Digital Technology and Social Protection: Promises and Pitfalls

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October 28, 2025

BREAD-IGC Online Course on Social Protection

Motivation

- Digital technology is ubiquitous – we are using it right now :)

- Growth has exploded in the last two decades; "digital public infrastructure" can transform delivery of social protection programs
  - World Bank claims "transformational potential in today's digital age can be likened to the way roads, railways, and other physical infrastructure fueled economic transformation in previous centuries"

- Governments in developing nations face non-trivial hurdles in transferring benefits to vulnerable populations across remote locations
  - Identifying vulnerable populations is difficult; transfers may "leak"; last-mile hurdles abound

Promises and pitfalls

- Digital technology could help resolve these hurdles: one could potentially send electronic transfers to automatically targeted and digitally verified beneficiary at the touch of a button!
- But beneficiaries–especially most vulnerable–might get excluded; and costs might outweigh benefits
- The truth can only be determined by representative data and rigorous research
  - Research that isolates causal impact of technology is surprisingly limited (only 10 papers!)
- We will go through details of existing evidence on potential benefits and costs, with specific examples

Roadmap

Definitions

- "Social protection" refers to "redistributive programs, which seek to assist the poor, and social insurance programs, which aim to insure against shocks" (Banerjee et al 2023)

- Will only consider the following digital technologies: mobile phones, mobile money, digital payment systems, digital identification (IDs), and digital data
  - Given their prevalence in the developing world & potential in social protection
  - Others are too broad ("the internet") or too specific (custom apps) or not enough evidence yet (Gen AI)
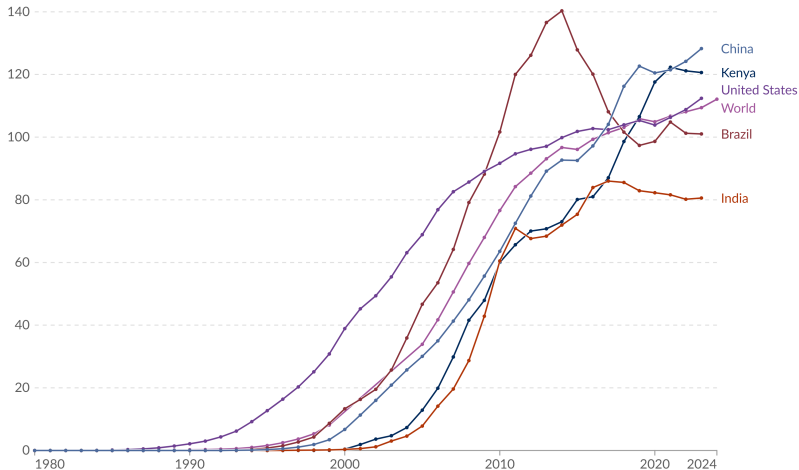
Adoption and use around the world

- **Phones**: 11.9 billion cellular connections, 5.6 billion unique mobile phone subscribers; $> 70\%$ population with mobiles; smartphones dominate (GSMA 2023 data)

Mobile phone subscribers

Mobile phone subscriptions per 100 people, 1980 to 2024

This number can get over 100 when the average person has more than one subscription to a mobile service.

Data source: International Telecommunication Union (ITU), via World Bank (2025)

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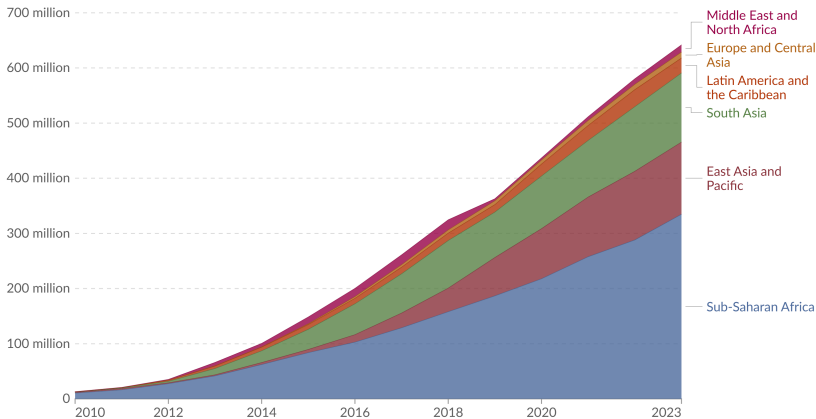
Adoption and use around the world

