

Finding Missing Markets: Evidence from an Export Crop Adoption and Marketing Intervention in Kenya

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Abstract

In much of the developing world, many farmers grow crops for local or personal consumption despite export options which appear to be more profitable. Thus many conjecture that one or several markets are missing. We report here on a randomized controlled trial conducted by DrumNet in Kenya that attempts to help farmers adopt and market export crops. DrumNet encourages the adoption of export oriented crops by providing smallholder farmers with information about how to switch to export crops, with credit for purchase of the agricultural inputs, and with marketing services by then facilitating the transaction with exporters. The experimental design randomly assigns pre-existing farmer self-help groups to one of three groups: (1) a treatment group that receives all DrumNet services, a treatment group that receives all DrumNet services except credit, and a control group. Overall, the complete package of DrumNet leads to an increase in production of export oriented crops and lower marketing costs that translate in income gains for new adopters.

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1 Introduction

Why do farmers continue to grow crops for local markets when crops for export markets are thought to be much more profitable? Several answers are possible: missing information about the profitability of these crops, lack of access to the necessary capital to make the switch possible, lack of infrastructure necessary to bring the crops to export outlets, high risk of the export markets, lack of human capital necessary to adopt successfully a new agricultural technology, and misperception by researchers and policymakers about the true profit opportunities and risk of crops grown for export markets.

We conduct a randomized controlled trial with DrumNet, a for-profit Kenyan organization, to examine whether a package that helps farmers organized into Self Help Groups (SHG) adopt, finance and market export crops can indeed be sustainable and lead to higher farmer income. The experimental design includes two treatment groups (one with credit and one without) and a control group. The intervention is a package of services, and with the exception of credit, the design does not permit isolating out the reasons for the failure in the first place. We also examine whether there are heterogeneous treatment effects along certain important characteristics, such as preexisting crop choice and education.

This experiment is motivated by a recent push in development to build sustainable interventions that help complete missing markets. Other similar interventions include the provision of real-time prices for fish in markets along the shore to boat owners returning with their catches [Jensen 2007] and an intervention in India to provide internet kiosks in small villages in order to better inform citizens of market opportunities [e-choupal paper, HBS]. To examine whether these programs are welfare improving, and lead to higher growth, one must measure their impact. Two approaches seem plausible for measuring impact: one infers impact by examining the convergence of market prices (Jensen 2007), a second compares the welfare of participants and non-participants.

Particularly in our setting, one should be concerned that entrepreneurial and motivated individuals (those with the unobservable “spunk”) are most likely to participate, hence a randomized controlled trial seems necessary in order to measure the impact convincingly. To the best of our knowledge, no such randomized controlled trial

has been completed to date. The literature on agricultural services, reviewed by Anderson and Feder (2003) and on technology adoption, reviewed by Conley and Udry (2003), stress that both data quality and methodological issues are important qualifiers to the prevailing evidence in favor of high returns from extension or adoption. They conclude that more evaluative work is needed to better assist policymakers.

We find positive but not overwhelming impacts from DrumNet. DrumNet does lead to more farmers growing export crops, increasing their production and lowering their marketing costs. While we do not find a statistically significant average impact on income, we do find that income did increase for first-time growers of export oriented crops.

The next section provides some background information regarding the Kenyan horticultural market and the DrumNet program. Section 3 describes the research design in more detail. Section 4 analyzes the decision to participate in DrumNet. Section 5 analyzes the impact of DrumNet and Section 6 concludes.

2 The DrumNet Program and Context

Kenya's horticultural sector¹ has received a great deal of attention over the past decade due to the rapid and sustained growth of its exports to Europe (Jaffee 1994, 1995, Dolan et al., 2001 Minot and Ngigi, 2002, Muendo and Tschirley, 2004). This impressive growth is believed to have contributed to increased rural incomes and reduced rural poverty. Yet, while over 90 percent of smallholder farmers in all but the arid regions of Kenya produce horticultural products, fewer than 2 percent do so directly for export (Bawden et al., 2002).

The few Kenyan smallholders who have succeeded in producing for the export market face a new set of challenges since January 2005 under the EUREPGAP requirements. These requirements are driven by European consumers' demand for safe, high quality food, and emphasize the traceability of horticultural production. Exporters must be able to trace production back to the specific farm from which it came in order to ensure quality and safe production and handling procedures. A decline in the share of

¹ Horticulture sector is defined here to include fruit and vegetable production and marketing, but not flowers.

exports by smallholders, from about 75 percent in the early 1990s to a current less than 50 percent (Minot and Ngigi 2002, Jaffee 1995, Muendo and Tschirley, 2004), suggests that it has become increasingly difficult for smallholders to maintain their participation in the export sector.

In the context where DrumNet operates, the lack of information flows and difficulty completing transactions among producers, financial institutions, and marketers of agricultural produce seem to be a major hurdle. Several factors seem to be relevant. First, there is no strong market for truck rentals in order to transport crops to the main market, perhaps due to costs due to the poor road infrastructure, or perhaps due to coordination failures amongst farmers in order to overcome large fixed costs of renting a truck (Axinn, 1988; Freeman and Silim, 2002). On the finance side, banks and microfinance institutions have experimented with crop financing and farm input loans and have experienced poor repayment rates, and high transaction costs. On the export marketing side, farmers exhibit mistrust of final pricing, partly due to inability to contract perfectly on the quality of the crop, and partly due to uncertainty of prices in international markets.

DrumNet is a horticultural export and cashless micro-credit program that tries to overcome these barriers by linking smallholder farmers to commercial banks, retail providers of farm inputs, and exporters. A farmer that wants to be a member of DrumNet has to satisfy the following requirements: (i) be a member of a registered SHG with the Department of Social Services, (ii) express an interest, through the SHG, in growing crops marketed by DrumNet, namely French beans, baby corn or passion fruit, (iii) have irrigated land, and (iv) be able to meet the first Transaction Insurance Fund (TIF) commitment (roughly USD 10 or the equivalent of a week's laborer wages).

