Appendix to

Seasonal liquidity, rural labor markets and agricultural production

A.1 Model Appendix

We use this Appendix to derive the optimality conditions for labor supply and consumption and show comparative statics with respect to effective interest rates and initial resources, which are necessary for the model predictions described in Section 2. We also show conditions under which the net output effects (prediction 2) are positive with equilibrium wage responses.

A.1.1 Set up

Following Section 2, rational households maximize utility from consumption and leisure over two periods:

$$\max_{c,l} \; log(c_{i1} - \underline{c}) + \frac{1-\alpha}{\alpha} log(l_{i1}) + \rho log(c_{i2} - \underline{c}) \tag{A.1}$$

subject to

$$c_{i1} \leq S_{i0} + (\bar{h} - l_i - d_i)w + B_i$$

$$c_{i2} \leq y(d_i) - B_i[(1+r^b)1(B_i > 0) - (1+r^s)1(B_i < 0)],$$

where B_i is net borrowing ($B > 0$ implies borrowing and $B < 0$ implies saving) during the first period. Defining the effective interest rate faced by each farm as

$$r_i^e = \begin{cases} 1 + r^b(S_{i0}) & \text{if } B_i > 0 \\ 1 + r^s & \text{if } B_i < 0 \end{cases},$$

we can express the overall budget constraint as

$$S_{i0} + h_i w + \frac{1}{r_i^e} y(d_i) - d_i w - c_1 - \frac{1}{r_i^e} c_2 \geq 0.$$

With Cobb-Douglas production and a fixed land endowment, optimal labor demand (on-farm input) d^* is a function of productivity, wages and interest rates:

$$d_i^* = k \left(\frac{\beta A_i}{w r_i^e} \right)^{\frac{1}{1-\beta}}. \tag{A.2}$$

Equation (A.2) implies optimal output $y(d^*(A_i, w, r_i^e))$, so that we can define net wealth as $S_i^* = S_0 + \frac{1}{r_i^e} y(d_i^*) - d_i^* w$ as the sum of initial endowment and expected profit. The overall budget constraint can be simplified to

$$S_i^* + h_i w - c_1 - \frac{1}{r_i^e} c_2 \geq 0. \tag{A.3}$$

The three first order conditions with respect to first and second period consumption and first period leisure are given by

$$\frac{1}{c_1 - \underline{c}} - \lambda = 0$$

$$\rho \frac{1}{c_2 - \underline{c}} - \lambda \frac{1}{r_i^e} = 0$$

$$-1 \frac{1-\alpha}{\alpha} \frac{1}{\bar{h} - h_i} + \lambda w = 0$$

Re-arranging terms, we can express period specific consumption as

$$c_1 = \frac{\alpha w}{1-\alpha}(\bar{h} - h_i) + \underline{c}$$

and

$$c_2 = \rho r_e \frac{\alpha w}{1-\alpha}(\bar{h} - h_i) + \underline{c}$$

Plugging these into the simplified budget constraint yields

$$S^* + h_i w - [\frac{\alpha w}{1-\alpha}(\bar{h} - h_i) + \underline{c}] - \frac{1}{r_i^e}[\rho r_i^e \frac{\alpha w}{1-\alpha}(\bar{h} - h_i) + \underline{c}] = 0. \tag{A.4}$$

Before turning to the optimality conditions and comparative statics labor and consumption, it is useful to sign the derivates of $S_i^* = S_0 + \frac{1}{r_i^e} y(d_i^*) - d_i^* w$ with respect to effective interest rates and initial resources. In a partial equilibrium setting where wages do not adjust to interest rates, the derivate is given by

$$\frac{\partial S_i^*}{r_i^e} = -\frac{1}{(r_i^e)^2} y(d_i^*) + (\frac{1}{r_i^e} \frac{\partial y}{\partial d^*})(\frac{\partial d^*}{\partial r_i^e}) - \frac{\partial d^*}{\partial r_i^e} w. \tag{A.5}$$

The first term is negative, the second negative and the third positive so the sign of the overall expression is not immediately obvious. However, we also know from equation (A.2) that the discounted marginal product of labor ($\frac{1}{r_i^e} \frac{\partial y}{\partial d^*}$) will always be larger or equal to the marginal wage cost, which means that the overall expression must always be negative, which implies that net output increases with lower interest rates when wages stay constant.

A.1.2 Labor supply (h^*) and demand (d^*)

Equation (A.4) can be rearranged as the optimal labor supply condition:

$$h_i^* = \frac{\frac{\alpha}{1-\alpha}(1+\rho)\bar{h} + \frac{1}{w}\left[\underline{c}(1+\frac{1}{r_i^e}) - S_i^*\right]}{(1+\frac{\alpha}{1-\alpha}+\rho\frac{\alpha}{1-\alpha})}. \tag{A.6}$$

Prediction 1 depends on the signs on $\partial h_i^*/\partial r_i^e$ and $\partial h_i^*/\partial S_{i0}$. The first is given by

$$\frac{\partial h_i^*}{\partial r_i^e} = \frac{\frac{1}{w}[\frac{-\underline{c}}{(r_i^e)^2} - \frac{\partial S^*}{\partial r_i^e}]}{1+(1+\rho)(\frac{\alpha}{1-\alpha})},$$

which can be signed as follows. The first term in the numerator is negative while the second term is positive (by subtracting the negative partial in equation (A.5). Higher interest rates increase the relative price of consumption, and thus induce a substitution effect towards leisure; this is offset by the negative income effect (loss in net wealth), which creates additional incentives to work.

Optimal labor demand is given above in equation (A.2), for which the derivative with respect to r_i^e can easily be seen to be negative.

A.1.3 Consumption

Equation (A.4) can be rearranged to express optimal first period consumption as

$$c_1 = \frac{\underline{c}(1-\alpha) + \underline{c}(-\alpha r_i^e + r_i^e\rho(\alpha-1)) + r_i^e S_i^*(\alpha-1) + \overline{h} r_i^e w(\alpha-1)}{-r_i^e + r_i^e\rho(\alpha-1)}$$

which can be simplified to

$$c_1^* = \frac{\underline{c}(\frac{1}{r_i^e} + \frac{\alpha}{1-\alpha} + \rho) + S_i^* + \overline{h}w}{\frac{1}{1-\alpha}+\rho}. \tag{A.7}$$

This expression is increasing in S_{i0}, which enters only through S_i^*. The sign of

$$\frac{\partial c_1^*}{\partial r_i^e} = \frac{\frac{-\underline{c}}{(r_i^e)^2} + \frac{\partial S^*}{\partial r_i^e}}{\frac{1}{1-\alpha}+\rho}$$

is unambiguously negative since both the first and the second terms are negative.

