# Innovation, Experimentation, and Economics

Michael Kremer

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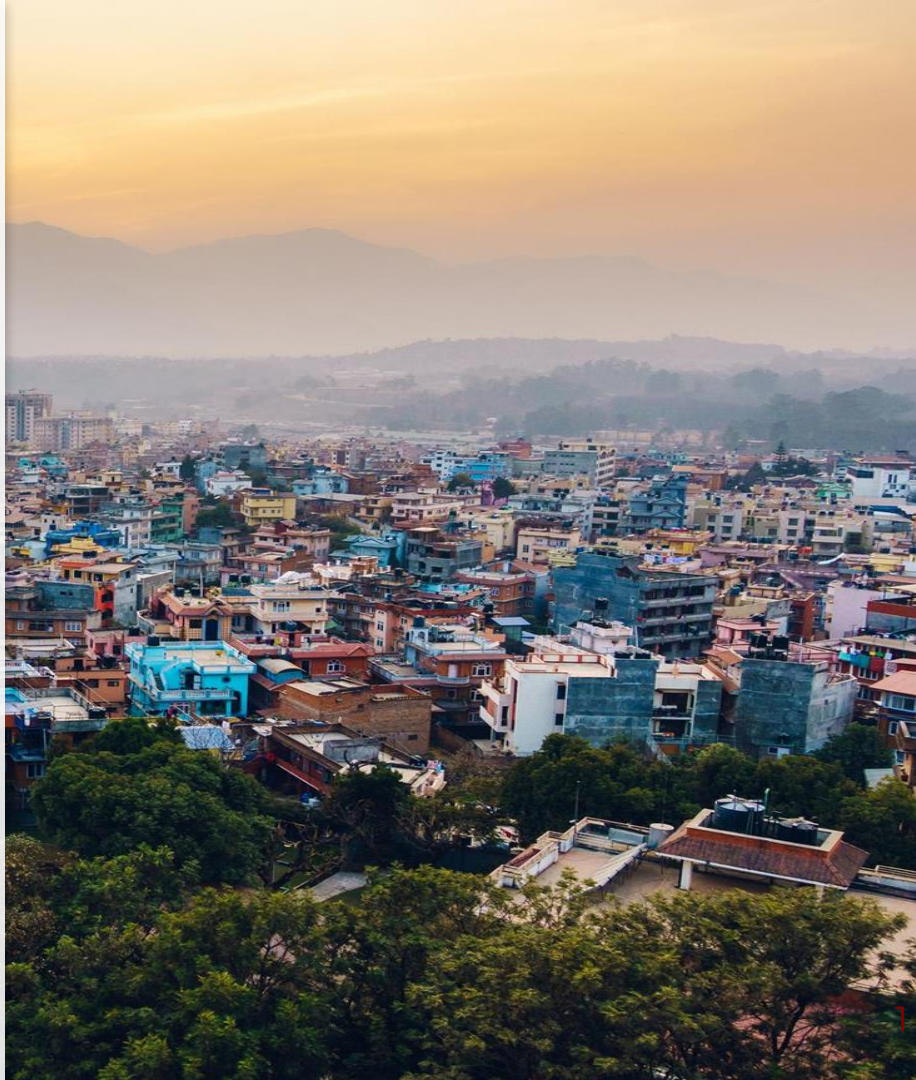


# The experimental method in development economics

Features of the experimental approach:

1. Causality
2. Rich context
3. Specific, practical problems
4. Collaborative
5. Iterative

**Science**

**Policy**

**Innovation**

# Example: Digital delivery of weather information to farmers

- Farmers in low- and middle-income countries are increasingly vulnerable to weather uncertainty due to climate change
- New technology allows more accurate and timely weather forecasts (e.g., monsoon onset)
- Evidence from RCTs that farmers change behavior in response to weather information; share info; response to behavioral framing; impact of message repetition.
- Estimated gains for one type of forecast in India alone are in the billions of dollars.

