The Effect of "Plus" Services in Microfinance: A Doubly Robust Machine Learning Approach

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Motivation

- Microfinance Institutions (MFIs): Offer financial services to the poor, who are excluded from the formal financial system.
- Dual Mission: Outreach to the poor while covering costs.
- Commercialization Trend: from credit-only to credit-plus-deposit institutions.
- Besides loans and savings, the poor may benefit from "Plus" services.
  - Financial Plus: insurance, remittances, payment facilities
  - Nonfinancial Plus: educational services, business training, health promotion, gender empowerment
- Challenge: Plus services may introduce trade-offs between outreach and financial results which, in turn, may limit financial inclusion.

Scope and Objectives of This Study

- **Evaluate the impact of offering financial and nonfinancial plus services on the outreach and financial sustainability of MFIs.**
- Offer insights into the potential trade-offs between financial performance and outreach.
- Use machine learning to learn complex data relationships, overcoming traditional methods' limitations.
- Cover a period of 12 years (2007-2018) capturing the commercialization of the industry.

Key Findings

- We find that nonfinancial plus services allow MFIs to improve the depth and breadth of their outreach.
- However, MFIs that only add financial plus products serve fewer and less-poor clients and experience "mission drift" that has important policy implications for financial inclusion.

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Contributions to Literature

- Contributes to the literature on trade-offs between financial sustainability and outreach within an MFI.
- Contributes to the broader literature on scope economies related to "plus" financial services as well as their impact on clients.
  - Microinsurance – decreases take-up rate (Miranda and Nadolnyak, 2023, Banarjee 2014); use leads to better practices, thus better outreach (Karlan et al 2014, Bulte, 2020).
  - Other: remittances – cheaper with FinTech in Kenya; unknown consequences.
- Offers the first causal estimates of the impact of microfinance plus services on the performance of MFIs.
  - Lensink et al., 2018 find a positive association between outreach and portfolio quality, without financial drawbacks.

Contribution to Literature

- Relates to work on impact on clients - controversial results (Banerjee et al 2015, Banarjee et al 2019, Dahal and Fialla, 2020; Hartarska and Nadolnyak 2008, Morduch, 2023).
- Relates to studies on the impact of non-financial plus services on clients
  - Women Empowerment – improved well-being and socioeconomic status in Pakistan and India (Rehman et al.; Modei et al., 2014)
  - Business Training – improves business knowledge and retention rates (Karlan and Valdiva, 2011); income and welfare (Bulte, 2018; Danquish 2021)
  - Education – financial education improves financial behavior (Zia, 2023)
  - Health services – limited in econ literature, seeking better health services increases capacity to spend on health, potentially improving loan repayment (Ahmed 2006).

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Data

- Data Source: MIX MARKET
- Period: 2007–2018
- Sample: 2100 observations of about 700 MFIs from 74 countries
- Variables:
  - Outcomes: Operational self-sufficiency (OSS), return to assets (ROA), number of loans outstanding (NuLO), number of active borrowers (NAB), depth of outreach (Depth)
  - Plus Services: Binary variables (offered or not); Financial plus (Insurance, Other) Non-financial Plus (Educational Service, Empowerment of Women, Enterprise Development, Health Services)
  - Controls: Age, Asset size, measures of the target market type, organizational type, profit status, measures of capital structure, variables capturing the external market environment, country characteristics and others

Data

Services	Counts	Fraction of observations offering the services
MFI Plus (combination of at least one financial and one nonfinancial services)	939	0.44
Financial plus services		
1. Voluntary insurance	599	0.28
2. Other financial services	1,009	0.47
Nonfinancial plus services		
1. Educational services	1,191	0.56
2. Empowerment services for women	988	0.47
3. Enterprise development services	915	0.43
4. Health services	518	0.24

Table: Fraction of observations in the dataset that offer traditional as well as financial or nonfinancial services.

