Randomized Program Evaluation:
A Microfinance Experiment in Ghana

Kampala RPC Workshop, Day 2

January 29, 2008

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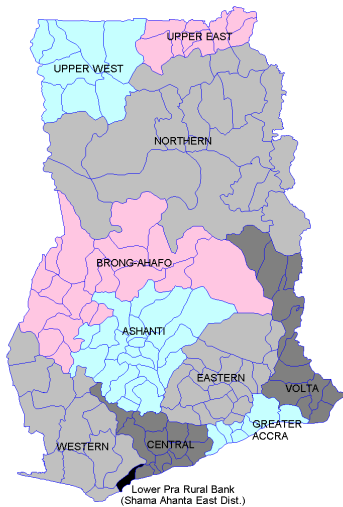Motivation & Questions
Program Background

Motivation

Policy motivation:

Donors are pouring large sums into microfinance;
We should stop to ask what it's accomplishing.

- Globally: More than US$ 1 billion is committed annually to microfinance programs (CGAP 2005)
- Ghana: Sept. 2006 President Kufuor inaugurated a new US$ 50 million Micro-Credit and Small Loans Scheme which will make loans of between US$ 100 and US$2,000 with zero collateral requirements.

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Questions

Incidence	Who wants credit/who gets it?
Impact	What is the causal impact of program participation on business profits, food security and, ultimately, child height/weight?
Investment vs. Insurance	Credit may serve a variety of functions. What does microfinance finance?

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The 'Credit with Education' Program (CWE)

Run & financed by a partnership between two organizations:

- Freedom from Hunger. U.S. based NGO provides technical assistance, and helps secure subsidized finance from donors (UNICEF, etc.).
- Lower Pra Rural Bank. Staffs and implements the project, retains all profits.

Two-pronged intervention, targeted exclusively at women but no other means testing/minimum requirements dictated by the project.
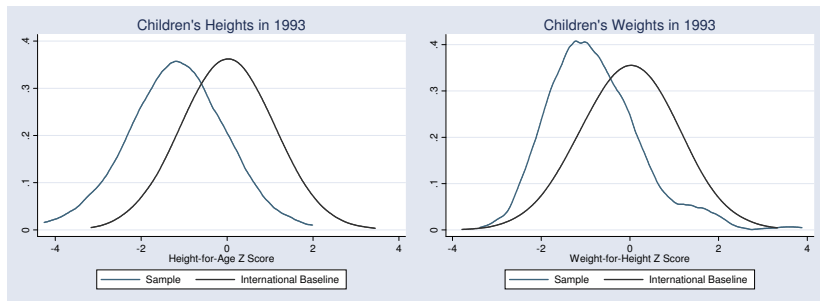
- **Credit.** Small loans (up to roughly \$300) intended to finance income-generating activities.
- **Education.** Curriculum focuses on three areas: health and nutrition, business skills, and management of the Credit Association itself. Roughly 1 hr per week, during CA meetings.

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Anthropometrics & Welfare

Two anthropometric measures employed here:

Wasting = low weight-for-height, a.k.a acute malnutrition, as it generally
reflects short term calorie depravation

Stunting = low height-for-age, a.k.a chronic malnutrition, due to a deficiency
of micronutrients (often not found in inexpensive staples).

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The Experimental Design

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Village level randomization

- 11 program villages eligible for treatment from 1993 - '96.
- 6 control villages eligible only after 1996.
- Stratified by size & distance from main road (4 cells)
- All women in treatment villages invited to join program. 23% accepted.

Departures from pure randomization:

- In four villages, ex ante political considerations guided assignment.
- In one randomly assigned treatment village, there was insufficient demand to open a Credit Association. Whole stratification dropped (bringing total from 19 to 17).

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Due to interest in child nutrition, survey sampled **exclusively mothers** with infants.

Baseline Survey, August 1993

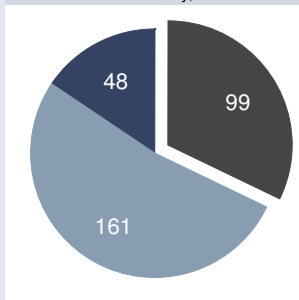- Conducted before program was launched, spanning program & control villages.
- Random sample of women with children 12 - 24 months (extended to 36 in follow-up).
- 308 respondents = average of 18.1 per village.
- Follow-up information on whether individuals joined the program.

Follow-up Survey, August 1996

- 306 respondents - **not a panel of individuals**.
- Deliberate over-sampling of participants.