Similarly, second period consumption is given by

$$c_2^* = \frac{\underline{c}(-1 + r_i^e\rho(1-\alpha)) + \rho r_i^e S^*(\alpha-1) + \overline{h}\rho r_i^e w(\alpha-1)}{-1+\rho(\alpha-1)}$$

which can be simplified to

$$c_2^* = \frac{\underline{c}(\frac{1}{1-\alpha} - r_i^e\rho) + \rho r_i^e S^* + \overline{h}\rho r_i^e w}{\frac{1}{1-\alpha}+\rho}. \tag{A.8}$$

with

$$\frac{\partial c_2^*}{\partial r_i^e} = \frac{\rho(-\underline{c} + S^* + r_i^e \frac{\partial S^*}{\partial r_i^e} + \bar{h}w)}{\frac{1}{1-\alpha} + \rho}.$$

Consumption seasonality is expressed as the ratio c_2^*/c_1^*:

$$\frac{\underline{c}(\frac{1}{1-\alpha} - r_i^e\rho) + \rho r_i^e S^* + \overline{h}\rho r_i^e w}{\underline{c}(\frac{1}{r_i^e} + \frac{\alpha}{1-\alpha} + \rho) + S_i^* + \overline{h}w},$$

which is increasing in r_i^e.

$$\frac{\partial(c_2^*/c_1^*)}{\partial r_i^e} = \frac{\frac{\partial c_{2^*}}{\partial r_i^e} \times c_1^* - \frac{\partial c_{1^*}}{\partial r_i^e} \times c_2^*}{(c_2^*)^2} = \frac{[\rho(-\underline{c} + S^* + r_i^e \frac{\partial S^*}{\partial r_i^e} + \bar{h}w)] \times c_1^* - [\frac{-\underline{c}}{(r_i^e)^2} + \frac{\partial S^*}{\partial r_i^e}] \times c_2^*}{(c_2^*)^2} \quad \text{(A.9)}$$

The relative size of the first and second terms in the numerator determines the sign on equation (A.9). With positive interest rates, $c_2^* > c_1^*$ and $\frac{\partial c_{2^*}}{\partial r_i^e} < \frac{\partial c_{1^*}}{\partial r_i^e}$ such that the second term is larger than the first and the overall sign is positive.

A.1.4 Output with equilibrium wage increases

As outlined in the main text, we expect equilibrium wages to adjust to increased labor demand and decreasing labor supply. With endogenous wages, equation (A.5) becomes

$$\frac{\partial S_i^*}{r_i^e} = -\frac{1}{(r_i^e)^2} y(d_i^*) + (\frac{1}{r_i^e}\frac{\partial y}{\partial d^*})(\frac{\partial d^*}{\partial r_i^e}) + (\frac{1}{r_i^e}\frac{\partial y}{\partial d^*})(\frac{\partial d^*}{\partial w})(\frac{\partial w}{\partial r_i^e}) - \frac{\partial d^*}{\partial r_i^e} w - \frac{\partial d^*}{\partial w}(\frac{\partial w}{\partial r_i^e}) w - d^*(\frac{\partial w}{\partial r_i^e}) \quad \text{(A.10)}$$

As before, the first term is negative, and the difference between the marginal product of labor and the wage cost must be less than or equal to zero. The net output effect (and thus also the net effect on S_i^*) of higher interest rates is directly determined by the change in labor inputs, which is a function of the direct effect of interest and the indirect effect of lower wages. This is negative as long as $\left|\frac{\partial d^*}{\partial r_i^e}\right| > \left|\frac{\partial d^*}{\partial w}\frac{\partial dw}{\partial r_i^e}\right|$ which we assume to be the case. Empirically, this assumption is not very restrictive; it rules out a scenario in which wages respond so strongly to interest rates that the labor supply response outweighs the direct effect of interest rates on demand, and labor inputs actually increase.

A.2 Model Calibration and Simulation

The main objectives of our model simulations are twofold: first, to simulate the impact of loan provision on the welfare of treated and untreated farms (who are not in our data) in treatment communities, and second, to simulate the effects of a scaled up version of the program that lowered credit market interest rates for all farmers (which was not our design). To match the simulations to our setting, we calibrated the model such that the observed distribution of agricultural output at baseline matched the empirical distribution, conditional on the initial distribution of grain and cash resources measured at baseline.

We use the following parameter assumptions. Average resources in grain and cash reported at baseline were low, with a mean of 400 Kwacha, and a median of 50. We start our calibration with these values, and assume that the minimum consumption level $\underline{c}$ over the hungry season is 200 Kwacha. As discussed in the text, this corresponds to the approximate cost of three bags of maize, which covers the basic hungry season caloric needs of the average family in the sample. Evidence on subjective discount rates in sub-Saharan Africa is limited, but the available estimates suggest a range of 5-10 percent per year (Bauer and Chytilová 2010). We thus assume a subjective discount rate (ρ) of 5 percent over the six month intervention period. Survey questions collected self-reported interest rates that are high on average and vary considerably, with reported rates of up to 100 per month. To ensure our model is not driven by outliers in reported interest rates, we imposed a maximum rate of 150 percent over the six month period, with minimum rates of 50 percent, consistent with the close to 100 percent loan take up at a six month interest rate of 30 percent. Based on our baseline data, average land size was set at 2 hectares, while household labor was normalized to 1. α and β were set such that the marginal effect of labor and land on output, as well as the marginal effect of leisure and consumption on utility were the same. The main parametric assumptions are summarized in Table A.1.

To calibrate our model to the empirical setting, we further assume that the distribution of farm-level productivity A_i is log-normal, and correlated with S_{i0}. The empirically observed correlation between farm-level fixed effects (estimated from the panel, controlling for treatment only) and our baseline measure of S_{i0} was 0.4, which we use in the calibration. We then calibrate the mean and standard deviation of the productivity distribution such that that the empirical distribution of agricultural output matches the empirical distribution of output at baseline, with mean output value of 3500 Kwacha and a standard deviation of 3000 Kwacha (mean 7.8 and SD 0.8 on the log scale). The model then iteratively determines the market clearing wage for a given set of interest rates. As shown in the following table, the mean and standard deviation of the simulated distribution of agricultural output were very close to the empirical distribution. The simulated equilibrium (market clearing) wage in the baseline simulation was 17.4 Kwacha per day, which is only slightly higher what we empirically observe.