# Evidence on an Interactive Voice Response System

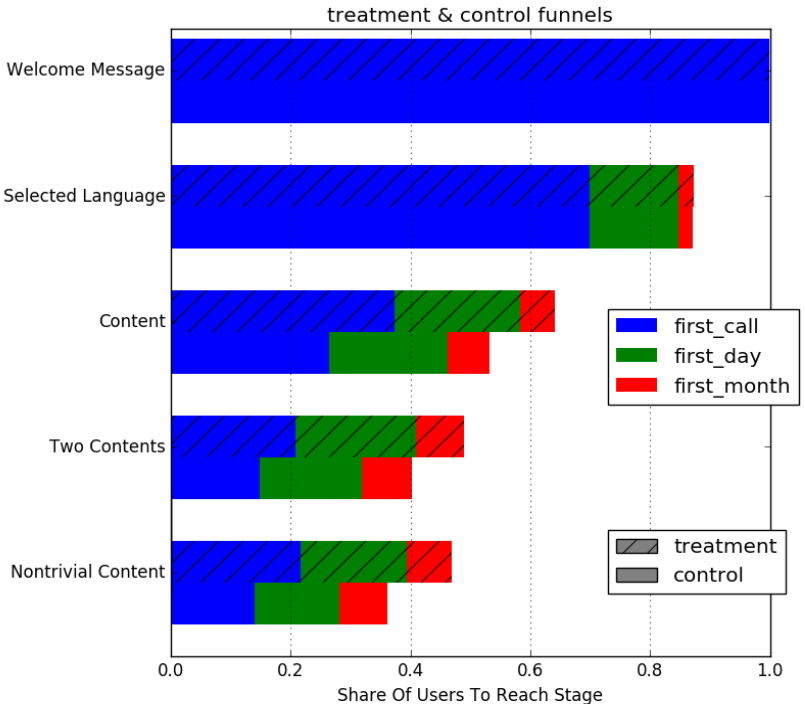
- IVR system accessed by 3.1 million farmers
- 600,000 new callers per year
- Usage is low, attrition is high and user experience is relatively poor
- System is complex, covers 21 crops in multiple languages



Source: Walter, Kremer, Reich, un, Herwaardenk, Yesigat

# Feedback loop through focus groups, funnel analysis, A/B testing

- Increases share of users accessing content from 52% to 63%
- Similar patterns in other contexts




Source: Walter, Kremer, Reich, Sun, Herwaardenk, Yesigat

# Development Innovation Ventures (DIV)

We examine the experience of USAID's Development Innovation Ventures (DIV):

First describe the model, then address three related questions

- Is development innovation a good investment?
- Which innovations scale?

Speculation on reasons for empirical patterns in data, implications for structuring funding

Disclosure, I am Scientific Director of DIV, and was involved in developing some of these innovations

Considerable evidence on return to investing in R&D based on natural sciences, less evidence on

- Impact investing/social entrepreneurship
- Social science innovation experiments

Michael Kremer, Sasha Gallant, Olga Rostapshova, Milan Thomas. Work in progress.

# Development Innovation Ventures (DIV) at USAID

Open grant funding to support innovation in international development

- Across sources of innovation, sectors, geographies, scaling approaches
- Broad definition of innovation

Tiered funding based on rigorous evidence

- Stage 1: Piloting
- Stage 2: Testing
- Stage 3: Transitioning to scale

# DIV selection and investment process

- Procurement rules and small staff limited solicitation and co-creation during 2010-2 period
  - Private and social investors try to add value through technical support, linkages.
- Peer review based on application, engagement with development economics researchers
  - Staff input, but no investment memo process, advocacy role
- Potential for scale assessment
  - Emphasis on cost
  - Flexibility on team composition
  - For innovations designed to scale through public sector no requirement for matching funds or separate “implementer” and “evaluator”

# Early portfolio: 43 awards to 41 innovations

| Award title | Organization | Countries | Stage |
|---|---|---|---|
| Affordable Glasses for Presbyopia | For-profit | India | 2 |
| Developing a Supply Chain for Hermetic Storage of Grain | Academic | Afghanistan | 1 |
| Developing Affordable Postpartum Hemorrhage Tamponade | Non-profit | Ghana | 1 |
| Developing a Sustainable Distribution Model for Cook Stoves | Non-profit | Ethiopia, Sudan | 2 |
| Developing Sustainable Sanitation in Urban Slums | For-profit | Kenya | 1 |
| Digital Attendance Monitoring | Non-profit | India | 2 |
| Election Monitoring Technology | Academic | Afghanistan | 1 |
| Electricity for Sub-Saharan Africa: EGG-energy's Solar Hubs | For-profit | Tanzania | 1 |
| Evaluating the Impact of Mobile Banking and Business Skills | Academic | Mozambique | 2 |
| Examining Barriers to Fertilizer Use | Academic | Kenya | 1 |
| Experimental Evidence of the Components of Entrepreneurship | Academic | Uganda | 1 |
| Fighting Tuberculosis through Community Based Counselors | Non-profit | India | 1 |
| Ghana National Apprenticeship Program Impact Evaluation | Academic | Ghana | 2 |
| Home Solar Systems | For-profit | Uganda | 2 |
| Household Hand-Washing Device-Commercial Development | Non-profit | Vietnam | 1 |

