that Aadhaar is allowed for public sector use but is not allowed for private sector use unless it is backed by law. There was an implicit understanding that private sector use meant commercialization. I think this paper's recommendation of consensual use with alternate options should be the main determinant of future uses and not whether use is by the private or the public sector. The paper should incorporate a richer discussion of the Supreme Court case only in this context (and not in the context of privacy as the other discussant had mentioned), as that is something which is quite extensively written on.

Overall, I think this paper makes an inordinately valuable addition to the literature on the subject. I commend the authors wholeheartedly.

General Discussion

The chair, Arvind Subramanian, praised the comments by the discussants and opened the General Discussion by reading out a question from Sandhya Garg, about the last mile challenge: "How easy was it for people to withdraw money using smart cards or Aadhaar-based systems?"

Devesh Kapur suggested exploring the one other pan-India identification, the Voter ID. It is a valid government ID though only individuals above the age of

18 years are eligible to get it. However, it might still be useful for the authors to look at that ID and the problems of exclusion and inclusion relating to the most long-standing national ID system in India since Independence. He cited reasons as to why that cannot be used as a fallback option when there are problems of authentication of Aadhaar, because after all, it is a government ID, and it is ostensibly quite universal. There is an issue that voter IDs are location-specific. But now that the PDS, which was also location-specific, will be replaced with the “One Nation One Ration Card” scheme, that is likely to change. Additionally, the Election Commission has now begun to shift from a paper-based voter ID to an electronic voter ID, which can be downloaded on one’s phone.

Responding to the Discussants’ comments, Sandip Sukhtankar clarified that the authors had never forced governments to implement a scheme or a program that they are not planning on doing. In fact, in every single case, the government had already taken a decision on what to do and how they were going to do it, and the authors simply persuaded the officials to roll it out in a randomized fashion.

Regarding the questions on the last mile challenge, and payments through smart cards, Sandip Sukhtankar thought that the smart cards did well to enable making of the payments in cash at the village level. This was also one of the reasons why transactions costs had gone down and people found it easier to collect their payments. He said that it is a fantastic idea to think about using the voter ID as a fallback but raised concerns about the veracity of the database. He hypothesized that the problems may not be of exclusion, but instead of inclusion.

Arghya Sengupta expressed the need for an Aadhaar 2.0 legislation. He asserted that the experience of the last five years, in terms of what has worked and what has not, will help design the new legislation. The Aadhaar needs to have some of the features that the paper pointed out, such as consensual use and fallback options. There is also a need to facilitate private sector use and to ensure privacy protections. Such an Aadhaar 2.0 legislation can become a firmer backbone given the fact that Aadhaar is here to stay.

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