DrumNet clients first receive a four week orientation course in which the process is explained. Farmers learn about the need to employ Good Agricultural Practices on their farms to ensure the quality and safety of their produce that will meet EUREPGAP requirements, they open a personal savings account with a local commercial bank and, for those in the credit-treatment group, they make the first cash contribution to the Transaction Insurance Fund (TIF) that will serve as partial collateral for their initial line of credit. They also decide on the TIF percentage that DrumNet will automatically

deduct from each future marketing transaction. Maximum loan size is four times their balance in the TIF. The initial TIF amount depends on the specific crop the farmer wants to grow and the area under cultivation.²

When harvest time comes, DrumNet negotiates with the exporter a price and will arrange for the produce pick-up at pre-specified collection points. Usually, there is a collection point for every 4 or 5 SHGs. In each collection point, a transaction agent is appointed among the members to serve as liaison between DrumNet and the farmers.³ At these collection points, farmers grade their produce and package it, although the exporter has the final word on the grading.

In the credit-treatment group, DrumNet works with local agricultural retail stores to coordinate the loans. The retailers are trained in basic DrumNet record keeping and submit receipts to DrumNet to receive payment.

Once the produce is delivered to the exporter at the collection points, the exporter pays DrumNet who in turn will deduct any loan repayment, pre-specified TIF percentage and credits the remainder to individual bank savings accounts that each farmer opened when they registered.

Initially, DrumNet focused on passion fruit, a profitable but challenging crop sold both in export and local markets. The favorable climate and small farms in Kirinyaga favors this fruit crop, and DrumNet farmers have seen strong results. Beginning in 2004, the DrumNet team began to also support the production of two other crops in high demand with Kenyan exporters, French beans and baby corn. These crops have additional advantages over passion fruit — they are less capital intensive, simpler to grow, and have shorter growing periods leading to faster economic returns. Because of

² For example, passion fruit in one quarter of an acre requires an investment of Ksh 5,000 (USD 67) but does not bear fruit for 6 months. The initial TIF for passion fruit is Ksh 1,250. French beans and baby corn only require an investment of Ksh 3,000 per one quarter of an acre and harvesting takes place after 3 months. In Kirinyaga, both French beans and baby corn can be grown and harvested all year.

³ Transaction agents are responsible for coordinating activities within farmer groups. The number of these agents has expanded from approximately 10 in early 2004 to 35 in January 2005. One member of each new farmer group is nominated as the transaction agent, receives additional training, and serves as the main point of contact for DrumNet, facilitating the market transactions. These farmers communicate frequently with the DrumNet staff, both in person in the office and via mobile phones. They are an important conduit of information about pickup schedules, market prices, approved field practices, and shifting grading standards.

this, very few SHG members that participated in DrumNet decided to grow passion fruit. Instead, they focused on french beans and baby corn.

3 Data and Design of Evaluation

The evaluation was conducted in the Gichugu division of the Kirinyaga district of Kenya. First, in December 2003, we collected from the Ministry of Agriculture a list of all horticulture SHGs in Gichugu that had been registered since 2000. There were 96 registered SHGs comprising approximately 3,000 farmers. These data included inactive or disbanded as well as active groups. We therefore administered a “filter” survey to the leaders of each registered SHGs. The primary goal of this survey was to eliminate the inactive or disbanded SHGs.

Of those that passed the filter survey, we randomly assigned the 36 SHGs into three experimental groups of 12 each: (1) all Drumnet services, “treatment-credit,” 12 SHG’s, totaling 290 individuals, (2) all DrumNet services except credit, “treatment-no credit”, 12 SHG’s, totaling 372 individuals, and (3) control (12 SHG’s, totaling 377 individuals). Figure 1 presents a map of Gichugu with the location of the treatment and control SHGs. As evidenced by the map, both treatment and control groups are randomly scattered throughout the area.⁴

After the assignment was done, we checked that the three groups were similar statistically on the limited variables available from the filter survey (i.e., number of members in 2004, SHG age since creation, access to paved road, percentage of members that were already growing export oriented crops, etc.). Panel A of Table 1 reports these orthogonality checks. The last column reports the differences between the treatment group and the controls, along with the significance levels. Although credit SHGs start off slightly worse than control SHGs in terms of infrastructure and remoteness, overall the three experimental groups seem quite similar. Regardless, in the analysis, we will include SHG fixed effects.

In April 2004, we conducted a baseline of 726 farmers randomly from the selected 36 SHGs. At the time of the baseline survey, Drumnet had not yet started operations or marketing, and thus no one had heard of it. During the follow-up in May 2005, we

⁴ Since the area is rather small, potential contamination of the control group is a concern. However, in the follow-up interview fewer than 15 percent of members in control SHGs had heard about DrumNet.

expanded the sample to include 389 SHG registered members at the time of the baseline. (See Figure 2 for a Timeline of Events). Table 1.B reports the average characteristics of these SHG members in treatment-credit SHGs, treatment-no-credit SHGs and control SHGs. All members used in the analysis were registered members at the time of the baseline. The number of observations per variable is either 726 if the information was only elicited in April 2004 or 1,115 if we also asked the question at follow-up retrospectively for the additional sample of 389 members that were included in the follow-up.

About half of the household income of these farmers came from farm activities, while the rest came from employment (both formal and informal), remittances, or government support. Most farmers own the land they cultivate. The median farm size was one acre. Farmers grew subsistence crops (beans, maize, potatoes, and kale) half of the time and cash crops such as coffee, bananas, or tomatoes 34 percent of the time. Twelve percent of the farmers were already growing French beans, the main horticulture crop promoted by DrumNet.

Farm operations are low-tech and so is farm investment. Most farmers use only manual human labor, with fewer than 5 percent utilizing animal labor or machinery to boost productivity. This is not surprising given the small size of the farms. In addition, three quarters of those surveyed rely solely on family labor, not requiring hired labor to plant or harvest crops.

To market their produce, nearly all used the traditional networks of brokers, resellers, and other intermediaries. A few marketed produce directly to consumers locally, and none reported marketing their produce in regional market centers or directly to large-scale end-buyers.⁵ Only 6 percent of the farmers reported access to motorized transport (public transport, car, or truck) for hauling their produce; nearly all transport by foot, bicycle, or animal drawn cart. Most farmers have little control over which intermediaries they work with – three-quarters reported having relationships with three or fewer brokers and a 45 percent reported working exclusively with a single broker. Most produce transactions are cash-on-delivery, and most occur at the farm gate. Although these

⁵ The prime exception was coffee, which in this region is almost exclusively marketed through cooperatives.

traditional arrangements are convenient for the farmer, they erode any advantages of price comparison and informed decision making, generally placing the farmer at a disadvantage.