When we simulate a reduction in credit market interest rates for 50 percent of farmers, the calibration model shows an increase in wages to 19.1 Kwacha, which corresponds to a 10 percent increase, relative to baseline, similar to the estimated treatment effect. When we instead simulate a scenario with full treatment, wages increase to 20.7 Kwacha. These results are summarized in Table A.2.

Table A.1: Parametric assumptions for model simulations

Parameter	Value
ρ	0.95
r^e	1.5-2.5
k	2
$\underline{c}$	200
α	0.5
β	0.5
S_{i0} (mean, median)	400, 50
corr(S_{i0}, A_i)	0.30

Notes: Values used to calibrate the model. ρ is the subjective discount rate; r^e is the effective interest rate; k is land; $\underline{c}$ is the subsistence threshold; α is a consumption utility parameter; β is the relative productivity of labor to land; S_{i0} is baseline reserves, measured in Kwacha; $corr(S_{i0}, A_i)$ is the correlation between baseline reserves and land productivity. The correlation between S_{i0} and A_i was estimated using a panel fixed effects model.

Table A.2: Model simulation comparisons

	Baseline data	Simulated baseline	Simulated partial treatment effect (log change)	Simulated full treatment effect (log change)
Wage (w)	15.3	17.4	0.093	0.174
Hungry season consumption (c_1)	NA	1190	0.074	0.15
Ln(y), mean	7.8	7.8	0.08	0.03
Ln(y), SD	0.8	0.79	-0.001	-0.011
Overall utility	NA	12.9	0.10	0.20

Notes: Comparison of outcomes observed at baseline to simulated outcomes. All measures are in Zambian Kwacha. Average exchange rate during the study period was 6 Zambian Kwacha per USD. Column 1 shows baseline values. Columns 2-4 show estimates from our calibrated model, with column 3 restricted to treated farmers for comparison with our estimated treatment effects. Wages correspond to daily ganyu earnings. In the simulations, wages are computed over the entire season, and then divided by 100 working days. Hungry season consumption is measured in Kwacha over a three month period at the household level. Ln(y) is the log of agricultural output value (gross). Overall utility is measured on a logarithmic scale.