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Sample Sizes - Mother/Child Pairs

| Baseline Survey, 1993 | Follow-up Survey, 1996 |

48
99
161

90
104
112

Treatment Group — 'Non-Compliers'
Control Group

Graphs by round

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Table: Sample Size by Community

	Sample of Mothers				Population
	1993		1996		of Clients
	Future	Non-		Non-	in 1996
	Clients	Clients	Clients	Clients	(Mothers/Non)
Program Communities					
Aboso	4	6	7	8	35
Anto	10	21	17	17	51
Assorku	3	26	8	10	60
Atwereboanda	3	7	1	7	30
Beposo	9	20	10	9	28
Essaman	5	25	4	8	32
Nyankrom	0	10	2	7	25
Obinyim Okyena	3	7	7	10	28
Old Daboase Junction	3	7	7	8	27
Shama Junction	6	24	20	19	93
Yabiw	2	8	7	9	34
Sub-Total	*48*	*161*	*90*	*112*	*443*

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Table: Sample Size by Community

| | Sample of Mothers | | | | Population |
| | 1993 | | 1996 | | of Clients |
	Future Clients	Non-Clients	Clients	Non-Clients	in 1996 (Mothers/Non)
Control Communities					
Asem Asa	.	10	.	10	.
Bokokope	.	9	.	10	.
Daboase	.	30	.	33	.
Kobino Ano Krom	.	10	.	11	.
Kumase	.	30	.	30	.
Nkwantakese	.	10	.	10	.
Sub-Total	.	*99*	.	*104*	.
Grand Total, 614	.	*260*	.	*216*	.

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Household Enterprises
$\left\{\begin{array}{ll} \text{"Profits":} & \text{Self-reported, before deducting} \\ & \text{interest payments \& own earnings} \\ \text{Net Income:} & \text{Revenue minus costs} \\ \text{Capital:} & \text{Value of assets used for business} \end{array}\right.$

Nutrition
$\left\{\begin{array}{ll} \text{Anthropometrics:} & \text{HAZ and WHZ scores} \\ \text{'Lean' months} & \text{Months in which household had} \\ & \text{difficulty finding enough food.} \\ \text{Food expenditure:} & \text{NB: expenditure not consumption.} \end{array}\right.$

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Table: Baseline Summary Statistics, 1993

	Control Villages	Program Villages	Testing Randomization
	(1)	(2)	(3)
HAZ	-.966 (1.147)	-1.270 (1.173)	-.304 (.139)**
WHZ	-.927 (1.031)	-.703 (1.138)	.224 (.130)*
'Lean' Months	1.821 (2.296)	1.912 (2.514)	.090 (.309)
Food Expenditure	12164.3 (7991.3)	11323.3 (8421.0)	-841.0 (1098.7)
Profit	7322.7 (29151.8)	6391.4 (10205.6)	-931.2 (1264.5)
Net Income	8341.2 (45807.4)	6195.4 (12156.4)	-2145.8 (1684.5)
Capital	32621.0 (76862.3)	21952.7 (42467.8)	-10668.3 (9070.0)

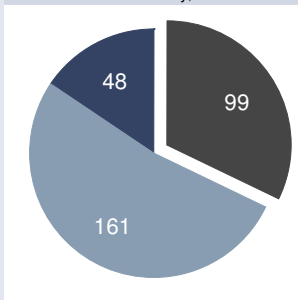All monetary values are in real 1995 Ghanaian Cedis.
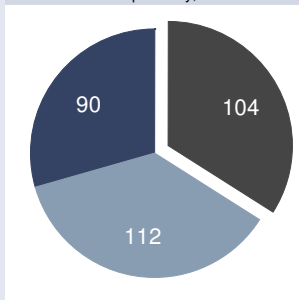
Incidence

