Evaluation of the impact of a Ghanaian mobile-based MIS on the first few users using a quasi-experimental design

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Workshop on African Market Information Systems
Bamako, Nov. 30 to Dec. 2, 2011

Outline

What do we know about MIS impact?

Theoretically, MIS may improve spatial arbitrage and increase bargaining power for farmers. But very limited empirical evidence:

- Impact of Foodnet MIS in Uganda (radio program)
  - Svensson & Yanagizawa (2009, 2010): higher farm-gate price of maize + increase in the share of the output sold
- Impact of Reuters Market Light MIS in India (SMS)
  Fafchamps & Minten (2011): no significant effect on the price received by farmers selling crops for auction

Crop marketing chain

- Aryeetey & Nyanteng (2006): food crop farmers may carry their produce to market; but most farmers sell at the farmgate, to traders who travel to them.
- Local traders sell to long-distance traders who engage in spatial arbitrage $\rightarrow$ central markets in producing areas like Techiman and urban markets like Accra are well integrated (Abdulai, 2000).
- ICT boom in sub-Saharan Africa over the past decade may have further improved spatial arbitrage conditions

$\Rightarrow$ Look at potential improved bargaining power rather than spatial arbitrage.

Esoko Market Information Services

- Esoko (formerly TradeNet) began in 2005 with funding from USAID (MISTOWA project). For-profit private company with private investors.
- They collect data on crop prices on 30 markets and supply subscribers via text messages. (also other mobile-based services, other contents)
- Esoko have worked since 2007 with an NGO (SEND West Africa) that facilitated the acquisition of mobile phones for 500 farmers in the Northern region and set them up for automatic SMS alerts on prices.

Objectives and Method

- I use a quasi-experimental approach to estimate the causal effect of an Esoko-based program on marketing performances of beneficiaries of the NGO-funded program.
- Performance is measured through the share of output sold and crop prices received by farmers during marketing season 2009-2010.
- The impact of Esoko MIS on users is defined as the difference between the level of outcome observed among users and the level that we would have observed in absence of MIS $\Rightarrow$ Matching methods aim to estimate the counterfactual level.

Objectives and Method

- Basic idea behind matching methods:
  - we cannot observe what would be the level of users' performances in absence of MIS, so we estimate this counterfactual level from available data on non-users' performances.
  - Users being different from non-users in absence of MIS, we correct for the so-called selection bias.
- I use difference-in-differences (DID) matching estimators (nearest neighbour matching, kernel matching, local linear regression).
- A typical DID-matching estimator calculates the mean difference between treated farmers' mean changes in performances between dates t0 (before the treatment) and t1 (after the treatment), and the mean changes of their matched counterparts.

Identification strategy

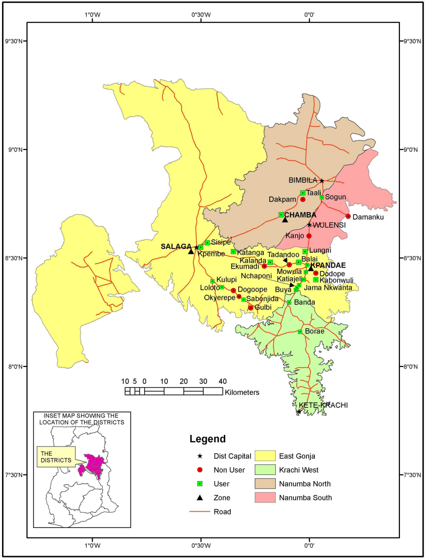
Validity of matching estimators relies on strong hypotheses:

- Absence of diffusion effect: implies no contamination of control group, assumption threatened if:
  - Price information results in new allocation between markets, leading to new market prices (for everybody) $\Rightarrow$ previous quantitative evidence shows market integration already.
  - MIS users share price information with non-users $\Rightarrow$ qualitative evidence suggests that farmers share information with OP and community members, so no spillovers accross communities.
- Control for selection bias/confounders: complicated by the fact that users also benefit from other programs (NGO funded) whereas non-users do not $\Rightarrow$ available data can help to control for this.