B.1 Appendix tables and figures

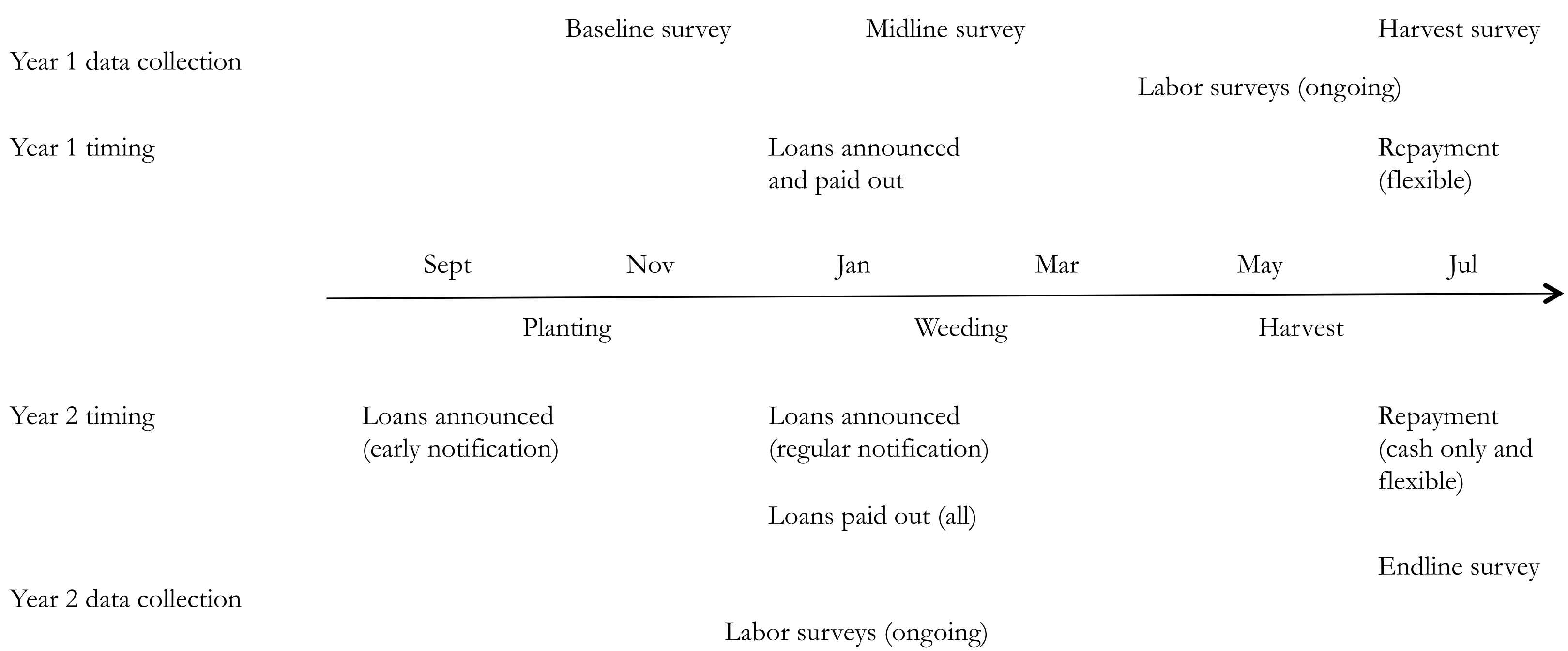

Figure B.1: Study implementation

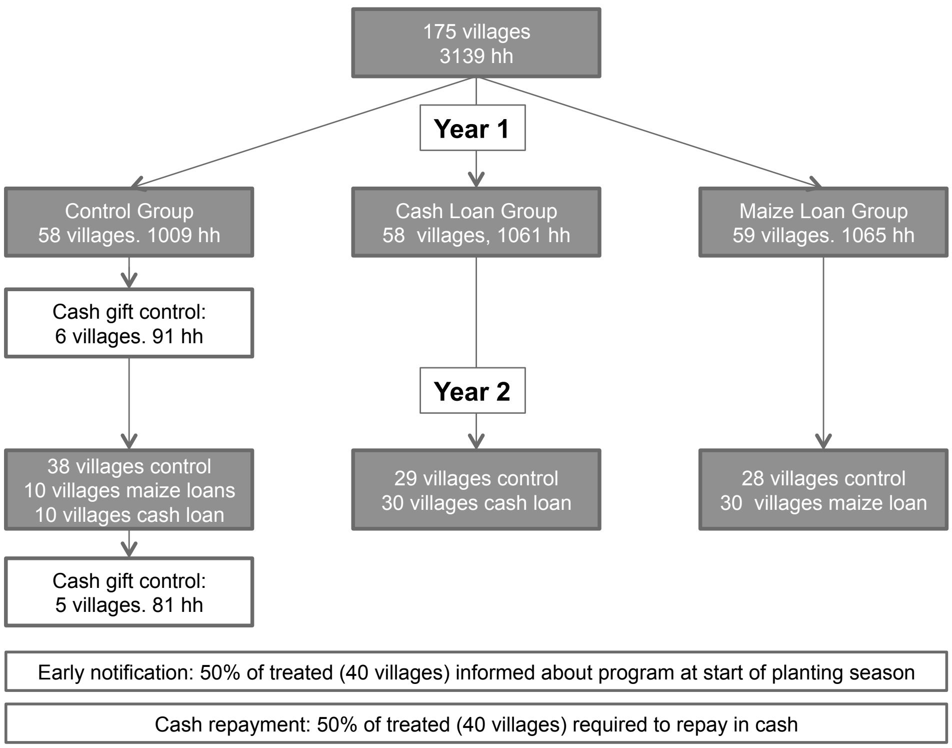

Figure B.2: Study design

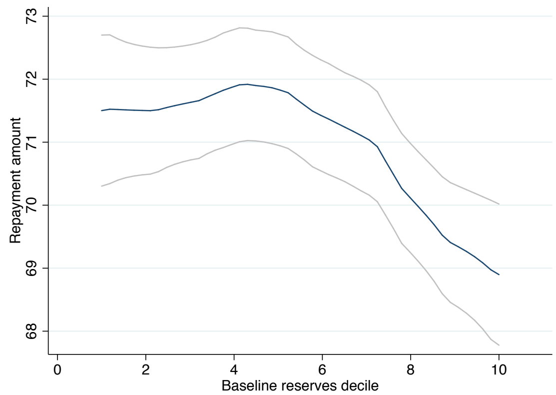

Figure B.3: Interest rates by baseline resources (grain and cash savings)

Notes: Responses to survey question asking how much respondent would have to repay in a month for 50 Kwacha borrowed today from a source other than friends or family. The sample is restricted to the control group and the confidence intervals are from a local polynomial smoothing. The x-axis shows deciles of a measure of baseline cash and grain reserves.

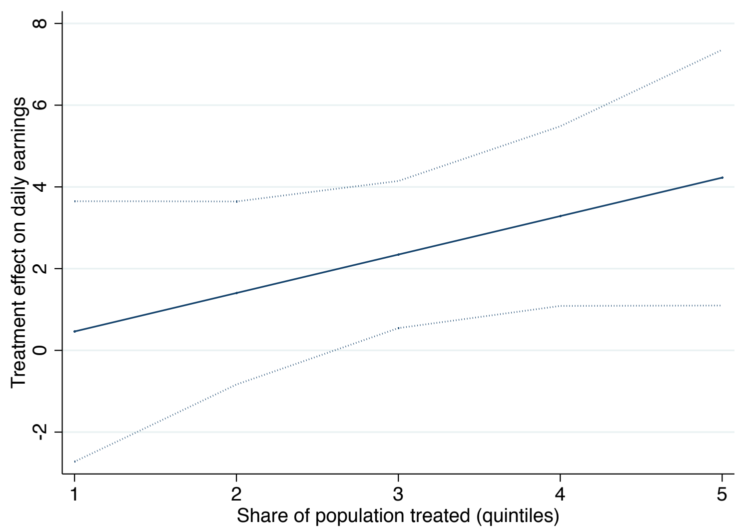

Figure B.4: Treatment effect on daily earnings, by share of village treated

Notes: Village level median daily reported earnings during the hungry season, in villages treated for the first time (pooled across years) relative to the control group. Regressions control for geographic variables, including distance to the nearest paved road. Figure shows 90 percent confidence intervals based on standard errors clustered at the village level.

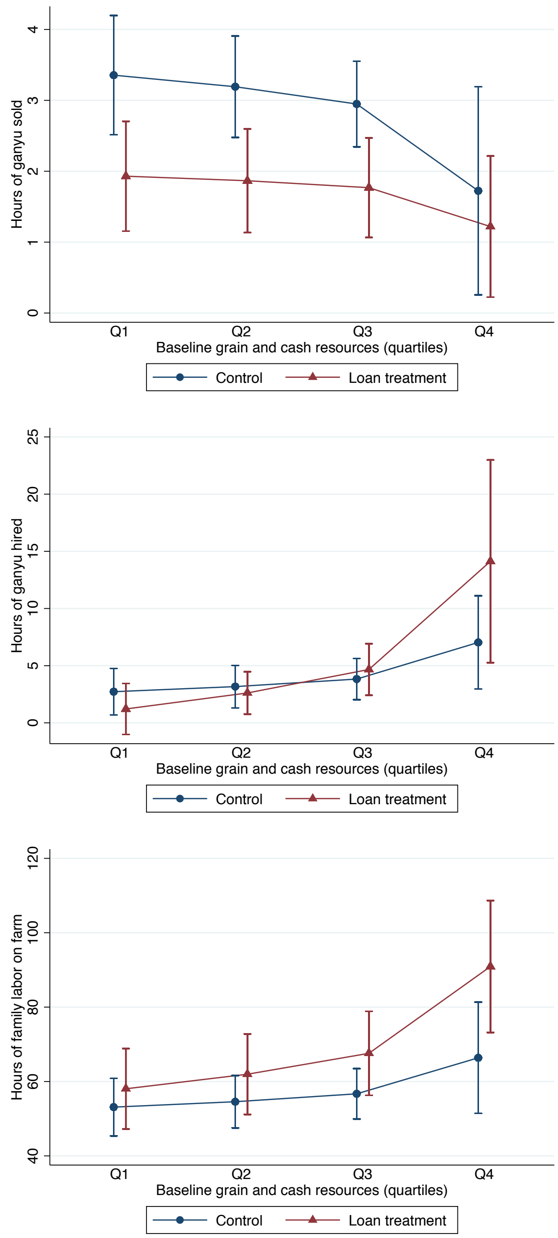

Figure B.5: Effect on labor market participation, by baseline reserves, year 2

Notes: Plots are the same is in Figure 2, for year 2.