4 Participation Decision

Using the baseline data, we now examine the decision to participate in the program offered by DrumNet. While almost 40 percent of the members from credit groups joined DrumNet, only 20 percent did so when credit was not included as a DrumNet service. If we look at SHGs rather than individuals, 10 out of 12 SHGs in the treatment-credit group joined DrumNet, compared to only 5 out of 12 from the treatment group without credit. This provides clear evidence that, at a minimum for increasing take-up, credit is perceived by farmers as an essential factor for cultivation of export-oriented crops.

Table 2 shows the determinants of participation in DrumNet. Under “All” (Column 1) we examine all SHG in the treatment group, irrespective of whether they were offered credit or not. Under “Credit” (Column 2) we only examine only SHGs that were offered credit. Among the individual characteristics, literacy, larger households, and being a SHG officer contribute significantly to the probability of participating in DrumNet. Having a deposit in a bank, despite having the expected sign, does not influence significantly the decision to take part in DrumNet. The largest coefficient is found in the no-credit group, because cash is required to make the upfront loan guarantee payment (TIF), and the larger the savings, the easier it is to come up with the funds.

We find a somewhat surprising result regarding land characteristics. Members in the credit group with relatively high harvest yield per acre are less likely to participate in DrumNet. This perhaps is due to farmers with high yields being satisfied with what they grow and not wanting to change crop varieties. In addition, although the coefficients are not statistically significant, households with larger landholdings per member are also less likely to join DrumNet. Less surprisingly, households with a larger percentage of irrigated land are more likely to participate, probably reflecting the fact that having irrigated land was a requirement for participation.

Farmers who sell directly to the market and use hired labor and machines or animal traction, are less likely to join DrumNet. This is intuitive: these farmers are already using the services that DrumNet intends to provide. Consistent with this argument, those who

are already growing export crops are less likely to join DrumNet, except for members in the no-credit SHGs. For the no-credit SHG members, because switching crops requires credit, farmers are required to withdraw from savings, or secure a loan on their own. Either way, this is an obstacle to participate in DrumNet.

All in all, it seems that it is not the wealthier farmers or those that use the most efficient techniques the ones that sign up for DrumNet. Indeed, it is those members that face severe constraints and that see DrumNet as their hope to mitigating some of them.

5 Impact of Drumnet

From commencement in October 2003 to May 2005, DrumNet facilitated over 7,000 marketing transactions on behalf of 647 member farmers and generated Kshs1.3M (US\$16,705) in gross revenue. Table A.1 reports the average number of transactions and the total amount earned per member. It is clear that members in the credit treatment group transacted more with DrumNet, earning larger incomes. One cannot conclude a priori that the no credit group is producing less of these crops because they could be selling the produce to local traders rather than DrumNet. However, because the prices offered by DrumNet are competitive, it seems likely that the production is indeed lower for members of the no credit group.⁶ Again, this fact provides further evidence that DrumNet customers may be credit constrained.

Tables 4 presents the basic impact analysis. We use both baseline and follow-up data to construct a difference-in-difference estimate of impact. Instead of a treatment indicator variable, we use fixed effects for each SHG. The coefficient of “Post x Treatment” identifies the impact of DrumNet on farmer outcomes. In Panel A we report results for the pooled treatment groups, and in Panel B we separately estimate the impact of Drumnet with and without credit. The econometric specification is as follows:

$$(1) \quad Y_{ijt} = \alpha_j + \beta Post_t + \delta Post_t \times Treatment_j + \varepsilon_{ij},$$

and

⁶ Table 4 explores more formally the impact of DrumNet on prices. The price of export crops perceived by members in treatment SHGs are higher than those perceived by members in control SHGs. However, the standard errors are large, and thus the differences are not statistically significant.

$$(2) \quad Y_{ij} = \alpha_j + \beta Post_t + \delta_C Post_t \times Credit_j + \delta_{NC} Post_t \times No\ Credit_j + \varepsilon_{ij},$$

where Y_{ij} is the outcome measure, α_j is the SHG fixed effect, $Post_t$ is a dummy that takes value 1 in year 2005, $Treatment_j$ is a dummy that takes value 1 if the SHG j is a treatment SHG. In specification (2), the dummies $Credit_j$ and $No\ Credit_j$ are defined analogously.

The outcome measures will walk through the process in order to examine at what steps DrumNet causes change. We examine, in chronological order: whether export crops are grown, the percentage of area devoted to cash crops, use of inputs, production of export crops, value of harvest, marketing expenditures and household income. We also examine use of lending or savings services from other formal financial institutions.

First, we find the immediate effect on growing an export crop is strong and significant: treatment individuals are 20% points more likely to be growing an export crop than control individuals, and likewise a greater proportion of their land is dedicated to cash crops. We do not find any increase in expenditure on inputs.

Next we examine production of export crops in Kgs and find large increases for baby corn but insignificant increases for French beans. Most farmers that were already growing export crops were only growing French beans, not baby corn. Thus, the increased production of baby corn can be attributed to DrumNet entirely. Marketing expenditures were also lower for treatment members compared to control members.

Unfortunately, the more difficult to measure outcomes of the value of the produce and household income are positive but statistically insignificant (t-statistics are about 1).

Finally, members in treatment SHGs seem to be obtaining loans for formal sources (other than DrumNet) and are also more likely to have a deposit with a formal institution. The finding on increased borrowing from formal sources is explained below. The finding on the increased number of members with a savings account in a formal institution is not surprising because DrumNet opened an account with all SHG members that did not have one previously to facilitate transactions.

In Panel B, we examine differential effects for the credit and no-credit groups. Surprisingly, despite the differential take-up rates, we do not find many significant

differences between the credit and no-credit groups even on the intent-to-treat specification employed. We find little to no difference in farm yield. An interesting result is that among treatment members, those in the no-credit group are more likely to take out a loan from a formal institution. Because DrumNet does not give credit to these farmers, participants are forced to resort to other lenders for funding.