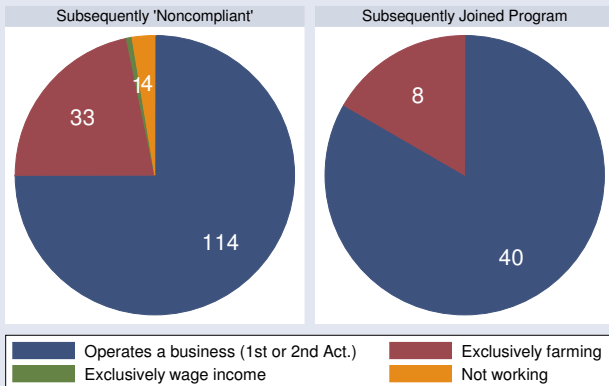**(a.k.a., Who Gets Credit?)**

Sample Sizes - Mother/Child Pairs

Mothers' Economic Activities: Program Communities Only - '93

Table: Loan Take-Up

	Probit for Participation		Regression of Loan Size	
	(1)	(2)	(3)	(4)
Palm Oil	-.514 (.341)	-.883 (.411)**	-.067 (.168)	-.064 (.174)
Bakery/Prepared Food	.602 (.217)***	.453 (.250)*	.073 (.134)	.047 (.143)
Smoked Fish	.859 (.307)***	1.003 (.329)***	.109 (.189)	.120 (.192)
Profits		-.00002 (.00004)		
Profits^2		3.71e-11 (1.04e-09)		
Capital		.00002 (9.96e-06)**		
Capital^2		-1.01e-10 (5.49e-11)*		
Own Land Dummy		-.278 (.231)		-.024 (.159)
Age		.037 (.016)**		.006 (.010)
Schooling		.049 (.027)*		.017 (.015)
Obs.	200	200	83	83

Table: Probits for Selection on Outcome Measures

Nutrition Outcomes		Business Outcomes	
HAZ	.033 (.082)	Log Net Income	.259 (.141)*
WHZ	.139 (.084)*	Log Profit	.214 (.137)
Log Food Exp.	.043 (.169)	Log Capital	.174 (.108)
Log Meat Exp.	.061 (.136)	Net Income	7.14e-06 (7.52e-06)
'Lean' Months	.032 (.038)	Profit	1.00e-05 (8.88e-06)
Breast Feeding Dummy	.078 (.213)	Capital	2.80e-06 (2.09e-06)
Diarrhea Knowledge	.508 (.317)		

Each coefficient corresponds to a separate equation.

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Treatment Effects

Let Y_i^T be the 'potential outcome' for individual i if treated, and Y_i^C otherwise. Our goal is to compute the causal impact of treatment T on the outcome Y.

$$\beta_i = Y_i^T - Y_i^C$$

Or more realistically, the average treatment effect for some subset of the population, $\mathrm{E}[\beta_i|T]$. The problem of selection bias is that

$$\mathrm{E}[\beta_i|T] = \mathrm{E}[Y^T|T] - \mathrm{E}[Y^C|C]$$

iff $\quad \mathrm{E}[Y_i^C|T] = \mathrm{E}[Y_i^C|C].$

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Suggestion Designs & Partial Compliance

Partial compliance:

- Assignment to the treatment group does not guarantee treatment.

- Nor, in principle, does random assignment to the control group guarantee non-participation.

Suggestion Designs:

- Treatment group is invited or encouraged to participate.

- In our case, the vast majority of women in program communities opted not to participate in the program.

- Presumption that participation is (positively) correlated with the treatment effect.

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Intention-to-Treat Effect (ITT)

The ITT is computed as the mean difference between program and control communities:

$$\begin{aligned}
\text{I.T.T.} &= \text{E}[Y_i|Z=1] - \text{E}[Y_i|Z=0] \\
&\neq \text{E}[\beta_i|T]
\end{aligned}$$

- Measures the average, causal effect of the program on all eligible women.
- Note, this is distinct from the Average Treatment Effect (ATE).
- Often particularly relevant for policy analysis.

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Local Average Treatment Effect (LATE)

Suppose we're willing to assume that there are no externalities in the program.

- Then, the ITT must be driven entirely by the participants.
- Thus the **effect of treatment on the treated** is computed as the ratio of the ITT to the proportion of treated individuals in the treatment group.

$$LATE = \mathrm{E}[\beta_i | T] = \frac{\mathrm{E}[Y_i | Z = 1] - \mathrm{E}[Y_i | Z = 0]}{\mathrm{E}[T_i | Z = 1] - \mathrm{E}[T_i | Z = 0]}$$

- Wald estimator, equivalent to the **instrumental variables** estimate of β, using the randomization as the instrument.

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Econometric Specification

To compute the ITT, we can estimate the following equation

$$Y_{ijt} = \alpha Z_{jt} + \mu_j + \nu_{jt} + \epsilon_{ijt}$$

Even if randomization was imperfect:

$$\mathrm{E}[Z_{jt}\mu_j] \neq 0 \quad \text{but we can include village FEs}$$
$$\mathrm{E}[Z_{jt}\nu_{jt}] \neq 0 \quad \text{this is a problem}$$
$$\mathrm{E}[Z_{jt}\epsilon_{ijt}] = 0 \quad \text{as Z doesn't vary within } j$$