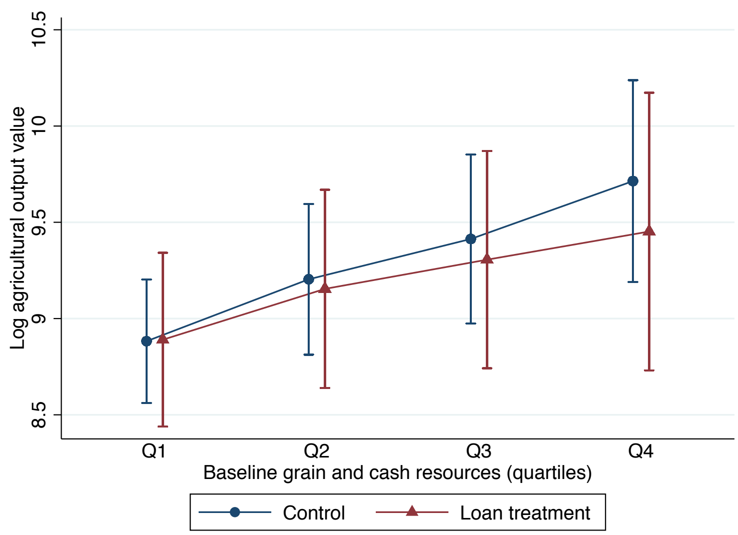

Figure B.6: Effect on log agricultural output, by baseline reserves, year 2

Notes: Plots are the same is in Figure 3, for year 2.

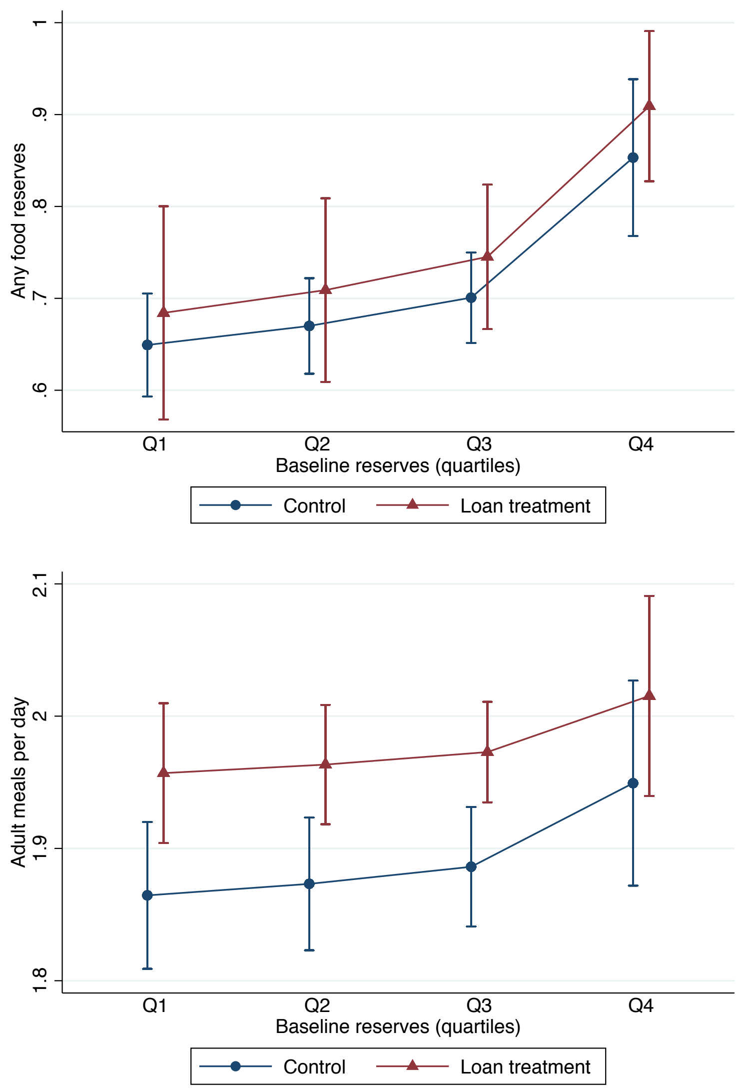

Figure B.7: Treatment effect on consumption variables, by baseline reserves, year 2

Notes: Plots are the same is in Figure 4, for year 2.

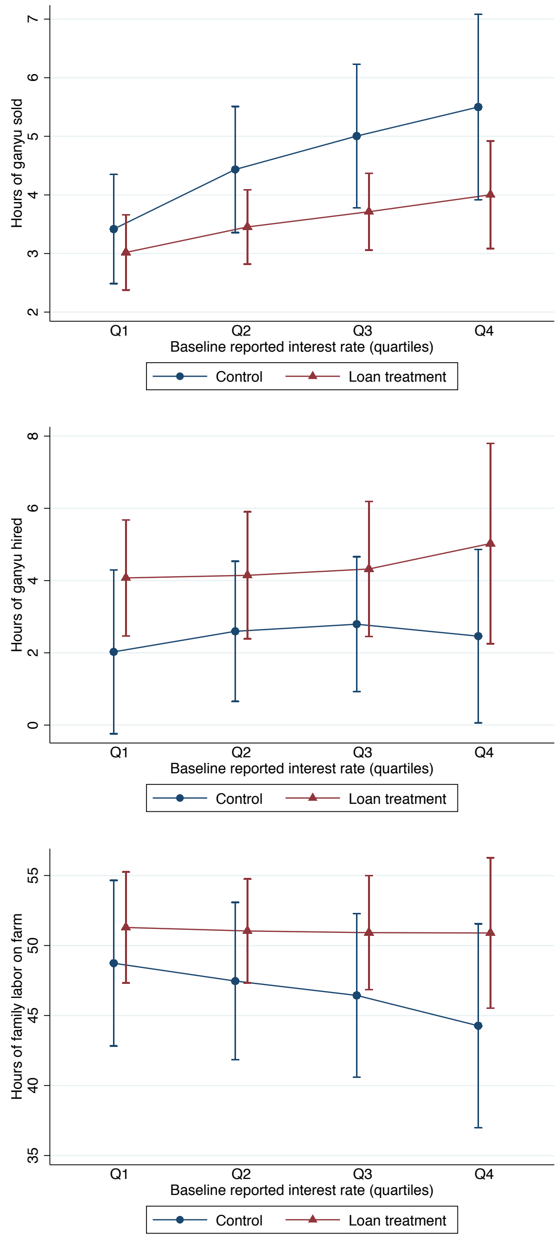

Figure B.8: Effect on labor market participation, by baseline interest rates

Notes: Plots are the same is in Figure 2, using an alternative proxy for heterogeneity in effective interest rates.