Another noticeable difference is household income: the no-credit group has a positive increase in household income whereas the credit group does not. The difference in the coefficients is significant at the 5 percent level. Although both coefficients are insignificant, the no-credit one is borderline significant. This finding is somewhat puzzling and deserves further investigation. One possibility is that the crop prices that members in the no credit group receive are actually higher than those of the credit group. Although DrumNet negotiates prices with exporters in an attempt to beat intermediaries, members of the no credit group can in principle sell to whoever offers the best price, while members of the credit group are forced to sell to DrumNet in order to repay the loan. To explore the possibility of different prices, Table 4 reports the results of a price regression. One can therefore decompose differences in prices before and after DrumNet by treatment and control groups. There are two specifications, one when we use the average price using all the transactions conducted by the SHG member, regardless of the buyer, and another that only includes transactions at the farm gate. In the first specification, where all crops are included, we find that the no credit group receives significantly higher prices at farm gate than the control, although there is no significant difference between the two treatment groups (p-value = 0.21). In the crop by crop analysis, we find that except for French beans, the no credit group gets higher prices than the control group, but these differences are not significant. In the case of the French beans, note the credit group received significantly higher prices than the no credit group. Since we documented earlier that credit group members transact more with DrumNet, this result suggests that DrumNet is effective at securing higher prices to French bean growers, and that no credit group members possibly do not sell their production to DrumNet or miss pick-up appointments, in which case are then forced to sell the perishable produce to the first trader that comes along.

In Tables 5 and 6, we examine heterogeneous treatment effects for those who were already growing DrumNet export crops versus those that were not (Table 5) and for males versus females (Table 6). For each outcome variable we employ the above specifications, also presented in Table 3.

In Table 5 we find that those who benefit the most are precisely first-time growers of export crops. While old adopters do not devote more land to cash crops nor do they increase production of French beans, first-time adopters do so significantly. Both old adopters and new adopters increase their production of baby corn, since as mentioned before, baby corn was introduced by DrumNet. Interestingly, only old adopters perceive a reduction in marketing costs. This could be explained by the fact that first-time adopters were only selling at the farmgate, while old adopters were hauling their produce to be exported to markets.

Most importantly, we find here that income is significantly larger for first-time treatment members. When we disaggregate credit and no-credit impact, it is the first-time adopters in the no-credit group that experience a significant increase in income. However, the difference in coefficients between credit and no-credit is not significant.

6. Conclusions

We examine whether an intervention to help smallholder farmers access export markets can improve household income. We find that the program does succeed in getting farmers to switch crops, and that as a result farmers earn higher net margins and higher gross prices for their produce. When we compare members that were offered credit to those that were not, we find that credit is effective in improving yield per acre, but this improvement does not translate into differential income gains. This suggests that access to credit is *not necessarily* the primary explanation for why farmers are not accessing these markets on their own. However, given the higher yield for the credit group, we believe further evidence is needed before concluding which components of the Drumnet program are necessary and which are not.

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Figure 1: Location of SHGs in Gichugu Division: Treatment (black), Control (white).