Data

Service	OSS	ROA	NuLO	NAB	Depth
MFI Plus (combination of at least one financial & one nonfinancial service)	-0.05*** (0.0022)	-0.003 (0.484)	90,399*** (0.000)	80,162*** (0.000)	0.116*** (0.0013)
Financial plus services					
1. Voluntary Insurance	-0.029 (0.1044)	0.004 (0.4113)	76,551*** (0.0004)	63,489*** (0.0014)	0.137*** (0.0006)
2. Other Financial Services	-0.050*** (0.0019)	-0.004 (0.3209)	48,127** (0.0136)	44,264** (0.0136)	0.345*** (0.000)
Nonfinancial plus services					
1. Educational Services	-0.027* (0.0940)	-0.001 (0.7683)	97,008*** (0.000)	86,111*** (0.000)	-0.079** (0.0290)
2. Empowerment of Women Services	-0.022 (0.1803)	0.004 (0.2867)	58,259*** (0.0029)	50,047*** (0.0053)	-0.289*** (0.000)
3. Enterprise Development Services	-0.012 (0.4572)	-0.003 (0.5421)	56,587*** (0.0040)	50,836*** (0.0049)	-0.130*** (0.0003)
4. Health Services	0.015 (0.4339)	-0.005 (0.3106)	117,756*** (0.000)	105,457*** (0.000)	-0.23*** (0.000)

Table: Differences in mean performance by service type
* p<0.1, ** p <0.05, *** p <0.01

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Methodology - Motivation

- Parametric methods
  - Easy to implement and interpret
  - Limit the flexibility of the model and could lead to misspecification bias
- Non parametric methods
  - Could struggle with high-dimensional data (curse of dimensionality)
  - Have slow convergence rates (Wasserman (2006))
- Semiparametric methods - Double Machine Learning
  - Handle complex, high-dimensional data without relying on restrictive functional form assumptions
  - Have fast convergence rates and well known asymptotic properties (Chernozhukov et. al (2018))

Double Machine Learning (DML)

- Double robust estimation:
  - Semiparametric method that combines the treatment mechanism and the outcome mechanism to obtain the treatment effects estimates
  - Consistent estimates as long as one of the mechanisms is correctly specified
- Double robust machine learning:
  - Relies on double robust estimation
  - Estimates both mechanism non parametrically

DML - Model Framework

- Y - observed outcome - (OSS, ROA, NuLO, NAB or Depth)
- X - explanatory variables that affect potential outcomes and treatment
- D - 1 if firm offers a particular service and 0 otherwise
- Y_1 - outcome if $D = 1$
- Y_0 - outcome if $D = 0$

Interested in average treatment effect (ATE): $E[Y_1 - Y_0]$.

Assume:

- $(Y_1, Y_0) \perp\!\!\!\perp D|X$ (selection on observables)
- $0 < \text{P(D=1|X)} < 1$ (overlap)

DML - ATE Optimization Function

Let $E[Y|X,D] = g(X,D)$, $E[D|X] = m(X)$, and $\eta = (g,m)$.

$$\psi^{ATE}(W;\theta,\eta) = g(X,1) - g(X,0) + \frac{D(Y - g(X,1))}{m(X)} - \frac{(1-D)(Y - g(X,0))}{1 - m(X)} - \theta$$

θ_0^{ATE} solves $E[\psi^{ATE}(W;\theta,\eta)] = 0$ (Chernozhukov et. al. (2018))

DML - ATE Optimization Function

Let $E[Y|X,D] = g(X,D)$, $E[D|X] = m(X)$, and $\eta = (g,m)$.

$$\psi^{ATE}(W;\theta,\eta) = g(X,1) - g(X,0) + \frac{D(Y - g(X,1))}{m(X)} - \frac{(1-D)(Y - g(X,0))}{1 - m(X)} - \theta$$

- Estimate η nonparametrically
- Use the score above to estimate $\hat{\theta}^{ATE}$