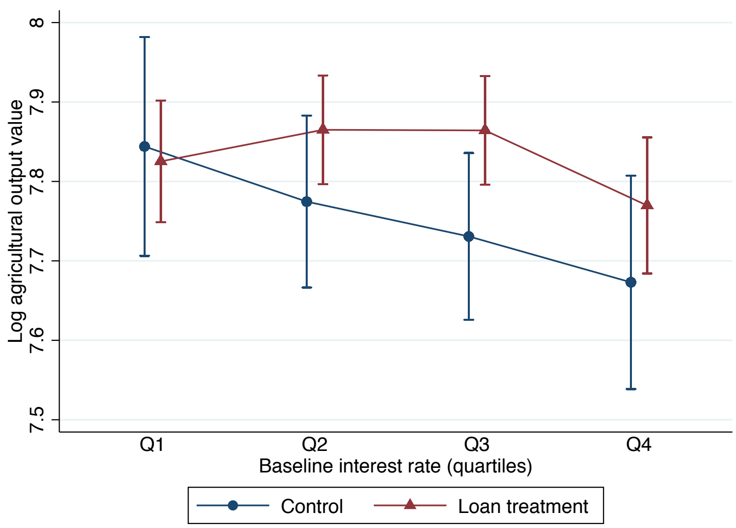

Figure B.9: Effect on log agricultural output, by baseline interest rates

Notes: Plots are the same is in Figure 3, using an alternative proxy for heterogeneity in effective interest rates.

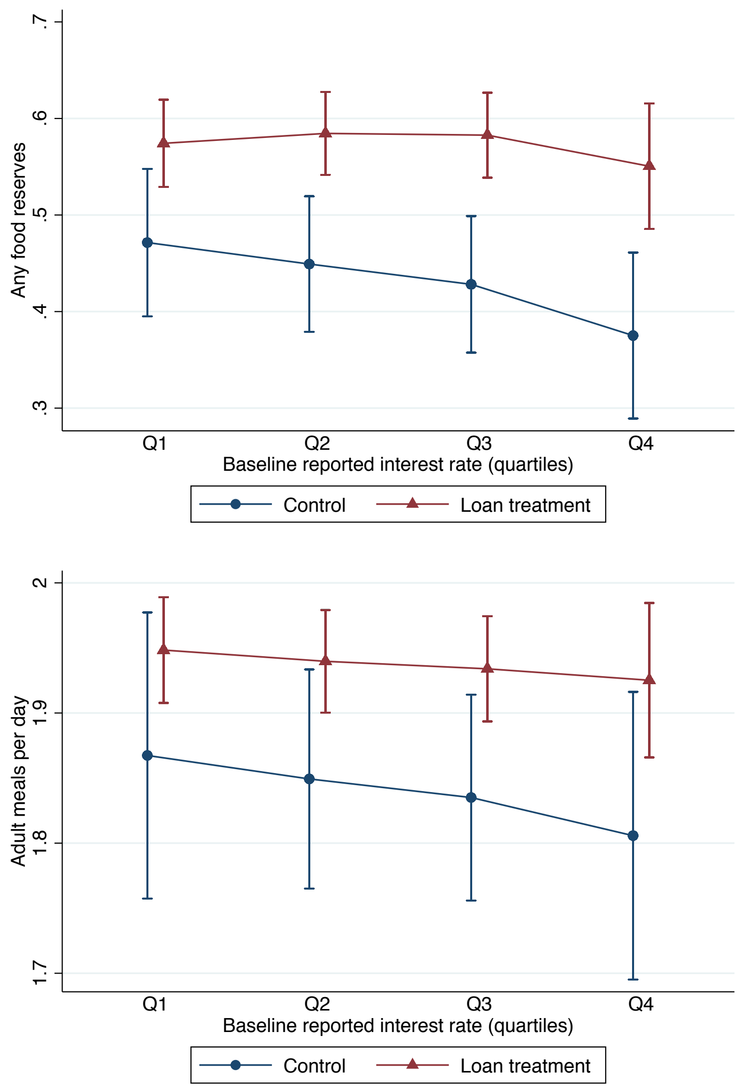

Figure B.10: Effect on consumption variables, by baseline interest rates

Notes: Plots are the same is in Figure 4, using an alternative proxy for heterogeneity in effective interest rates.

Table B.1: Loan treatments

	Loan (January)	Repayment (July)	Implied interest
		A. Maize Loan	
Offer	3 bags (50 kg ea)	4 bags (50 kg ea)	30%
Value (official)	K 195	K 260	33%
Value (reported)	K 261	K 234	-10%
		B. Cash Loan	
Offer	K 200	K 260	30%

Notes: Columns describe the loan and repayment terms, and the implied interest rate for the maize and cash loan treatment arms. The official value is the government-set maize price. The reported value is the average reported in the harvest survey for buying and selling maize.

Table B.2: Attrition, by survey round

Year 1 treatments	Baseline	Y1 Harvest	Y2 Endline	Midline	Labor 1	Labor 2	Labor 3	Labor 4
Sampled	3139	3139	3139	1223	1531	1679	1673	827
Cash loan treatment	0.34	0.009	-0.009	-0.008	-0.014	-0.003	0.029	0.010
		(0.007)	(0.008)	(0.010)	(0.021)	(0.025)	(0.022)	(0.021)
Maize loan treatment	0.34	-0.005	0.008	0.000	-0.008	-0.022	-0.011	-0.055***
		(0.008)	(0.008)	(0.010)	(0.024)	(0.028)	(0.028)	(0.020)
Year 2 treatments	**Baseline**	**Y1 Harvest**	**Y2 Endline**	**Midline**	**Labor 1**	**Labor 2**	**Labor 3**	**Labor 4**
Cash loan treatment	0.23	-0.000	-0.012	-0.010	-0.003	0.049*	0.026	0.003
		(0.008)	(0.009)	(0.013)	(0.025)	(0.026)	(0.024)	(0.021)
Maize loan treatment	0.24	-0.008	0.010	-0.001	0.015	-0.059	-0.013	-0.015
		(0.008)	(0.008)	(0.010)	(0.029)	(0.036)	(0.036)	(0.023)
Conditional on treatment								
Early notification sub-treatment	0.50	0.012	-0.025**	0.007	0.003	-0.048	0.008	-0.013
		(0.010)	(0.010)	(0.015)	(0.035)	(0.043)	(0.040)	(0.028)
Cash repayment sub-treatment	0.51	-0.003	0.002	-0.000	-0.017	-0.091**	-0.037	-0.033
		(0.010)	(0.011)	(0.015)	(0.035)	(0.041)	(0.040)	(0.027)

Notes: Column 1 shows the share of sampled baseline households by treatment arm in Year 1 (Panel A) and Year 2 (Panel B). Each subsequent column reports the number of sampled households and the regression of whether the household was in the survey round on treatment indicators, conditional on being sampled for the survey. Standard errors are clustered at the village level.