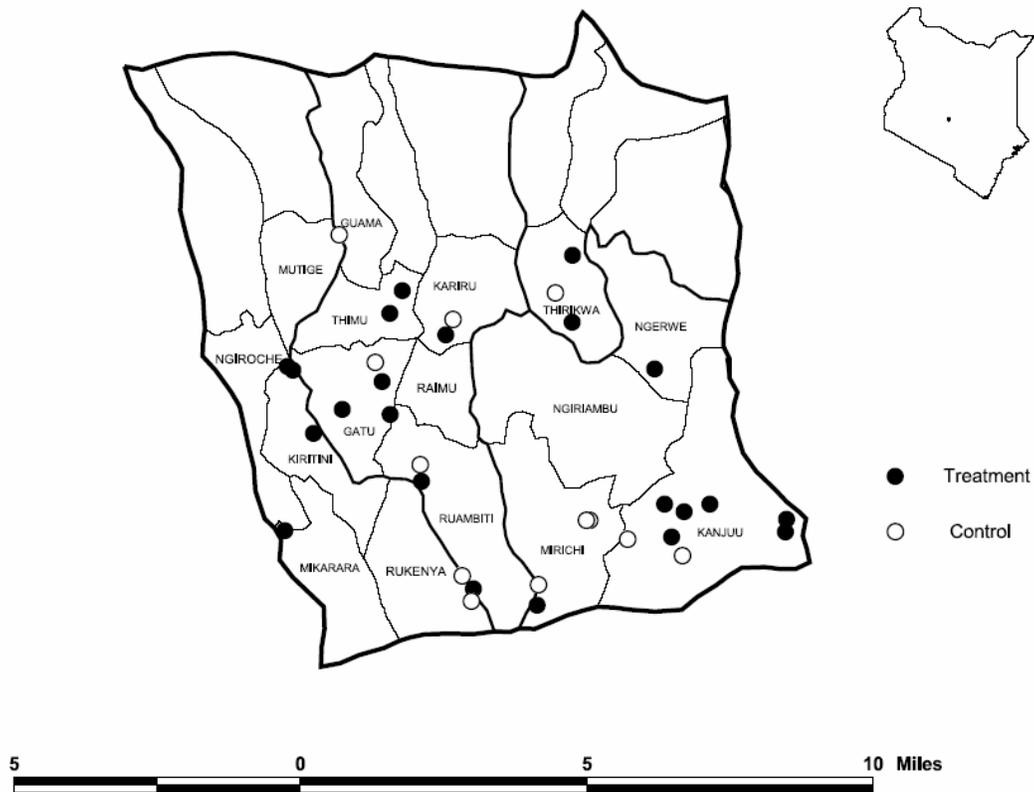


Figure 2: Timeline of Events

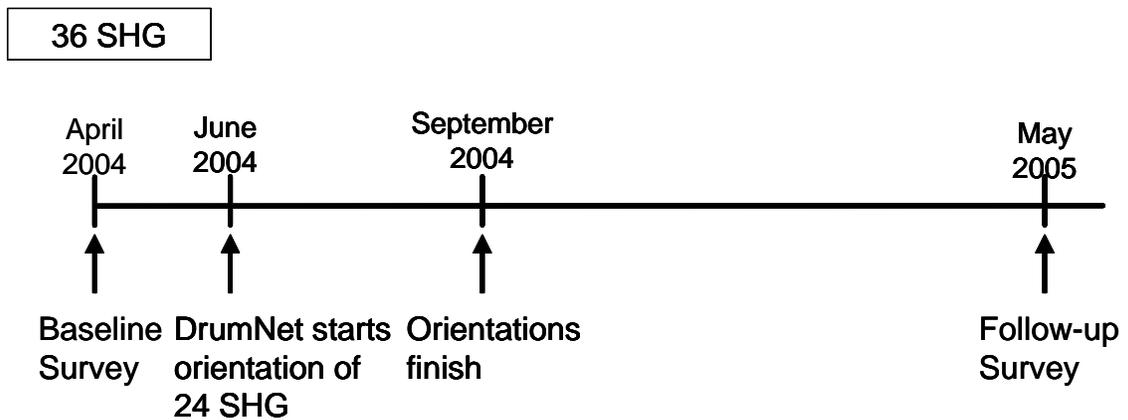


Table 1
Baseline Characteristics
Means and Standard Deviations

Panel A: SHG characteristics from Filter Survey								
	N. of Obs.	Means			Difference	Means		F-stat
		All	Control	Treatment	[t-stat]	Credit	No credit	[p-value]
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Current number of members	36	28.7 (17.5)	31.4 (19.6)	27.3 (16.6)	-4.13 [-0.66]	24.2 (11.3)	31.0 (21.3)	0.67 [0.52]
Age of SHG (months)	36	4.77 (4.89)	4.99 (3.9)	4.66 (5.39)	-0.33 [-0.19]	5.24 (6.24)	3.97 (4.37)	0.21 [0.81]
SHG has social activities (1 = yes)	36	0.53 (0.51)	0.75 (0.45)	0.42 (0.5)	-0.33 [-1.93]	0.46 (0.52)	0.36 (0.5)	1.94 [0.16]
Fee contribution to the SHG per member	36	103 (106)	87.5 (56.9)	111 (124)	23.1 [0.61]	111 (128)	110 (126)	0.18 [0.83]
SHG has an account in the bank (1=yes)	36	0.64 (0.49)	0.67 (0.49)	0.63 (0.49)	-0.04 [-0.24]	0.62 (0.51)	0.64 (0.5)	0.03 [0.97]
Main road paved (1 = yes)	36	0.86 (0.35)	1.00 (0)	0.79 (0.41)	-0.21 [-1.73]	0.69 (0.48)	0.91 (0.3)	2.81 [0.07]
Km to main market	36	5.82 (3.6)	5.08 (3.2)	6.19 (3.79)	1.10 [0.86]	5.42 (3.09)	7.09 (4.46)	1.02 [0.37]
Time to the main market (minutes)	36	41.5 (47.1)	22.5 (16)	51.0 (54.6)	28.5 [1.76]	65.0 (68.6)	34.5 (25.3)	3.02 [0.06]

Data from Panel A comes from the SHG filter survey conducted in February 2004. Each observation is a SHG. Data from Panel B come from the baseline survey, conducted in April 2004. Each observation is a SHG member. The standard deviation of each variable for columns (1) - (3) and (5)-(6) appear below the means in brackets. In Panel A (Panel B), the first column includes all SHGs (members). The following column (Control) includes control SHGs; the next column, SHGs that received DrumNet services including those that also received credit (Credit) in column (5) and those that did not (No credit) in column (6). Column (4) reports the difference between Treatment and Control SHGs and the t-stat below in square brackets. Column (7) reports the F-stat associated with the null hypothesis of Credit and No Credit being jointly equal to zero. The p-value of the test is reported below in square brackets. Only SHG members at the time of the baseline are included.

Panel B: Household characteristics from Baseline Survey

	N. of Obs.	Means			Difference	Means		F-stat
		All (1)	Control (2)	Treatment (3)	[t-stat] (4)	Credit (5)	No credit (6)	[p-value] (7)
<i>Member</i>								
Age of member	1115	41.2 (11.9)	39.6 (11.7)	41.9 (12.1)	2.37 [1.24]	42.0 (11.9)	41.8 (12.1)	0.79 [0.46]
Literacy	1115	0.91 (0.28)	0.90 (0.29)	0.91 (0.28)	0.02 [0.56]	0.94 (0.24)	0.89 (0.31)	1.87 [0.17]
Months as member in SHG	726	52.6 (39.7)	57.4 (44.3)	49.9 (36.5)	-7.52 [-0.68]	49.0 (33.3)	50.6 (39.2)	0.28 [0.76]
Deposit in a formal bank (1=yes)	726	0.69 (0.46)	0.71 (0.46)	0.69 (0.46)	-0.02 [-0.35]	0.71 (0.45)	0.66 (0.47)	0.41 [0.66]
Loan from formal institutions (1=yes)	726	0.04 (0.21)	0.07 (0.27)	0.03 (0.17)	-0.04 [-2.43]	0.05 (0.22)	0.01 (0.09)	10.83 [0.00]
Logarithm of total household income	726	3.49 (1.19)	3.59 (1.18)	3.44 (1.19)	-0.15 [-1.10]	3.67 (1.16)	3.23 (1.18)	3.93 [0.03]
Number of Household members	726	4.58 (2.09)	4.54 (2.12)	4.61 (2.08)	0.06 [0.26]	4.71 (2.23)	4.52 (1.94)	0.30 [0.74]
<i>Land</i>								
Harvest yield per acre (in Ksh 1,000)	726	29.7 (61.5)	33.9 (64.5)	27.3 (59.8)	-6.59 [-1.03]	25.8 (41.3)	28.6 (72.2)	0.89 [0.42]
Pct of irrigate irrigated land	1115	0.39 (0.31)	0.39 (0.29)	0.40 (0.32)	0.01 [0.22]	0.43 (0.32)	0.36 (0.32)	0.75 [0.48]
Total landholdings (Acres)	726	0.55 (0.59)	0.55 (0.59)	0.54 (0.60)	-0.01 [-0.10]	0.57 (0.62)	0.52 (0.58)	0.29 [0.75]
Pct. Land devoted to cash crops	1115	0.58 (0.25)	0.60 (0.24)	0.57 (0.26)	-0.03 [-0.71]	0.59 (0.24)	0.55 (0.28)	0.41 [0.67]
<i>Production</i>								
Value of harvested produce (in Khs 1,000)	726	44.4 (72.6)	48.1 (72.8)	42.3 (72.4)	-5.78 [-0.87]	47.5 (78.1)	37.7 (66.9)	1.32 [0.28]
Grows export crops (1=yes)	1115	0.48 (0.49)	0.58 (0.47)	0.43 (0.48)	-0.15 [-1.66]	0.49 (0.49)	0.36 (0.47)	2.29 [0.12]
Production of french beans (in 1,000 Kg.)	1115	3.33 (14.4)	2.79 (13.1)	3.60 (14.9)	0.81 [0.54]	4.49 (17.0)	2.72 (12.5)	0.60 [0.55]
Production of baby corn (in Kg.)	1115	5.15 (108)	9.50 (158)	3.03 (73.1)	-6.47 [-0.69]	5.82 (104)	0.26 (1.59)	1.15 [0.33]
Sells to market (1=yes)	726	0.39 (0.49)	0.41 (0.49)	0.39 (0.49)	-0.02 [-0.54]	0.36 (0.48)	0.41 (0.49)	0.36 [0.70]
Total spent in marketing (in Khs 1,000)	726	1.00 (8.18)	0.36 (2.13)	1.36 (10.1)	1.00 [1.95]	2.03 (13.8)	0.78 (4.91)	2.42 [0.10]
Uses hired labor (1=yes)	1115	0.33 (0.45)	0.32 (0.44)	0.33 (0.46)	0.01 [0.32]	0.36 (0.47)	0.31 (0.45)	0.72 [0.49]
Uses Machinery and/or animal force (1=yes)	1115	0.06 (0.23)	0.09 (0.28)	0.04 (0.19)	-0.05 [-2.12]	0.04 (0.18)	0.05 (0.20)	2.70 [0.08]
Use of inputs	1115	0.94 (0.23)	0.94 (0.22)	0.94 (0.23)	0.00 [0.02]	0.95 (0.21)	0.93 (0.24)	0.45 [0.64]