- **Phones**: $> 70\%$ population with mobile; smartphones dominate
- **Mobile money**: 1.35 billion accounts; $>\$1$ trillion transactions (Suri et al., 2023)

Mobile money usage

Active mobile money accounts

Mobile money accounts are financial accounts managed via mobile devices. They offer services like deposits, transfers, and payments, mainly in regions with limited banking access.

Middle East and North Africa
Europe and Central Asia
Latin America and the Caribbean
South Asia
East Asia and Pacific
Sub-Saharan Africa

Data source: GSM Association (2024) OurWorldinData.org/technological-change | CC BY

Note: Accounts are considered active when they have been used to perform at least one mobile money payment during the last 90 days of each year. North America is not shown because mobile money accounts are not used across this region.

Adoption and use around the world

- **Phones**: $> 70\%$ population with mobile; smartphones dominate
- **Mobile money**: 1.35B accounts; $>\$1T$ transactions
- **Digital payments**: 62% of beneficiaries got a digital payment in 66 developing countries
- **Digital IDs**: 161 countries have some form of digital ID system; India $>1B$ IDs
- **Digital data**: Unquantifiable explosion, especially given AI

Adoption in social protection

- Surprisingly low for mobile money transfers: only 20% of those who received a government transfer, only 4% of respondents overall, received a mobile money transfer from a government (WB Findex survey 2021)

Mobile money transfers
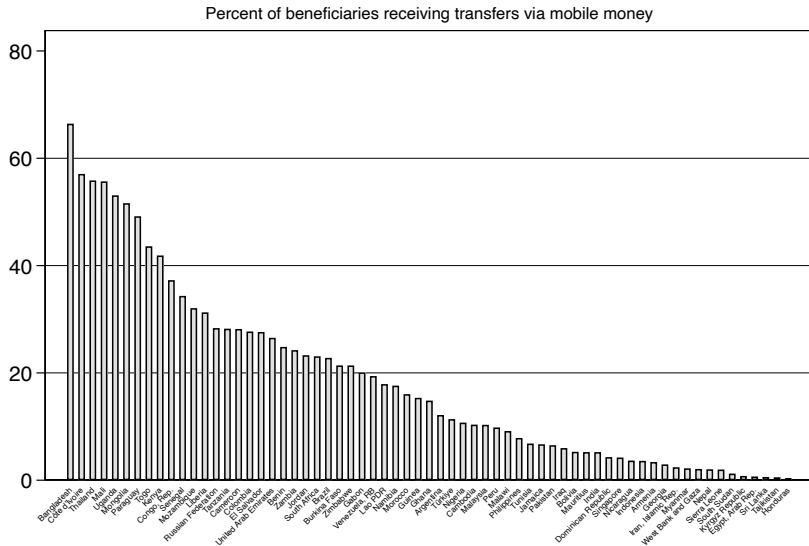
Percent of beneficiaries receiving transfers via mobile money

Adoption in social protection

- Surprisingly low for mobile money transfers: only 20% of those who received a government transfer, only 4% of respondents overall, received a mobile money transfer from a government (WB Findex survey 2021)
- Higher for digital payments: 54% of those receiving government transfers had them deposited into a bank account
- COVID-19 accelerated adoption: 80% of developing countries used digital payments in relief
- And even since I wrote original paper, big increases (e.g. cash transfers to women in India)

Roadmap

Four pathways to better delivery

Digital tools can improve every stage of program delivery

1. Identify and enroll beneficiaries
2. Transfer benefits securely and quickly
3. Redesign programs (choice, conditionality, anticipatory aid)
4. Harness spillovers (savings, empowerment, GE effects)

1. Identifying and Enrolling Beneficiaries

- Data-driven targeting can improve accuracy, timeliness, and coverage

- Examples:
    - **Togo:** Machine learning on phone metadata to target COVID aid (Aiken et al., 2022)
    - **Indonesia:** Unified registry improved targeting by 117% (Tohari et al., 2019)

- Integration across databases can enable basic income or conditional transfers (Barca, 2017; Pereira Guimaraes Leite et al., 2017).