Sampling

- Survey (summer 2010): recall survey marketing season 2009 + marketing season 2008.
- Sample:
  1. ECAMIC group is a user group of farmers who were signed up for SMS price alerts and trained within the framework of ECAMIC project (2008). They live in villages covered by SEND activities; $n = 196$
  2. PRESTAT group is a future user group of farmers who were signed up for SMS price alerts and trained within the framework of Prestat funding (starting in May 2010). They also live in villages covered by SEND activities; $n = 203$
  3. NO-SEND group is a non-user group of farmers who are not at all familiarized with Esoko services and were not likely to benefit from price information spread during last crop season. Those farmers live in villages that are not covered by SEND activities but in the same area. $n = 200$

Sampling



Source: the Geography Department of University of Ghana

Oucomes in 2009

	Ecamic			Prestat			No-SEND		
	# obs.	moy.	e.t.	# obs.	moy.	e.t.	# obs.	moy.	e.t.
Maize									
Prop. of growers	196	0.89	0.3	203	0.90	0.3	200	0.94	0.2
Maxi bag price	112	44.7	10.3	143	46.3	8.5	114	44.1	7.0
Change in price (08-09)	105	5.0	8.3	131	6.2	5.1	112	3.6	7.4
Maxi bags sold	125	25.7	40.1	157	31.0	48.4	119	53.3	75.6
Ratio bags sold/harvest	125	0.70	0.3	157	0.69	0.3	119	0.83	0.3
Change in ratio	115	0.02	0.2	146	-0.01	0.2	116	-0.02	0.1
Gnuts									
Prop. of growers	196	0.71	0.5	203	0.63	0.5	200	0.73	0.4
Maxi bag price	81	86.7	25.6	91	84.7	22.7	74	92.4	23.7
Change in price (08-09)	72	8.2	9.9	84	9.4	10.2	57	3.3	23.3
Maxi bags sold	82	6.4	3.7	91	8.6	20.5	74	10.2	16.1
Ratio bags sold/harvest	82	0.90	0.2	91	0.87	0.2	74	0.95	0.1
Change in ratio	74	-0.01	0.1	85	-0.03	0.1	63	0.04	0.1
Cassava									
Prop. of growers	196	0.66	0.5	203	0.66	0.5	200	0.71	0.5
Maxi bag price	49	43.6	25.7	46	22.0	11.8	50	22.6	11.9
Change in price (08-09)	41	6.9	14.2	39	2.2	6.0	38	-0.3	19.1
Maxi bags sold	68	17.6	25.7	61	37.0	46.8	62	38.4	49.7
Ratio bags sold/harvest	68	0.67	0.4	61	0.61	0.4	62	0.64	0.4
Change in ratio	63	0.05	0.3	57	0.00	0.1	57	0.04	0.3
Long bag price	49	39.6	17.5	50	36.7	17.4	61	37.6	11.1
Change in price (08-09)	35	5.6	10.3	39	3.8	9.8	52	0.6	6.2
Long bags sold	55	3.8	3.3	65	3.6	2.8	77	4.1	3.8
Ratio bags sold/harvest	55	0.61	0.3	65	0.46	0.3	77	0.55	0.3
Change in ratio	53	0.04	0.2	61	-0.02	0.2	75	-0.02	0.2

Covariates (pre-treatment levels)