DML Procedure

1. Get the equal length K- fold random partition $(I_1, ..., I_K)$ of the sample $W = (X, Z, Y)$. Define $I_k^c = W \setminus I_k$, where $I_j \cap I_k = \emptyset$ for $j \neq k$ and $\cup_k I_k = W$.
2. For each partition $I_k, k \in \{1, ..., K\}$, use the complement I_k^c to learn the nuisance parameter η. For L candidate models, train $\hat{\eta}_{k,l}$ for $l \in L$ with I_k^c and pick the one with the smallest mean squared error loss $MSE(\cdot)$ on the I_k: $\hat{l} = \arg\min_{l \in L} MSE(I_k)$. Then use $\hat{\eta}_k = \hat{\eta}_{k,\hat{l}}$ for the second step.
3. For each partition $I_k, k \in \{1, ..., K\}$, construct the estimator $\hat{\theta}_k$ by solving

$$|I_k|^{-1} \sum_{w \in I_k} \psi(w; \theta_k, \hat{\eta}_k) = 0$$

   where $|I_k|$ is the cardinality of set I_k and ψ is the score in slide 14.
4. Aggregate the estimators to get the estimated ATE: $\hat{\theta} = \frac{1}{K} \sum_{k=1}^{K} \hat{\theta}_k$.
5. Repeat steps 1-4 N number of times (with $N \geq 100$).

Estimating Nuisance Functions with Random Forests

- Motivated by the data structure and size, we use random forests to learn the treatment and outcome mechanism from the data.
- We use 2000 regression trees to construct the random forest estimator that is used to learn the treatment and outcome mechanism.
- We use a 2-fold cross validation for the DML procedure, resample 100 times and aggregate the results by taking the median of the estimators.

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Results

	OSS	ROA	NuLO	NAB	Depth
MFI plus services	-0.0483***	-0.0032	-813	-5814	-0.0357
	(0.0129)	(0.0047)	(26255)	(25958)	(0.0271)
Financial plus services					
1. Voluntary insurance	-0.0291*	0.0091**	-5278	-6159	0.0257
	(0.0176)	(0.0044)	(11859)	(11817)	(0.0286)
2. Other financial services	-0.0582***	-0.0025	-89873**	-77559**	0.0542**
	(0.0125)	(0.0049)	(38572)	(36084)	(0.0245)
Nonfinancial plus services					
1. Educational services	-0.0221*	-0.0067	35545*	21539	-0.038
	(0.0119)	(0.0051)	(18754)	(15311)	(0.0269)
2. Empowerment of women services	0.0113	0.0061	18151	9379	-0.1054***
	(0.014)	(0.0045)	(11758)	(11586)	(0.0174)
3. Enterprise development services	-0.0154	-0.0016	1576	9776	-0.059***
	(0.0159)	(0.0047)	(17228)	(17939)	(0.0197)
4. Health services	9e-04	-0.0036	53093***	48656**	-0.0137
	(0.0165)	(0.0095)	(16839)	(20670)	(0.0304)

Table: ATE after 100 splits with point estimates calculated with the median. The standard errors are reported in parenthesis.
* p$<$ 0.1, ** p$<$ 0.05, *** p$<$ 0.01

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Conclusions

- Many MFIs offer traditional microfinance services (loans, savings) alongside additional "plus" services to meet clients' needs.
- We estimate the impact of "plus" services on MFIs' outreach and financial performance using advanced machine learning methods.
- We find that:
  - Non-financial plus services improve outreach cost-neutrally, aiding in serving poorer and more clients.
  - When in addition to loans and savings MFIs offer only bank-like services (other than insurance), they move upmarket and serve significantly fewer and less poor clients.
- Policy Implications: Supporting nonfinancial plus services improves outreach while promoting commercialization with a range of financial plus services (such as remittances and payment services) drives MFIs upmarket.
- Microfinance is different from banking.