Case study: Cash transfers in Togo

- **Context & program**
  - No recent social registry; lockdowns spurred rural expansion
  - Registration & payments fully digital
- **Targeting approach**
  - Step 1: Use satellite-derived poverty maps to pick the 100 poorest cantons
  - Step 2: Train ML on mobile phone metadata to score subscriber poverty; prioritize the poorest within those cantons
- **Data for training/evaluation**
  - National field survey in 2018–2019 (n=6,171)
  - Phone survey in 2020 (n=8,915)

How did technology perform in Togo?

- **Performance vs. alternatives**
  - Compared to feasible geography-based targeting, ML+phone data reduced exclusion errors by ∼4–21% (higher precision/recall)
  - Compared to a hypothetical, perfectly calibrated PMT (requiring a full social registry), ML increased exclusion errors by ∼9–35%
  - Welfare: with a fixed budget ($4M) and equal transfer size, ML-based targeting weakly dominates geography in the rural context
- **Fairness & exclusion**
  - No systematic under-targeting of women or major ethnic groups; largest parity gaps under geographic methods
  - Main exclusion channels: phone access/usage, voter ID, awareness, digital literacy, and algorithmic recall (∼47% in rural setting)
  - Temporal decay: using models/data ∼18 months old reduced accuracy by 4–6% and precision by 10–14%
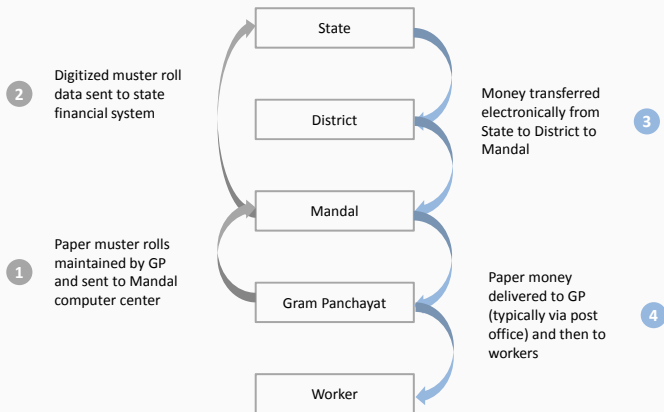
2. Transferring Benefits

- Direct digital payments can reduce leakage and administrative cost
- Examples
  - **India workfare program:** Biometric Smartcards cut leakage by 41% (Muralidharan et al., 2016)
  - **Public food program:** Authentication cut diversion under strict protocols (Muralidharan et al., 2025)
  - **India DBT for fuel:** DBT for cooking gas cylinder subsidy reduced leakage (Barnwal, 2019)
  - **Niger:** Mobile transfers saved 2.5 days in delivery time (Aker and Wilson, 2013)
- Phone-based monitoring improved timeliness of transfers (Muralidharan et al., 2021)
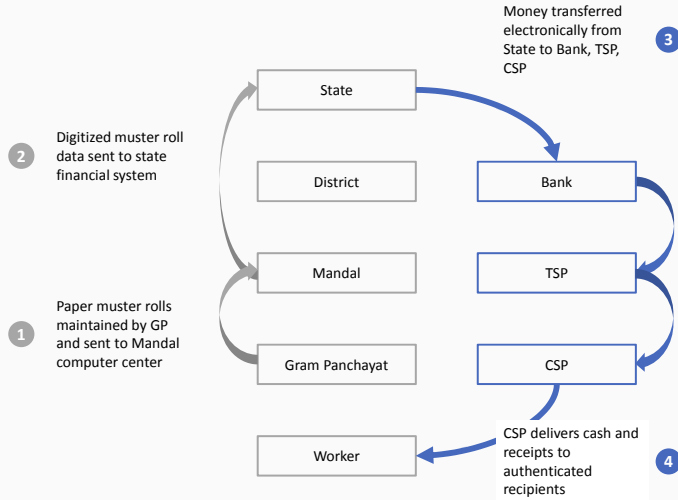
Case study: Smartcards program in India