Table 2
Individual determinants of Participation in DrumNet
OLS

	All (1)	Credit (2)	No credit (3)
Age	0.002 [0.002]	0.002 [0.003]	0.001 [0.002]
Literacy	0.178 [0.050]***	0.264 [0.061]***	0.1 [0.068]
Months in SHG	-0.001 [0.001]	-0.001 [0.002]	-0.001 [0.001]
SHG is an officer (1=yes)	0.147 [0.046]***	0.219 [0.076]**	0.07 [0.055]
Deposit in a formal bank (1=yes)	0.035 [0.043]	0.017 [0.085]	0.066 [0.037]
Logarithm of total income per household member	-0.006 [0.026]	-0.028 [0.044]	0.021 [0.017]
Number HH members	0.036 [0.009]***	0.044 [0.014]**	0.03 [0.008]***
Harvest yield per acre (in 1000 Ksh)	-0.0001 [0.0002]	-0.0012 [0.0006]*	0.0002 [0.0002]
Percent of land that is irrigated	0.148 [0.050]***	0.196 [0.083]**	0.131 [0.051]**
Total land per household member (Acres)	-0.004 [0.010]	-0.001 [0.019]	-0.009 [0.012]
Sells to market (1=yes)	-0.137 [0.038]***	-0.097 [0.045]*	-0.147 [0.054]**
Uses hired labor (1=yes)	-0.062 [0.030]*	-0.07 [0.031]**	-0.057 [0.047]
Uses Machinery and/or animal force (1=yes)	-0.105 [0.171]	-0.286 [0.153]*	0.091 [0.194]
Grows export crops (1=yes)	-0.016 [0.041]	-0.042 [0.079]	0.024 [0.039]
Observations	714	353	361
R squared	0.27	0.25	0.3
Mean dependent variable	0.391	0.453	0.330

The dependent variable is DrumNet membership. The column "All" uses the whole sample of registered SHG members at the time of the baseline in treatment SHGs, column "Credit" ("No credit") uses the subsample of registered SHG members at the time of the baseline in credit (no-credit) SHGs. Data come from the baseline survey conducted in April 2004 before DrumNet was introduced to the treatment SHGs. Standard errors clustered at the SHG are reported in brackets below the coefficient. The symbol *,**,*** represent significance at the 10, 5 and 1 percent, respectively. All regressions are estimated using linear probability model clustering the standard errors at the SHG level and include SHG fixed effects.

Table 3
Impact of DrumNet
OLS

Panel A: Treatment										
	Export Crop	Pct. Land devoted to cash crops	Use of inputs	Production of french beans (Kg.)	Production of baby corn (Kg.)	Value of harvested produce (in Khs 1,000)	Total spent in marketing (in Khs 1,000)	HH Income (in Khs 1,000)	Loan from Formal Institutions	Deposit in Formal Institutions
Post	-0.031 [0.055]	-0.059 [0.016]***	0.039 [0.016]**	1.32 [0.807]	29.304 [30.018]	-8.477 [4.446]*	3.185 [1.754]*	-0.071 [0.098]	-0.052 [0.012]***	0.126 [0.035]***
Post x Treatment	0.202 [0.063]***	0.04 [0.022]*	-0.003 [0.018]	1.79 [1.295]	415.412 [99.074]***	5.568 [6.691]	-3.874 [1.871]**	0.081 [0.115]	0.05 [0.015]***	0.075 [0.039]*
Num. Observations	2071	2071	2071	2071	2071	1682	1682	1682	1682	1682
R-squared	0.2	0.1	0.04	0.1	0.05	0.04	0.01	0.06	0.04	0.12
Panel B: Credit vs. No Credit										
	Export Crop	Pct. Land devoted to cash crops	Use of inputs	Production of french beans (in 1,000 Kg.)	Production of baby corn (Kg.)	Value of harvested produce (in Khs 1,000)	Total spent in marketing (in Khs 1,000)	HH Income (logarithm)	Loan from Formal Institutions	Deposit in Formal Institutions
Post	-0.031 [0.055]	-0.059 [0.016]***	0.039 [0.016]**	1.32 [0.807]	29.304 [30.025]	-8.477 [4.448]*	3.185 [1.755]*	-0.071 [0.098]	-0.052 [0.012]***	0.126 [0.035]***
Post x Credit	0.236 [0.073]***	0.038 [0.025]	-0.005 [0.020]	2.641 [1.722]	494.02 [156.028]***	1.346 [10.110]	-4.426 [2.184]*	-0.041 [0.129]	0.037 [0.022]	0.088 [0.047]*
Post x No Credit	0.169 [0.068]**	0.043 [0.027]	-0.001 [0.019]	0.974 [1.583]	339.99 [116.448]***	9.356 [6.300]	-3.379 [1.796]*	0.19 [0.115]	0.061 [0.014]***	0.063 [0.040]
Num. Observations	2071	2071	2071	2071	2071	1682	1682	1682	1682	1682
R-squared	0.2	0.1	0.04	0.1	0.06	0.04	0.01	0.07	0.04	0.12
Mean dep. variable	0.525	0.565	0.961	4.595	157.682	40.479	1.379	3.491	0.033	0.800
<i>P-value of Test Post x Credit = Post x No credit</i>										
	0.291	0.873	0.817	0.420	0.423	0.434	0.445	0.031	0.247	0.503

The variable Post takes value 1 in year 2005, when Follow-up was conducted. In Panel A, the variable Treatment is a dummy variable that takes value 1 if the member is in a treatment SHG. In Panel B, the variables Credit and No Credit are dummy variables for each treatment group. All regressions are estimated using OLS with clustering at the SHG level and SHG fixed effects. Robust standard errors are reported in brackets below the coefficient. The symbol *, **, *** represent significance at the 10, 5 and 1 percent, respectively. Only SHG members at the time of the baseline are included in the regression.