	Ecamic			Prestat			No-SEND		
	obs.	mean	sd	obs.	mean	sd	obs.	mean	sd
Characteristics									
Age	196	40.0	12.1	202	42.9	11.5	198	41.0	11.9
Can read	196	0.7	0.5	203	0.7	0.5	200	0.6	0.5
Experience	193	14.9	8.1	195	15.6	8.4	197	14.0	10.1
Distance to loc. market	193	11.7	9.5	195	15.1	22.3	186	23.8	25.7
Non-ag. revenue	196	412.5	962.2	203	629.7	1362.1	200	778.5	1874.4
Assets									
Radio	195	0.6	0.5	203	0.8	0.4	199	0.7	0.5
Cattle	196	0.6	1.9	203	1.8	10.9	200	2.7	13.4
Goats	196	2.9	5.2	203	4.4	6.2	200	3.5	5.7
Pigs	196	1.7	5.3	203	0.8	4.3	200	2.3	5.9
Chicken	196	12.9	9.9	203	11.5	8.8	200	12.3	10.5
Sheeps	196	1.6	3.6	203	1.5	3.1	200	1.3	3.8
Land (acres)									
Farm land	187	26.4	18.7	190	29.9	29.3	187	42.2	54.9
Cultivated area	181	12.3	11.0	182	13.8	9.8	171	18.0	15.6
Cassava	188	1.6	2.5	200	3.2	6.2	199	4.2	11.1
Gnuts	196	2.5	13.4	202	1.8	3.0	199	2.5	4.8
Maize	196	4.3	7.1	201	5.2	7.1	199	8.0	11.9
Yam	196	4.3	4.5	202	3.6	3.2	200	5.8	5.1
Inputs (cedis)									
Cassava	196	6.8	17.5	203	6.0	44.8	200	2.7	9.7
Gnuts	196	22.9	33.0	203	29.8	45.6	200	34.2	81.8
Maize	196	48.1	65.6	203	127.7	374.5	200	137.2	229.8
Yam	196	131.6	229.6	203	184.9	607.6	200	238.6	716.1
Credit									
Total	196	173.4	365.2	203	243.5	378.9	200	198.2	473.7
Total for inputs	196	128.4	336.3	203	210.2	368.8	200	179.9	467.6
Credit Union	196	0.7	0.5	203	0.6	0.5	200	0.0	0.2

Matching procedure

What factors drive both participation in Esoko program and marketing performances?

- We may think that farmers who chose to participate in the program are crop sellers, have some education level, live at a certain distance from the local market, sell at the farmgate, etc.
- We don't know much about the reason why farmers enter the association and participate in Esoko-based program;
- We only know that the NGO supporting these farmers has been working in this area for a long time, for historical reasons.

$\Rightarrow$ Users from this association may do not differ much from their neighbors (non-members).

$\Rightarrow$ I control for these differences if there are any.

Matching procedure

- On the contrary, in this case study, the main issue is related to other treatments that are concomitant with esoko-based program;
- Two main aspects of this famers association:
  - members may also benefit from credit union;
  - members may have opportunity to sell their produce as a group.
- These programs are confounding variables because they are highly correlated with esoko-based program and may also influence the marketing performances.

Impact on maize price received by users

- When controling for characteristics, assets and land, we detect an impact on the treated (att = average treatment effect on the treated).
- Users receive 3 cedis more than their matched counterparts for a maxi-bag of maize over 2008-09 ($\Delta Y^T = +5.5$ while $\Delta Y^C = +2$).

estimateur	att	se	stat	
NNM_PS_1	3.35	1.87	1.79	*
NNM_X_1	3.49	2.04	1.72	*
NNM_PS_4	3.08	1.49	2.07	**
NNM_X_4	3.35	1.51	2.21	**
PSM_Kernel	4.35	1.34	3.24	***
PSM_LLR	7.27	4.75	1.53	°
OLS_PS	2.59	1.29	2.00	**
OLS_X	2.17	1.24	1.75	*

Table: Impact on maize price

Impact on gnuts price received by users

- Users receive 7.5 cedis more than their matched counterparts for a maxi-bag of gnuts over 2008-09 ($\Delta Y^T = +8.5$ while $\Delta Y^C = +1$).

estimateur	att	se	stat	
NNM_PS_1	6.33	4.29	1.47	∘
NNM_X_1	7.75	3.72	2.08	**
NNM_PS_4	10.26	3.54	2.90	***
NNM_X_4	10.20	3.64	2.81	***
PSM_Kernel	7.87	5.00	1.58	∘
PSM_LLR	27.82	12.13	2.29	**
OLS_PS	6.52	3.90	1.67	*
OLS_X	10.78	3.75	2.87	***

Table: Impact on gnut price

Impact on cassava price received by users

- Users receive 6.5 cedis more than their matched counterparts for a long-bag of gnuts over 2008-09 ($\Delta Y^T = +5.5$ while $\Delta Y^C = -1$).