- Smartcards program: biometrically-authenticated cash outs of electronic benefit transfers to beneficiaries of a workfare program

- Randomized roll-out of program across 157 subdistricts (pop $\sim 19M$)

- As-is, at-scale experiment with representative data from multiple sources (administrative, survey)

Status quo payments

State

District

Mandal

Gram Panchayat

Worker

2 Digitized muster roll data sent to state financial system

1 Paper muster rolls maintained by GP and sent to Mandal computer center

3 Money transferred electronically from State to District to Mandal

4 Paper money delivered to GP (typically via post office) and then to workers

Money transferred electronically from State to Bank, TSP, CSP **3**

State

Digitized muster roll data sent to state financial system **2**

District

Bank

Mandal

TSP

Paper muster rolls maintained by GP and sent to Mandal computer center **1**

Gram Panchayat

CSP

Worker

CSP delivers cash and receipts to authenticated recipients **4**

Main takeaways

- Smartcards significantly improved program implementation
  - Less leakage, more work done, more access to work, easier and faster payments
  - Improvements spread across distribution, and $> 93\%$ prefer Smartcards over status quo
  - Time savings alone justified program costs

- Yet Chief Secretary was about to abandon program
  - Value of representative data

- Almost no one was hurt: importance of fallback mechanisms

3. Redesigning Programs

- Can enable flexible, beneficiary-centric design

- **Examples**
    - Cash or in-kind choice improves welfare (Muralidharan et al., 2018)
    - Predictive flood aid in Bangladesh enabled anticipatory transfers (Pople et al., 2021)
    - Electricity subsidy reform using digital meters and transfers (Mitra et al., 2023)

Case Study: Predictive flood aid in Bangladesh

Context and Design

- **Setting:** 2020 monsoon floods in Bangladesh affected over 5.5 million people
- **Objective:** Test whether pre-disaster ("anticipatory") cash transfers can mitigate humanitarian losses
- **Intervention:** World Food Programme sent BDT 4,500 (US$53) via mobile money to 23,000 vulnerable households *before* peak flooding
- Transfers arrived roughly **100 days earlier** than conventional relief

Identification and Data

- Implementation constraints (COVID-19, telecom limits) created quasi-experimental treatment variation
- Survey of ~9,000 households across 111 unions, 10–12 weeks after floods
- Outcomes measured: food security, asset loss, borrowing, well-being, and earning potential

Anticipatory Cash Transfers: Results and Policy Implications

Key Findings

- **Improved welfare:** Increased adult and child food consumption; 36% reduction in likelihood of skipping meals
- **Reduced losses:** Lower asset loss and reliance on high-interest borrowing; higher self-assessed earning potential
- **Timing matters:** Each day earlier receipt increased welfare gains; benefits diminished when transfers arrived >12 days post-peak flood
- Benefits were realized before any traditional humanitarian response began

Policy Implications

- Anticipatory action can reduce humanitarian suffering in forecastable shocks
- Requires pre-arranged finance, reliable early-warning systems, and digital payment infrastructure
- Demonstrates feasibility of scaling forecast-based financing for climate adaptation

4. Spillovers and Broader Impacts

- Digital inclusion can drive financial security and empowerment; spur spillovers

- **Examples**
  - Direct deposits increased savings and consumption smoothing (Brune et al., 2017)
  - Women's direct access to wages raised empowerment (Field et al., 2021)
  - Systemic improvements raised private wages and cut poverty (Muralidharan et al., 2023; Egger et al., 2022)

Case Study: Empowering women in India

Context and Motivation

- Gender norms—especially male stigma around wives' work—restrict women's employment opportunities
- Study tests whether increasing women's *control over earnings* can relax norm-based constraints