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| Award title | Organization | Countries | Stage |
|---|---|---|---|
| Improving Health Service Delivery Through Community Monitoring | Academic | Sierra Leone | 2 |
| Improving Patient Safety in Pakistan's hospitals | Non-profit | Pakistan | 1 |
| Increased Uptake and the Use of Safe Water Filters at Scale | Non-profit | Kenya | 1 |
| InSight: Mobile Accounting and Financial Inclusion | For-profit | India | 1 |
| Inventory Credit: Combining Storage and Savings To Increase Income | Academic | Sierra Leone | 2 |
| Leveraging Public-Private Partnerships for the Environment | Non-profit | India | 2 |
| Milele Tube Final Testing and Marketing Introduction | Non-profit | Kenya | 1 |
| Mobile Agriculture Extension | Academic | Kenya | 1 |
| Proteinuria Self-Test For Early Detection of Pre-Eclampsia | For-profit | Nepal | 1 |
| Psychometric Credit Assessment | Academic | Egypt | 2 |
| Recruiting and Compensating Community Health Workers | Academic | Zambia | 1 |
| Remittances for Educational Finance | Academic | Philippines | 1 |
| Renewable Powered Micro Grids for Rural Lighting | For-profit | India | 2 |

# Early portfolio: 43 awards to 41 innovations

| Award title | Organization | Countries | Stage |
|---|---|---|---|
| Road Safety Stickers | Academic | Kenya | 2 |
| Rural Solar Accessibility via Cooperative Society Retails | Non-profit | Uganda | 1 |
| Scaling Biochar: Improving Livelihoods and Sequestering Carbon | Academic | Kenya | 1 |
| SiGNa Chemistry, Inc. | For-profit | U.S. | 1 |
| Smoothing the Costs of Education: Microsavings in Schools | Academic | Uganda | 2 |
| Software for Community Health Workers | For-profit | India | 1 |
| Software for Community Health Workers | For-profit | India | 2 |
| Testing a Digital Platform's Ability to Recreate Rural CLTS | Non-profit | Ghana | 1 |
| The Role of Mobile Banking in Business Development | Academic | Kenya | 2 |
| Turning the Tap Off on Drug Resistant TB | Non-profit | India, Cambodia | 2 |
| Viability of Cyanobacterial Bio-fertilizer to Improve Crop Yields | For-profit | Ethiopia | 1 |
| Voter Report Cards | Non-profit | India | 1 |
| Voter Report Cards | Non-profit | India | 2 |
| Water Treatment Dispensers | Academic | East Africa | 3 |
| Women's Network to Improve Clean Energy | Non-profit | East Africa | 2 |