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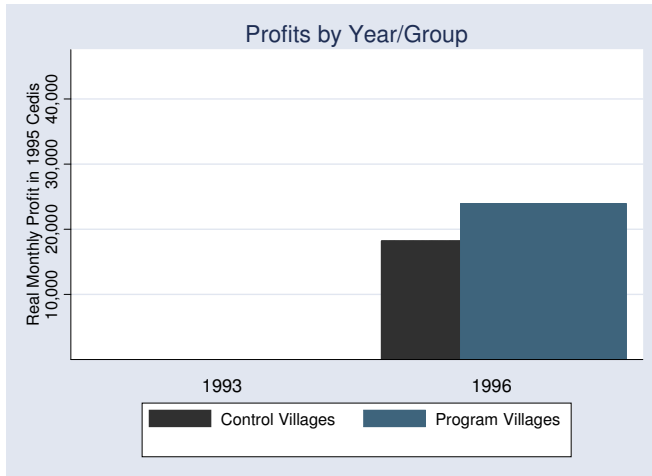. . . on Nutrition
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Econometric Specification

To estimate the LATE, consider the following econometric model
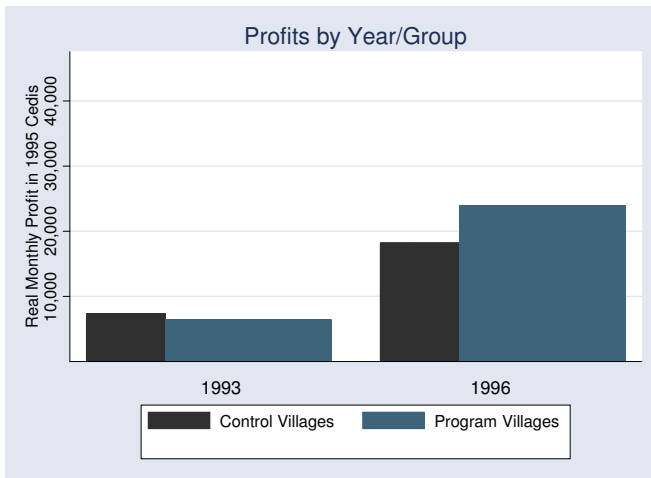
$$
\begin{aligned}
Y_{ijt} &= \beta_T T_{ijt} + \beta_X X_{1ijt} + \mu_j + \nu_{jt} + \eta_{ijt} \\
T_{ijt} &= \gamma_Z Z_{jt} + \gamma_X X_{2ijt} + \delta_{ijt}
\end{aligned}
$$

where, even allowing that $X_2 \subseteq X_1$, Z serves as a valid instrument for treatment.

Note however that we cannot exploit within-village variation in T:

- Use binary Z to instrument for binary T as well as loan size.
- Use introduction of program in village j as instrument for duration of treatment.

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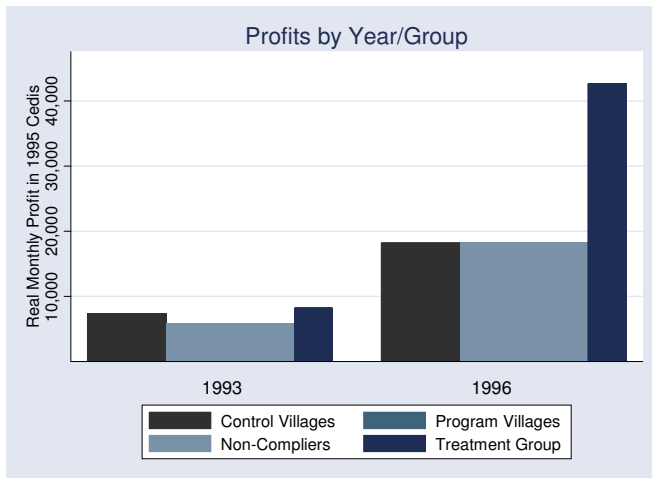. . . on Nutrition
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Table: Reduced-Form Impact on Income-Generating Activities

		$\hat{\beta}_T^{OLS}$ (Naive)	$\hat{\beta}_Z^{OLS}$ (ITT)	$\hat{\beta}_T^{IV}$ (LATE)
		(1)	(2)	(3)
Log Net Income	N=374	.295 (.179)*	.428 (.110)***	1.116 (.291)***
Log Profit	N=393	.531 (.179)***	.352 (.161)**	.934 (.419)**
Log Capital	N=352	.247 (.213)	.147 (.233)	.366 (.580)
Net Income	N=596	23444.570 (7732.627)***	5700.105 (4105.434)	24693.700 (16680.380)
Profit	N=609	23079.200 (5239.549)***	6145.467 (4432.011)	26695.750 (17941.180)
Capital	N=607	17792.370 (5572.376)***	11136.150 (10544.560)	49662.910 (45790.750)