Experimental Design

- Randomized Controlled Trial in 197 Gram Panchayats (rural Madhya Pradesh)
- 5 treatment arms varying combinations of
    1. Individual bank account for women
    2. Direct deposit of workfare wages into her account
    3. Training on account use
- Key comparison: "Accounts only" vs. "Direct Deposit + Training" (D2T)
- Sample: $\sim$4,500 women; follow-up after 1 and 3 years

Impacts on Labor Supply, Empowerment, and Gender Norms

Main Results

- D2T increased women's labor supply by **0.11 SD overall**, with gains in both public and private sectors
- Effects strongest among "constrained" women—those not previously working (0.21 SD overall; 0.29 SD private sector)
- No equivalent increase for "unconstrained" women; effects persisted for constrained women three years later
- Gains in bank account use (+0.15 SD) and banking autonomy (+0.12 SD)

Norms and Longer-Run Effects

- D2T liberalized women's own gender norms (+0.10 SD) and perceived community norms (+0.08 SD)
- Men's perceived norms became more accepting of wives' work (+0.09 SD)
- Suggests economic empowerment can gradually shift social norms even without explicit norm-targeting

Roadmap

Potential Pitfalls

1. Exclusion of the most vulnerable
2. Increased transaction costs
3. Weak data protection and legal safeguards

1. Exclusion Risks

- Vulnerable groups often lack access to digital IDs or phones (Totapally et al., 2019)
- **India:** 2.5% of respondents excluded due to Aadhaar issues (Abraham et al., 2017)
- Aadhaar-linked reforms temporarily excluded 300,000 beneficiaries from food program (Muralidharan et al., 2025)
- Measuring exclusion requires costly field verification

Case study: Food aid exclusion in India

- India's "Aadhaar" is world's largest biometric ID rollout, with ID #s issued to 1.42 billion people (98% of population) as of Sep 2025
    - A "game changer for governance" (Chidambaram, 2013) according to proponents, or a step that "undermines the right to life" (Khera, 2017) according to critics

- We (Muralidharan et al., 2025) examine its use to authenticate beneficiaries in India's subsidized food aid system (PDS)
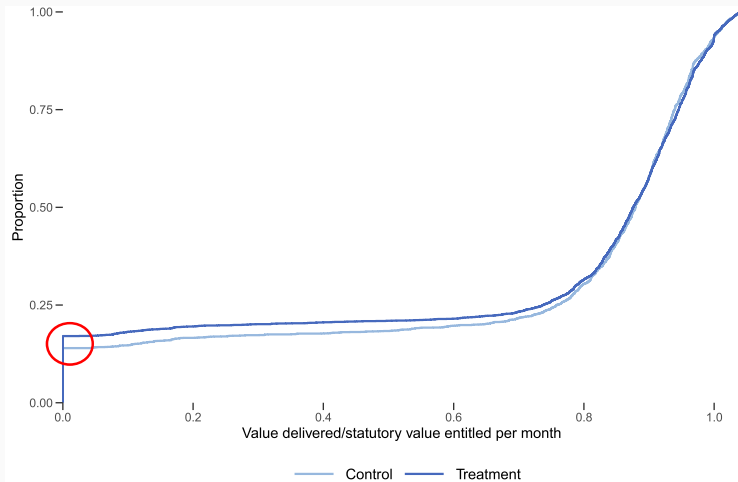   - Similar as-is, at scale evaluation
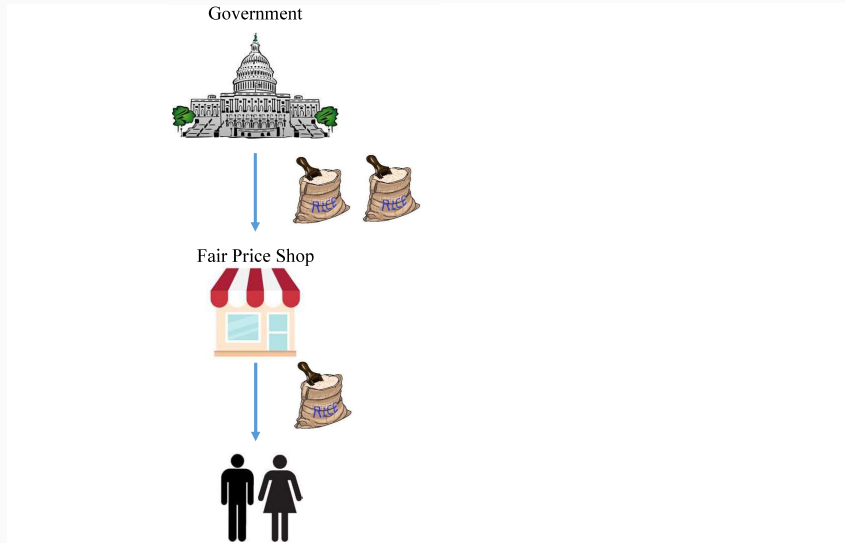
Aadhaar-based Biometric Authentication (ABBA)