# Methodology for assessing whether benefits exceed costs

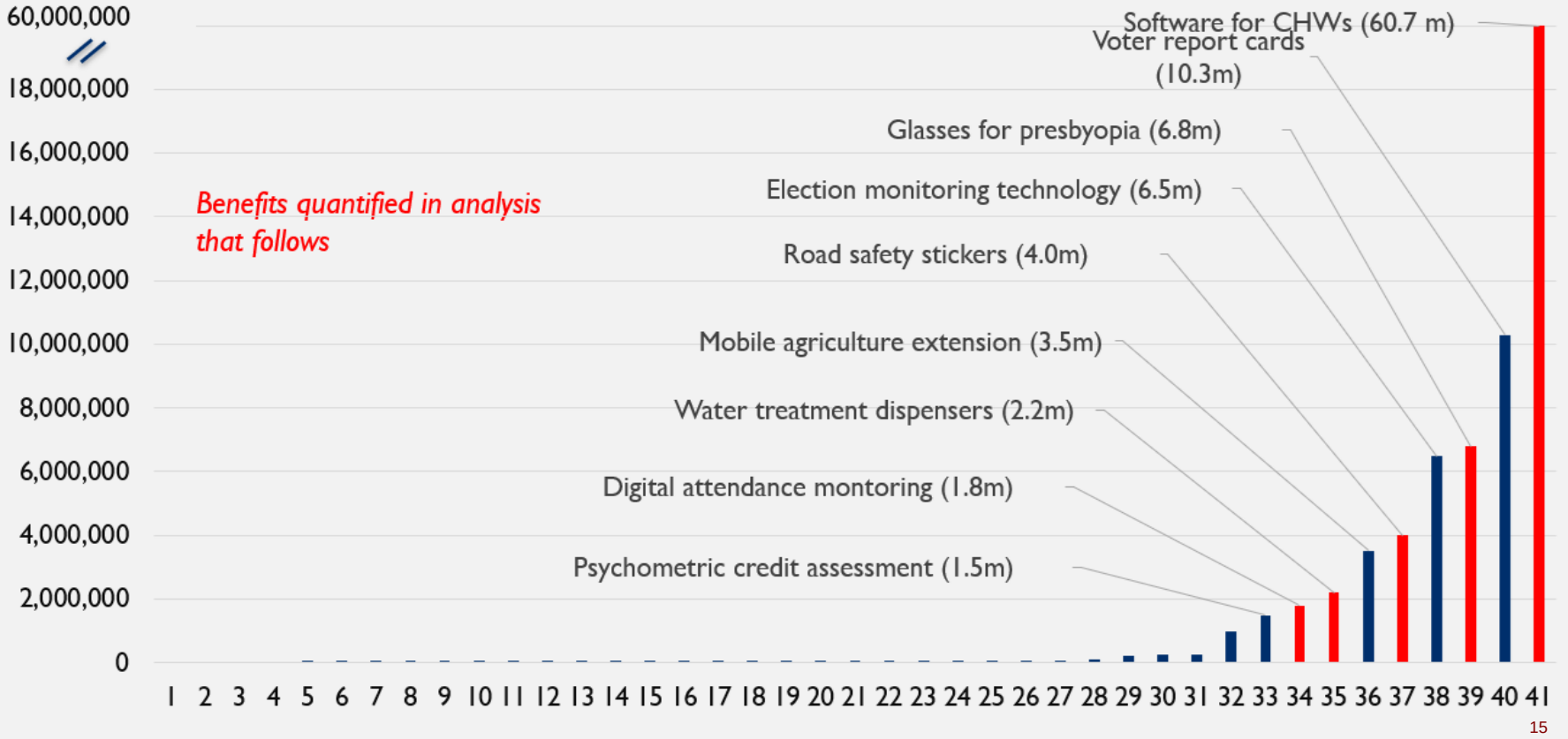
- Are discounted benefits of innovation investment > cost?
- Benefits = number of people reached x net benefits per person
- Include only share of benefits corresponding to share of innovation investment
  - **Avoids double-counting in computing sector-wide returns**
  - **Does not get at counterfactual**

# Difficulties estimating benefits

- Conceptual issues
- Data limitations (absence of credible impact assessment on form of innovation which scaled)
- Innovations often take time to scale; future unknown

- "Bounding" approach can determine whether development innovation is a good investment.
  - **Take advantage of skewed distribution of innovation scale**
  - **Compare benefits of a subset of high-scale innovations to cost of full portfolio**
  - **Use conservative assumptions**
  - **Can't compare bounds**

# Number of direct beneficiaries as of May 2020



# Example: Affordable glasses for presbyopia

- $430,000 innovation investment by DIV
- Tea-picker productivity improved by 22% (Reddy et al. 2018). Assume 11% gain.
- 6.8 million glasses distributed in 43 countries
- DIV innovation investment share = 5%
- $31.8 million in net benefits generated by DIV investment.

# Road safety stickers in minibuses (Kenya)


- $207,000 innovation investment by DIV
- Road accidents fell by 25% (Habyarimana and Jack 2015).
- Scaled to >40,000 minibuses
- DIV innovation investment share = 28%
- $2.6 million in net benefits generated by DIV investment.