estimateur	att	se	stat	
NNM_PS_1	6.45	3.44	1.88	*
NNM_X_1	6.45	3.44	1.88	*
NNM_PS_4	6.52	2.68	2.44	**
NNM_X_4	6.55	2.68	2.45	**
PSM_Kernel	6.65	2.19	3.04	***
PSM_LLR	5.87	3.85	1.53	°
OLS_PS	7.24	2.78	2.60	***
OLS_X	3.45	2.30	1.50	°

Table: Impact on cassava price

Confounding effects: discussion

Esoko users also benefit from access to credit via a credit union:

1. They use credit to buy inputs (seed, fertilizers). Having higher yields, they make larger transactions et get better prices (because buyers who travel to farmers reduce transaction costs and may consent to buy at a higher price)
   $\Rightarrow$ estimate would be biased upward;
2. They use credit to buy food or pay school fees. Not under liquidity constraint any more, they are able to better negociate prices.
   $\Rightarrow$ estimate would be biased upward;

Confounding effects: discussion

Data suggest indeed that only a small share of users declare not having access to credit (14%), contrary to non-users (47%).

Credit provider #1	Ecamic	Prestat	no-SEND	Total
no credit	**28**	**29**	**94**	150
friend	8	8	18	34
family	5	5	25	35
trader	0	2	45	47
credit union	**129**	**109**	**7**	245
microfi instit	19	20	0	39
SEND business prog	2	0	0	2
bank	5	30	11	46
Total	196	203	200	599

Table: Access to credit

Confounding effects: discussion

Moreover, it seems that credit is mainly invested in equipments or inputs.

Credit 2008 #1	Ecamic	Prestat	no-SEND	Total
no credit	28	29	94	151
food	2	8	6	16
livestock	1	3	3	7
inputs	**124**	**122**	**79**	**325**
equipments	**32**	**27**	**16**	**75**
other	9	14	2	25
Total	196	203	200	599

Table: Use of credit

Confounding effects: discussion

I thus control for this potential “credit union effect” using additional covariates when matching users to non-users: total credit used for equipments, total credit used for seeds and fertilizers,yield level observed in 2009.

estimateur	att	se	stat	
NNM_PS_1	3.19	2.04	1.56	°
NNM_X_1	3.42	1.84	1.86	*
NNM_PS_4	5.40	1.81	2.98	***
NNM_X_4	3.97	1.48	2.68	***
PSM_Kernel	3.19	1.80	1.77	*
PSM_LLR	4.01	4.59	0.87	
OLS_PS	2.53	1.41	1.79	*
OLS_X	2.23	1.28	1.74	*

Table: Impact on maize price controlling for inputs

Confounding effects: discussion

Data also suggest that some Esoko users (20%) manage to sell their produce as a group, while non-users almost never do this way.

	Ecamic	Prestat	no-SEND	Total
individual	36	46	142	224
mainly individual	118	109	52	279
group	4	0	0	4
mainly group	34	42	3	79
Total	192	197	197	586

Table: How did you sell your produce in 2008?

$\Rightarrow$ When running parametric estimation: att = 2.6 (se = 1.4)

Spillover effects

- The no-spillover assumption will not hold if ECAMIC group have shared Esoko price information with non-user group; But we do not expect that (based on farmers declarations in the survey).
- On the contrary, we expect that ECAMIC farmers have shared price information with PRESTAT farmers living in same communities, also members of the association.
- Indeed, when matching ECAMIC group to PRESTAT group, I failed to detect an impact significatively different from zero.

Conclusions

- Matching estimators suggest a significant impact on prices received by users for maize gnuts and cassava (10% increase in price), but:
- Although we tried to get rid of selection bias/confounding effects, we cannot exclude possible existence of remaining bias - especially when considering impact on cassava prices which appears huge.
- Supposing that this bias is positive, these estimates can be seen as upper bound of the impact we try to recover - without ignoring possibility of a zero impact of Esoko MIS.
- Consequently, better work could be done to improve identification strategy: RCT design is an appropriate tool (currently only a small number of farmers are Esoko-users).
- Currently at least three on-going projects based on RCT designs in Ghana: NYU Abu Dhabi project (northern/volta regions), IFPRI-IFAD project (northern region), INRA project (central region).