Government

Fair Price Shop

fingerprint
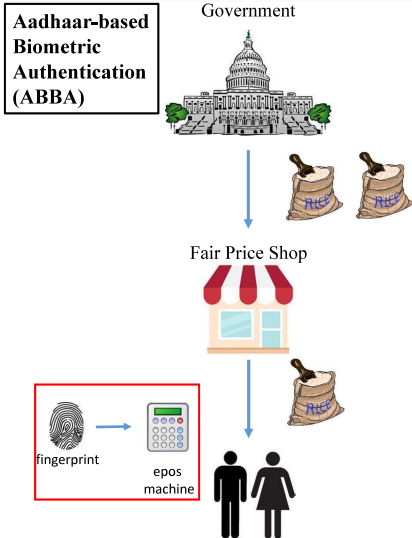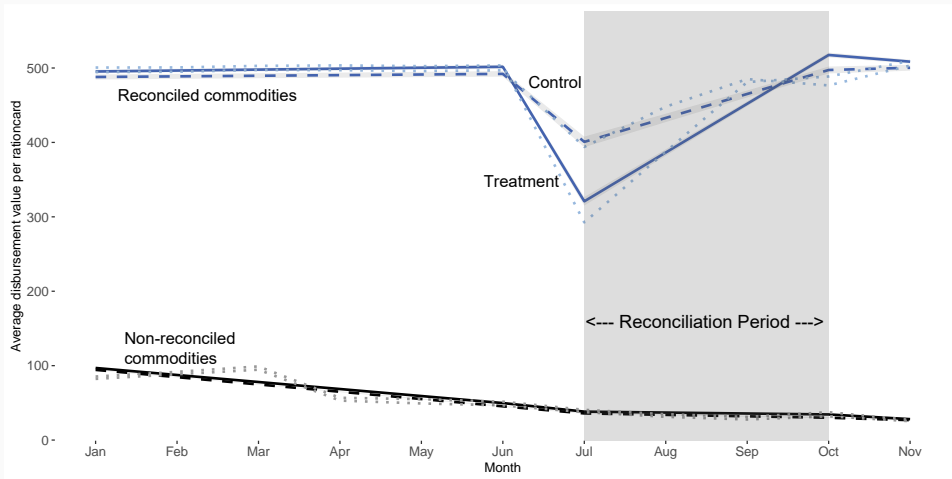
epos machine