Table 4
Impact of DrumNet on Prices
OLS

	All crops		Maize dry		Beans		Bananas		French Beans	
	All	Farmgate	All	Farmgate	All	Farmgate	All	Farmgate	All	Farmgate
Post	-8.12 (6.15)	-9.48 (12.44)	7.43 (11.92)	11.84 (17.86)	-108.12 (75.27)	-79.91 (84.46)	0.16 (2.70)	1.20 (2.81)	-0.04 (0.60)	-0.84 (1.35)
Credit	-3.71 (12.06)	-5.70 (23.17)	27.22 (38.03)	19.27 (47.25)	-144.08 (163.57)	-143.20 (204.37)	15.85 (12.26)	11.35 (11.70)	-0.06 (1.71)	-1.57 (1.86)
No Credit	3.97 (13.29)	24.94 (27.36)	72.16 (39.09)*	112.44 (54.07)**	-90.33 (154.76)	4.87 (207.65)	5.04 (11.88)	2.35 (12.23)	0.46 (1.54)	0.89 (2.54)
Post x Credit	7.68 (8.78)	5.72 (18.49)	-24.46 (30.68)	-39.94 (33.18)	140.39 (102.42)	88.94 (132.84)	-4.37 (5.21)	-1.63 (3.64)	1.16 (0.73)	0.74 (1.82)
Post x No credit	8.02 (9.21)	26.47 (14.96)*	-6.59 (15.52)	15.58 (25.71)	93.26 (95.24)	143.46 (117.97)	2.92 (3.86)	4.96 (4.06)	-0.42 (0.86)	-0.04 (2.23)
Constant	326.63 (7.35)***	494.30 (17.28)***	1,042.37 (32.82)***	1,047.87 (40.96)***	1,897.52 (101.93)***	1,798.47 (136.28)***	106.32 (8.48)***	104.65 (8.53)***	21.62 (1.33)***	19.59 (1.60)***
Number of Observations	2,397	1,022	325	204	190	129	614	532	594	151
R-squared	0.88	0.86	0.02	0.06	0.01	0.01	0.01	0.01	0.00	0.02
<i>P-value of Tests</i>										
Credit = No credit	0.6	0.22	0.12	0.04	0.75	0.5	0.38	0.45	0.69	0.27
Post x Credit = Post x No credit	0.97	0.21	0.55	0.11	0.61	0.69	0.17	0.09	0.04	0.72

The dependent variable is price per unit of weight depending on the crop. The first specification uses all crops and includes a crop fixed effect. The variable Post takes value 1 in year 2005. The variables Credit and No Credit are dummy variables for each treatment group. All regressions are estimated using OLS with clustering at the SHG level. Robust standard errors are in parentheses. The symbols *, ** and *** represent significance at the 10, 5 and 1 percent, respectively.

Table 5
Impact of DrumNet by Growing Export Crop in 2004

Panel A: Treatment																
	Pct. Land devoted to cash crops		Production of french beans (Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing		HH Income (logarithm)		Loan from Formal Institutions		Deposit in Formal Institutions	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Grows export crops at baseline																
Post	-0.08 [0.018]***	-0.035 [0.026]	2.03 [1.993]	2.099 [0.843]**	17.418 [23.363]	83.159 [48.475]*	-15.188 [7.704]*	1.795 [4.672]	4.866 [3.151]	2.139 [1.877]	-0.101 [0.090]	-0.097 [0.187]	-0.069 [0.013]***	-0.03 [0.016]*	0.096 [0.038]**	0.161 [0.037]***
Post x Treatment	-0.025 [0.028]	0.085 [0.032]**	-3.697 [2.425]	4.9 [2.022]**	486.101 [130.363]***	367.839 [106.589]***	2.077 [12.227]	8.897 [7.075]	-6.755 [3.284]**	-1.47 [1.964]	-0.086 [0.115]	0.408 [0.196]**	0.062 [0.022]***	0.031 [0.020]	0.068 [0.050]	0.08 [0.051]
# Observations	902	1039	902	1039	902	1039	807	804	807	804	807	804	807	804	807	804
R-squared	0.14	0.1	0.12	0.17	0.06	0.06	0.07	0.1	0.01	0.07	0.1	0.11	0.06	0.06	0.1	0.17
Panel B: Credit vs. No Credit																
	Pct. Land devoted to cash crops		Production of french beans (Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing		HH Income (logarithm)		Loan from Formal Institutions		Deposit in Formal Institutions	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Grows export crops at baseline																
Post	-0.08 [0.018]***	-0.035 [0.026]	2.03 [1.994]	2.099 [0.844]**	17.418 [23.376]	83.159 [48.499]*	-15.188 [7.709]*	1.795 [4.675]	4.866 [3.153]	2.139 [1.878]	-0.101 [0.090]	-0.097 [0.188]	-0.069 [0.013]***	-0.03 [0.016]*	0.096 [0.038]**	0.161 [0.037]***
Post x Credit	-0.029 [0.031]	0.107 [0.040]**	-4.268 [2.758]	8.171 [2.558]***	618.8 [206.670]***	413.467 [152.211]**	-3.548 [15.851]	19.723 [5.660]***	-7.799 [3.504]**	-0.335 [2.267]	-0.096 [0.140]	0.32 [0.199]	0.067 [0.031]**	-0.007 [0.027]	0.06 [0.064]	0.152 [0.051]***
Post x No Credit	-0.02 [0.040]	0.068 [0.036]*	-2.97 [2.721]	2.384 [2.459]	317.235 [105.461]***	332.739 [139.040]**	9.331 [13.378]	2.588 [8.159]	-5.409 [3.202]	-2.132 [1.898]	-0.073 [0.125]	0.459 [0.207]**	0.055 [0.019]***	0.053 [0.021]**	0.078 [0.051]	0.038 [0.057]
#Observations	902	1039	902	1039	902	1039	807	804	807	804	807	804	807	804	807	804
R-squared	0.14	0.1	0.12	0.18	0.07	0.06	0.07	0.1	0.01	0.07	0.1	0.11	0.06	0.06	0.1	0.17
Mean dep. Var	0.651	0.493	6.872	2.803	151.689	171.007	50.137	30.608	1.975	0.775	3.633	3.356	0.036	0.029	0.813	0.782
<i>P-value of Test Post x Credit = Post x No credit</i>	0.847	0.327	0.628	0.093	0.198	0.681	0.471	0.027	0.151	0.177	0.868	0.213	0.712	0.025	0.780	0.050