Table B.3: Attrition, by participation stage

Year 1		Invited	At meeting	Eligible	Take up
Cash loan treatment	N	1023	1023	1023	1009
	Share		1	1	0.99
Maize loan treatment	N	1019	1019	1016	999
	Share		1	1	0.98

Year 2		Invited	At meeting	Eligible	Take up
Cash loan treatment					
Pooled	N	701	660	658	643
	Share		0.94	1	0.98
Notification timing sub-treatment					
Standard notification	N	356	328	328	319
	Share		0.92	1	0.97
Early notification	N	345	332	330	324
	Share		0.96	0.99	0.98
Cash repayment sub-treatment					
Standard repayment	N	336	320	319	311
	Share		0.95	1	0.97
Cash only repayment	N	365	340	339	332
	Share		0.93	1	0.98
Maize loan treatment					
Pooled	N	718	663	662	639
	Share		0.92	1	0.97
Notification timing sub-treatment					
Standard notification	N	351	327	327	314
	Share		0.93	1	0.96
Early notification	N	367	336	335	325
	Share		0.92	1	0.97
Cash repayment sub-treatment					
Standard repayment	N	365	333	332	324
	Share		0.91	1	0.98
Cash only repayment	N	353	330	330	315
	Share		0.93	1	0.95

Notes: Table reports stages of household self-selection into eligibility. To be eligible, households had to attend the meeting (before learning treatment status) and hand in a consent form (after learning treatment status).

Table B.4: Summary statistics, by baseline resources

	Baseline grain and cash reserves			
	Q1	Q2	Q3	Q4
Baseline liquid resource value	87.689	303.555	632.688	2456.543
	[52.906]	[71.212]	[131.594]	[3140.612]
Age of HH head	45.288	42.552	41.23	41.711
	[16.498]	[15.413]	[14.548]	[13.359]
Female HH head	0.364	0.295	0.219	0.148
	[0.482]	[0.456]	[0.414]	[0.355]
HH members <5	0.925	0.922	0.964	0.961
	[0.984]	[0.902]	[0.874]	[0.954]
HH members 5-14	1.566	1.606	1.762	2.07
	[1.488]	[1.456]	[1.533]	[1.560]
HH members 15-64	2.168	2.259	2.499	2.817
	[1.189]	[1.159]	[1.264]	[1.410]
HH members >64	0.236	0.169	0.159	0.145
	[0.497]	[0.443]	[0.457]	[0.425]
HH did ganyu last year	0.749	0.678	0.599	0.456
	[0.434]	[0.468]	[0.490]	[0.498]
HH plans to do ganyu this year	0.771	0.7	0.6	0.456
	[0.421]	[0.458]	[0.490]	[0.498]
Acres of maize	1.825	2.031	2.298	3.134
	[0.983]	[1.056]	[1.236]	[1.705]
Acres of cash crops	0.774	0.934	1.129	1.311
	[0.966]	[1.022]	[1.200]	[1.295]
Baseline harvest value	1783.114	2265.881	3029.573	5146.266
	[1784.946]	[1759.697]	[2101.804]	[3531.302]
Crop diversity index	2.703	2.909	3.077	3.357
	[0.994]	[0.993]	[1.087]	[1.112]
Asset quintile	2.185	2.668	3.15	4.004
	[1.250]	[1.270]	[1.298]	[1.158]
Livestock value	1453.643	1997.187	3363.149	6938.573
	[3247.572]	[3629.446]	[5714.426]	[9137.440]
Input value	233.034	299.994	440.274	1024.885
	[455.743]	[493.898]	[537.268]	[1832.906]
Hired ganyu last year	0.171	0.26	0.323	0.532
	[0.376]	[0.439]	[0.468]	[0.499]
# of adults working on farm	2.534	2.512	2.653	2.996
	[1.294]	[1.247]	[1.295]	[1.513]
# of adults working in other IGA	1.26	1.191	1.108	1.027
	[1.017]	[0.953]	[0.982]	[0.961]

Notes: Baseline means and standard deviations by each quartile of baseline grain and cash resources. All monetary values are in Zambian Kwacha.