J Habyarimana, W Jack (2015) Proceedings of the National Academy of Science

# Discounted benefits of five projects/cost of portfolio

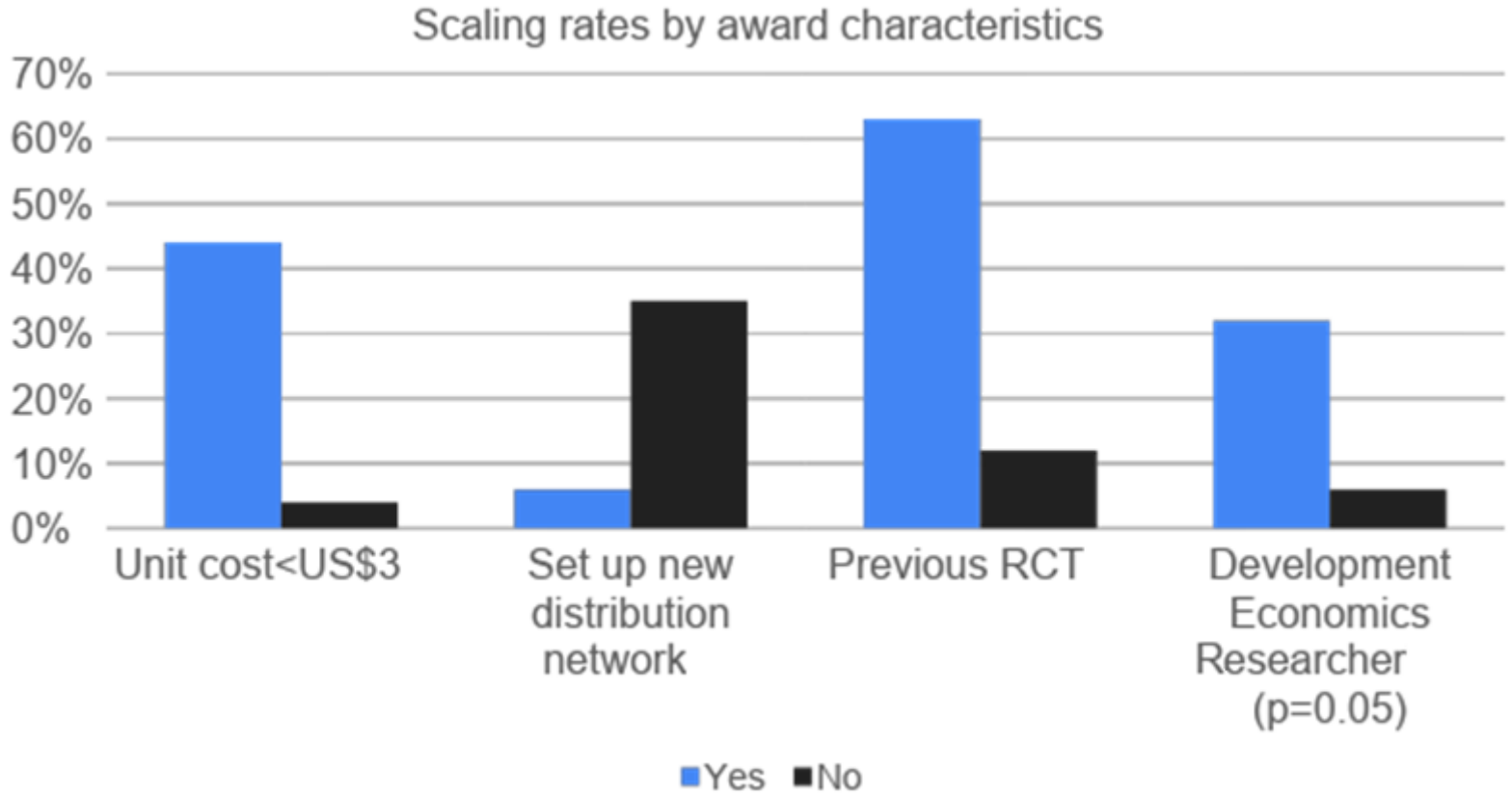
- Cost of portfolio (including administration) in 2010 USD: $16 million
- Net discounted benefits of five investments through 2019: $281million
- Lower bound on benefit cost ratio: 17

# Rate of scaling by award stage

| Award Stage | # of awards | % that reached >1m | Awards value (millions) | People reached (millions) | People reached per dollar |
|---|---|---|---|---|---|
| Stage 1, pilot (<$100k) | 24 | 17% | $2.4 | 19.9 | 8.3 |
| Stage 2, test (<$1m) | 18 | 25% | $9.6 | 77.3 | 8.1 |
| Stage 3, transition to scale (<$15m) | 1 | 100% | $7.4 | 2.2 | 3.3 |
| ALL | 43 | 22% | $19.3 | 99.4 | 5.2 |

*Difference between stages not statistically significant.*
*For multi-stage awards, reach allocated in proportion to sub-award values.*