The variable Post takes value 1 in year 2005, when Follow-up was conducted. In Panel A, the variable Treatment is a dummy variable that takes 1 if the member is in a treatment SHG. In Panel B, the variables Credit and No Credit are dummy variables for each treatment group. All regressions are estimated using OLS with clustering at the SHG level and SHG fixed effects. Robust standard errors are reported in brackets below the coefficient. The symbol *, **, *** represent significance at the 10, 5 and 1 percent, respectively. Only SHG members at the time of the baseline are included in the regression.

Table 6
Impact of DrumNet by Gender

Panel A: Treatment																		
	Export Crop		Pct. Land devoted to cash crops		Production of french beans (Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing		HH Income (logarithm)		Loan from Formal Institutions		Deposit in Formal Institutions	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
SHG member is a male	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Post	-0.054	0.022	-0.069	-0.046	1.39	1.234	-9.761	91.9	-13.669	-1.523	4.232	2.438	-0.223	0.236	-0.062	-0.017	0.116	0.166
	[0.062]	[0.091]	[0.018]***	[0.036]	[0.920]	[1.326]	[12.526]	[64.024]	[5.985]**	[8.729]	[2.959]	[2.330]	[0.123]*	[0.190]	[0.016]***	[0.035]	[0.032]***	[0.063]**
Post x Treatment	0.196	0.197	0.046	0.039	1.595	1.994	460.708	356.005	15.748	-4.309	-4.941	-3.208	0.198	-0.203	0.072	-0.009	0.077	0.02
	[0.078]**	[0.094]**	[0.027]*	[0.039]	[1.658]	[1.675]	[155.563]***	[138.619]**	[8.513]*	[10.555]	[3.026]	[2.676]	[0.144]	[0.211]	[0.019]***	[0.041]	[0.043]*	[0.068]
# Observations	1153	847	1153	847	1153	847	1153	847	940	675	940	675	940	675	940	675	940	675
R-squared	0.19	0.22	0.1	0.09	0.09	0.15	0.08	0.07	0.04	0.09	0.01	0.07	0.06	0.15	0.04	0.08	0.14	0.13
Panel B: Credit vs. No Credit																		
	Export Crop		Pct. Land devoted to cash crops		Production of french beans (Kg.)		Production of baby corn (Kg.)		Value of harvested produce (in Khs 1,000)		Total spent in marketing		HH Income (logarithm)		Loan from Formal Institutions		Deposit in Formal Institutions	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
SHG member is a male	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Post	-0.054	0.022	-0.069	-0.046	1.39	1.234	-9.761	91.9	-13.669	-1.523	4.232	2.438	-0.223	0.236	-0.062	-0.017	0.116	0.166
	[0.062]	[0.091]	[0.018]***	[0.036]	[0.921]	[1.327]	[12.531]	[64.062]	[5.989]**	[8.735]	[2.960]	[2.331]	[0.123]*	[0.191]	[0.016]***	[0.035]	[0.032]***	[0.063]**
Post x Credit	0.246	0.224	0.042	0.042	1.588	4.153	723.593	130.663	12.685	-5.972	-5.237	-4.367	0.132	-0.413	0.076	-0.061	0.082	0.022
	[0.088]***	[0.101]**	[0.031]	[0.040]	[1.930]	[2.290]*	[250.366]***	[101.749]	[10.929]	[16.620]	[3.109]	[4.079]	[0.161]	[0.236]*	[0.024]***	[0.057]	[0.049]	[0.080]
Post x No Credit	0.135	0.178	0.051	0.037	1.604	0.471	141.116	514.983	19.323	-3.259	-4.596	-2.475	0.275	-0.07	0.068	0.023	0.071	0.018
	[0.096]	[0.094]*	[0.035]	[0.044]	[2.437]	[1.481]	[54.063]**	[173.572]***	[9.265]**	[9.522]	[3.071]	[2.353]	[0.153]*	[0.206]	[0.019]***	[0.035]	[0.053]	[0.069]
#Observations	1153	847	1153	847	1153	847	1153	847	940	675	940	675	940	675	940	675	940	675
R-squared	0.19	0.22	0.1	0.09	0.09	0.15	0.09	0.07	0.04	0.09	0.01	0.07	0.07	0.15	0.04	0.09	0.14	0.13
Mean dep. Var	0.568	0.453	0.590	0.526	4.454	5.152	151.070	178.283	42.538	36.937	1.555	1.191	3.484	3.494	0.032	0.031	0.841	0.797
<i>P-value of Test Post x Credit = Post x No credit</i>																		
	0.254	0.338	0.813	0.864	0.996	0.072	0.029	0.040	0.570	0.854	0.613	0.577	0.304	0.038	0.715	0.075	0.805	0.943

The variable Post takes value 1 in year 2005, when Follow-up was conducted. The variable Treatment is a dummy variable that takes 1 if the member is in a treatment SHG. The variables Credit and No Credit are dummy variables for each treatment group. All regressions are estimated using OLS with clustering at the SHG level and SHG fixed effects. Robust standard errors are reported in brackets below the coefficient. The symbol *, **, *** represent significance at the 10, 5 and 1 percent, respectively. Only SHG members at the time of the baseline are included in the regression.

Table A.1
Transactions with DrumNet

Data come from the DrumNet administrative records.			
	Credit	No credit	
	Means		Difference
<i>French beans</i>			
Num. Transactions	4.69	2.27	2.423**
Total earned (Shillings)	2,707.35	121.29	1,496.1*
<i>Baby corn</i>			
Num. Transactions	6.33	4.06	2.27
Total earned (Shillings)	4,285.50	2,702.25	1,583.30
<i>Total</i>			
Num. Transactions	8.91	4.39	4.52*
Total earned (Shillings)	5,971.08	2,668.95	3,302.10
<i>N. of observations</i>	188	125	