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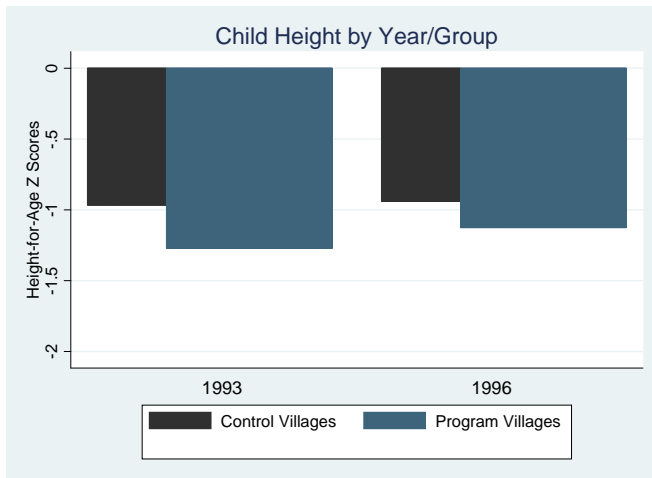. . . on Nutrition
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In 1996, average loan size was 76,245 Cedis ($\approx$ \$50) at 48% annual interest. This would imply a monthly loan payment of approximately 22,111 Cedis ($\approx$ \$16).

	Log Net Income	Log Profits	Abs. Net Income.	Abs. Profits
$\hat{\pi}^T$	72,647	48,001	52,070	45,541
$\hat{\pi}^C$	23,808	18,867	27,376	18,845
$(\hat{\pi}^T - \hat{\pi}^C)/\bar{L}$	64.1%	38.2%	32.4%	35.0%
$(\hat{\pi}^T - \hat{\pi}^C - P)/\bar{L}$	35.1%	9.2%	3.4%	6.0%

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Child Height by Year/Group

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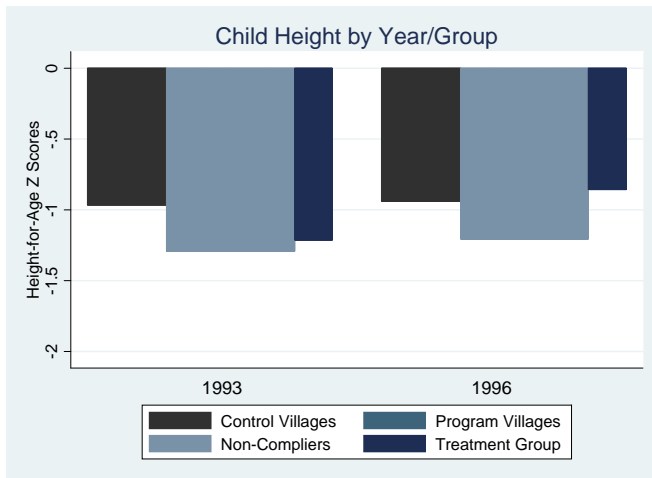**. . . on Nutrition**
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Table: Reduced-Form Impact on Nutrition Related Outcomes

		$\hat{\beta}_T^{OLS}$ (Naive) (1)	$\hat{\beta}_Z^{OLS}$ (ITT) (2)	$\hat{\beta}_T^{IV}$ (LATE) (3)
HAZ	N=605	.321 (.158)**	.082 (.189)	.358 (.816)
WHZ	N=605	.097 (.140)	-.195 (.185)	-.847 (.818)
Log Food Exp.	N=595	-.163 (.075)**	.109 (.075)	.458 (.323)
Log Meat Exp.	N=576	.051 (.079)	.093 (.178)	.421 (.808)
'Lean' Months	N=601	-.763 (.250)***	-.538 (.300)*	-2.325 (1.342)*
Breast Feeding Dummy	N=614	-.010 (.053)	.064 (.084)	.280 (.367)
Diarrhea Knowledge	N=614	.257 (.048)***	.113 (.034)***	.493 (.139)***

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Incidence

- 'Positive' selection into the program

- Age, schooling, education, income, capital all increase probability of participation

Impact

- Glass half full: positive effects on HAZ - no significant evidence these are driven by selection.

- Glass half empty: after controlling for selection, no significant HAZ impacts.

Investment vs. Insurance

- Impacts on profits are quite large, although may not reflect consumption changes if borrowers substitute away from farming.

- Impacts on 'hungry season' and height consistent with, though hardly proof of, improved ability to smooth.