Figure 1: Value received

Using electronic data to adjust distribution
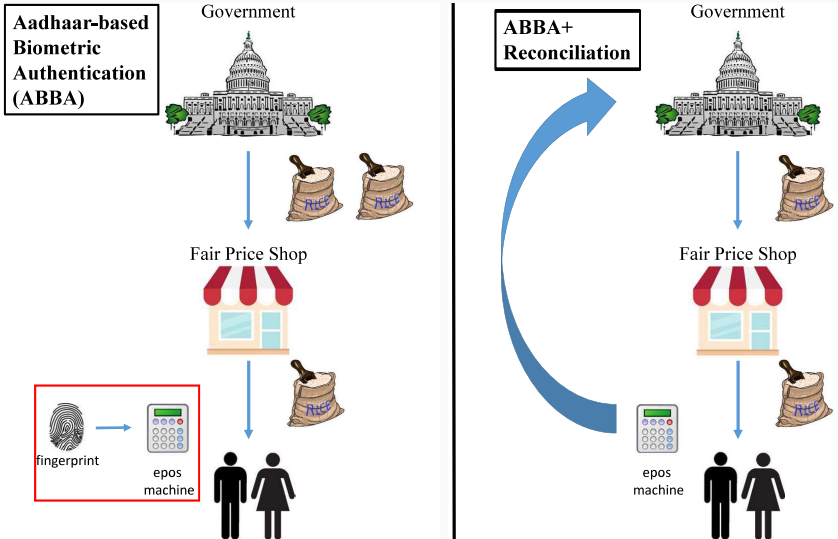
ABBA+: disbursals drop; big tradeoffs between value received and leakage

Figure 2: Value disbursed

Key takeaways

- **Stricter ID can trade off errors of inclusion and exclusion** in welfare programs
  - Evidence on how transaction costs affect incidence of welfare benefits

- **"Shadow costs" of controlling corruption** may be higher than direct costs

- Impact of **"technology"** depends far less on "context" than on **policy choices and program design**
  - Contrast to use of Smartcards in AP, which focused on beneficiary experience rather than fiscal savings

2. Transaction Costs

- Tech errors and authentication failures increase effort for users

- India: costs rose 17% after biometric authentication (Muralidharan et al., 2025)

- Afghanistan: mobile salary transfers delayed payments due to agent cash shortages (Blumenstock et al., 2015)

Case Study: Increased transactions costs in Afghanistan

Context and Motivation

- Afghanistan has 17M mobile subscribers but weak financial infrastructure; less than 5% of the population uses formal banking
- Mobile money (M-Paisa) introduced to improve payment security, transparency, and cost efficiency
- Study evaluates a large NGO's transition from **cash to mobile salary payments** using an RCT

Experimental Design

- Sample: 341 employees across 7 provinces (2012–2013)
- Random assignment
  1. **Treatment:** Receive salary via M-Paisa mobile money
  2. **Control:** Continue to receive salary in cash
- Both groups received phones, SIMs, and training
- Data: monthly phone surveys, administrative payroll data, and full transaction

Impacts on Firms, Employees, and Lessons Learned

Key Findings
- **Cost savings for firm:** Salary disbursement costs fell by $\sim$50% (US\$14.6 $\rightarrow$ US\$7.3 per employee-month)
- **Increased usage:** Treated employees more likely to use mobile money—especially airtime purchases and savings (+Afs 1,579 monthly balance)
- **Limited welfare effects:** No measurable changes in total savings, consumption, or well-being indicators
- **Delays and frictions:** 10% of mobile payments delayed early on (mostly due to agent cash liquidity)

Interpretation and Policy Implications
- Efficiency gains accrued mainly to **employers and operators**, not employees
- Agent liquidity, user literacy, and network coverage are critical for scale-up
- Highlights a broader pattern: digital systems can enhance transparency and cut leakage but may shift costs to beneficiaries in fragile settings

3. Data Privacy and Legal Gaps

- Only 48% of least developed countries have data protection laws (UNCTAD 2023)

- And even in countries that do, how they are implemented is critical
  - India's 2023 Data Protection Act imposes obligations but grants government exemptions

- Weak enforcement and limited technical capacity threaten accountability

Roadmap

1. Match technology choice to program objective

Policy Priorities

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2. Prioritize inclusion and offline fallback mechanisms

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5. Encourage replication studies to generalize evidence

- How to use AI for eligibility, fraud, and early warning *without* amplifying bias

- GE and network effects of digital public infrastructure

- Scalable designs for choice (cash vs in-kind) and anticipatory aid

- Replication across contexts: coordinated multi-country research

Conclusion

- Digital technology holds transformative promise for social protection

- But design matters: protocols, inclusion, and accountability determine outcomes

- Implementation is outpacing rigorous research; urgent need for replication and cross-country coordination

Thank you!

Email srs8yk@virginia.edu for questions/comments

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