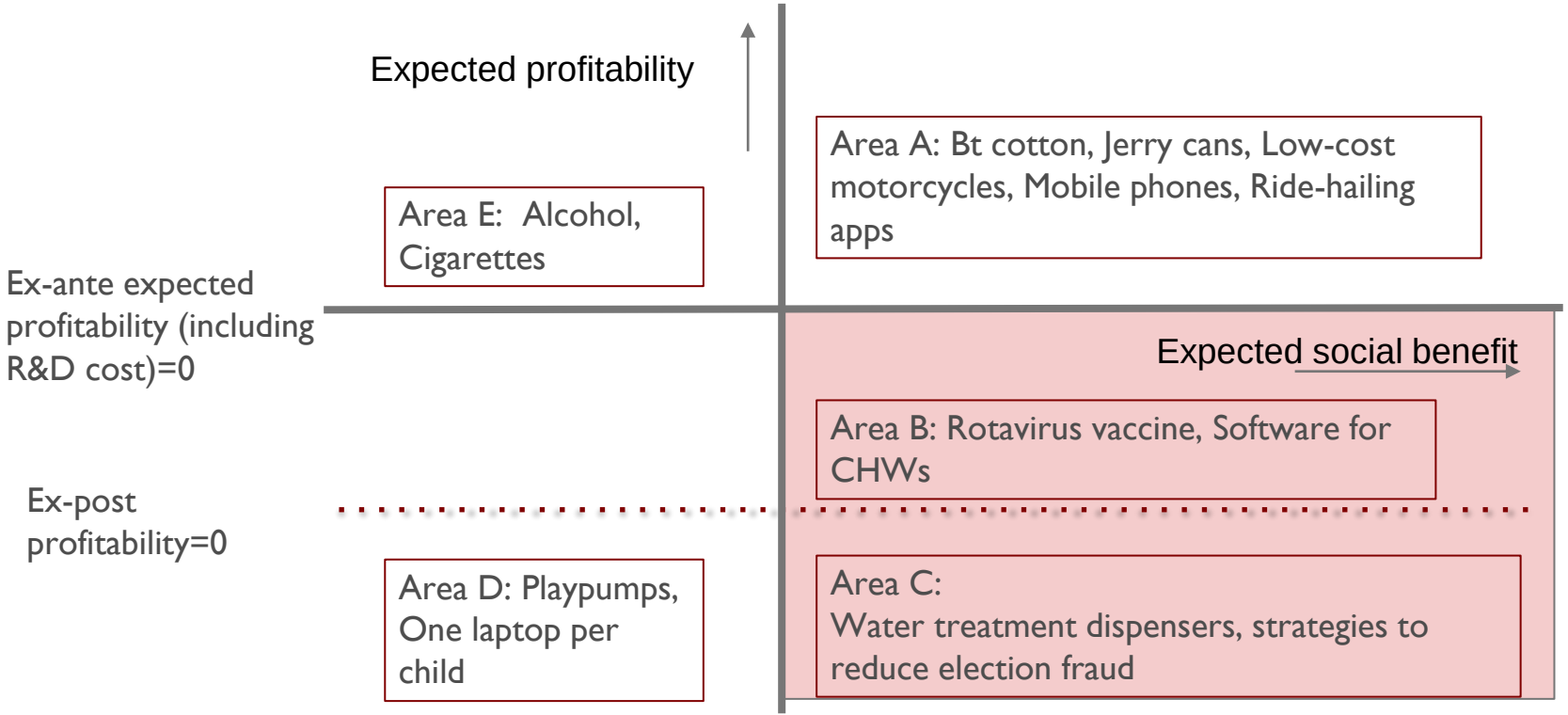
# Rate of scaling by award characteristics



# Why positive social returns when private investors more nimble?

- Commercial investors leave arbitrage opportunities for socially-motivated investors where low (ex-ante) expected private returns, but high social returns
- Low ratio of private to social returns when:
  - Low barriers to entry
  - Potential customer for innovation is government or other organization with monopsony power
  - Consumer does not obtain full value of product (externalities)

# Where are the arbitrage possibilities and additionality?



# Implications for design of social innovation funds

Some design features may generate social value in excess of private value

- ➔ Feedback for rejected applicants
- ➔ Extensive external peer review
- ➔ Researcher involvement, encouragement of publication of results
- ➔ Support for early-stage innovations
- ➔ Openness across sectors

# Implications for open, tiered, evidence-based social innovation fund

- Judge on portfolio basis
  - Distribution of payoffs is highly skewed, like venture capital investing
  - Count info may be misreading
- High benefit cost ratio suggests role for other social innovation funds
  - France has set up similar fund Fonds d'Innovation pour le Développement
- Potential in other areas where social value of innovations exceeds commercial value e.g., environmental sustainability
- Design to complement, rather than replicate, venture capital funds