Table B.5: Randomization balance

	Year 1			Year 2			Largest pairwise:	
	Control	Cash loan	Maize loan	Control	Cash loan	Maize loan	t-statistic	normalized difference
Age of HH head	42.785	42.875	42.439	42.623	42.994	42.574	0.783	0.026
	[14.990]	[15.280]	[14.960]	[15.335]	[14.669]	[14.901]		
Female HH head	0.243	0.271	0.254	0.255	0.261	0.255	1.459	0.045
	[0.429]	[0.445]	[0.436]	[0.436]	[0.440]	[0.436]		
HH members <5	0.925	0.975	0.928	0.922	0.941	0.989	1.609	0.051
	[0.907]	[0.940]	[0.940]	[0.910]	[0.941]	[0.959]		
HH members 5-14	1.775	1.72	1.758	1.721	1.747	1.82	1.474	0.046
	[1.530]	[1.545]	[1.492]	[1.506]	[1.549]	[1.531]		
HH members 15-64	2.473	2.424	2.41	2.429	2.478	2.408	1.137	0.038
	[1.259]	[1.325]	[1.264]	[1.279]	[1.311]	[1.267]		
HH members >64	0.172	0.187	0.173	0.183	0.167	0.174	0.897	0.03
	[0.441]	[0.473]	[0.457]	[0.457]	[0.459]	[0.457]		
HH did ganyu last year	0.614	0.636	0.611	0.617	0.634	0.616	1.19	0.036
	[0.487]	[0.481]	[0.488]	[0.486]	[0.482]	[0.487]		
HH plans to do ganyu this year	0.622	0.64	0.634	0.631	0.642	0.624	0.856	0.029
	[0.485]	[0.480]	[0.482]	[0.483]	[0.480]	[0.485]		
Acres of maize	2.368	2.3	2.299	2.342	2.246	2.351	1.816	0.062
	[1.411]	[1.294]	[1.403]	[1.332]	[1.368]	[1.449]		
Acres of cash crops	0.967	1.04	1.099	1.06	0.949	1.069	2.809	0.094
	[1.080]	[1.168]	[1.181]	[1.162]	[1.064]	[1.185]		
Baseline harvest value	3096.843	3037.518	3032.011	3092.466	3031.347	2993.88	0.849	0.027
	[2811.876]	[2607.473]	[2765.994]	[2712.900]	[2888.188]	[2597.123]		
Crop diversity index	2.978	3.042	3.011	3.05	2.955	2.98	2.071	0.064
	[1.120]	[1.018]	[1.084]	[1.109]	[1.001]	[1.063]		
Asset quintile	3.057	3.013	2.934	2.984	3.038	3.001	1.991	0.062
	[1.392]	[1.426]	[1.422]	[1.395]	[1.443]	[1.428]		
Livestock value	3586.024	3304.445	3423.568	3250.009	3479.293	3805.57	1.921	0.06
	[6220.081]	[6023.122]	[6590.769]	[6326.978]	[5759.958]	[6657.904]		
Input value	533.167	494.109	472.324	482.011	556.276	481.579	1.603	0.05
	[915.210]	[1365.201]	[807.085]	[808.145]	[1652.910]	[759.373]		
Hired ganyu last year	0.315	0.337	0.313	0.312	0.333	0.33	1.356	0.038
	[0.465]	[0.473]	[0.464]	[0.464]	[0.472]	[0.471]		
# of adults working on farm	2.687	2.688	2.646	2.671	2.717	2.635	1.187	0.044
	[1.356]	[1.361]	[1.347]	[1.377]	[1.343]	[1.315]		
# of adults working in other IGA	1.126	1.132	1.181	1.137	1.148	1.165	1.264	0.039
	[1.000]	[0.965]	[0.982]	[0.983]	[0.981]	[0.983]		

Notes: Baseline means for each major treatment group by year with standard deviations in brackets. All monetary values are in Zambian Kwacha.

Table B.6: Heterogeneous treatment effects, by baseline reserves

	Hours sold	Hours hired	Family hours on-farm	Log ag output	Adult meals
	(1)	(2)	(3)	(4)	(5)
Any loan treatment	-1.429*	0.121	4.777	0.173***	0.108*
	(0.791)	(1.243)	(3.691)	(0.059)	(0.059)
Baseline grain and cash reserves	-0.122***	-0.031	0.274	0.049***	0.006*
	(0.044)	(0.099)	(0.224)	(0.003)	(0.003)
Loan x Reserves	0.046	0.343**	0.046	-0.013***	-0.000
	(0.047)	(0.168)	(0.279)	(0.004)	(0.004)
Reserves^2	0.001**	0.001	-0.000	-0.000***	-0.000
	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)
Loan x Reserves^2	-0.000	-0.002	-0.002	0.000***	-0.000
	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)
Control group mean	4.531	2.428	46.558	7.752	1.840

Notes: Heterogeneous treatment effects, by baseline grain and cash reserves (x100 Kwacha), year 1 only. All specifications are conditional on month or year fixed effects and include geographic controls, and cluster standard errors at the village level.

Table B.7: Average treatment effects: Health outcomes (year 2)

	Any illness	Mental health problem	Self reported health PCA	Bicep circumfrence	Waist circumfrence	Grip strength repetitions	Grip strength duration
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Pooled treatments							
Any loan treatment	-0.077*	-0.027*	0.085	-0.597*	-1.228	0.582	1.652
	(0.045)	(0.016)	(0.151)	(0.354)	(1.037)	(2.816)	(3.715)
B. By treatment							
Cash	-0.104	-0.030*	-0.032	-0.596	-2.039	2.093	0.299
	(0.063)	(0.017)	(0.194)	(0.368)	(1.326)	(3.284)	(3.762)
Maize	-0.047	-0.025	0.204	-0.597	-0.412	-0.935	3.028
	(0.052)	(0.024)	(0.188)	(0.444)	(1.335)	(2.961)	(4.284)
Control group mean	0.785	0.040	-0.045	27.014	79.361	41.347	34.758
Observations	459	459	842	834	835	707	719

Notes: Treatment effects on self-reported health outcomes, measured during the short recall surveys during the hungry season, with a 2-week recall window in column 1. Columns 1 and 2 are measured only during year 2. Outcome variables are: an indicator for whether the household had any illnesses in the past two weeks (col 1), the respondent's score on an index of mental health problems (col 2), an aggregate score of self reported health (col 3) and measures of bicep and waist circumfrence (col 4 and 5) and grip strength test outcomes (col 6 and 7). All specifications are conditional on month-year fixed effects, include baseline controls, and cluster standard errors at the village level. Columns 2-7 also control for respondent gender and age.

Table B.8: Capital inputs and cash crops

	Seeds	Fertilizer	Chemicals	Total input value	Acres cash crops
	(1)	(2)	(3)	(4)	(5)
A. Pooled treatments					
Any loan treatment	-39.654***	-13.040	22.617	-35.512	0.050
	(14.119)	(45.874)	(25.668)	(65.301)	(0.050)
B. By treatment					
Cash	-41.061**	6.713	-0.971	-37.953	0.065
	(16.038)	(55.377)	(10.116)	(73.738)	(0.056)
Maize	-38.250**	-32.718	46.196	-33.080	0.034
	(15.405)	(50.729)	(50.186)	(83.237)	(0.060)
Control group mean	137.234	813.018	58.598	1051.946	1.005
Observations	3984	3987	3979	3989	3997

Notes: Treatment effects on acres of cash crops (column 1) and input values (columns 2-5). Outcomes in columns 2-5 are self reported expenditures or value (when received on credit) in Kwacha for the past season. All specifications include baseline controls, and cluster standard errors at the village level.

Table B.9: Other consumption smoothing

	Input loan	Low interest informal loan	High interest informal loan	Sold asset	Sold livestock	Green maiz
	(1)	(2)	(3)	(4)	(5)	(6)
A. Pooled treatments						
Any loan treatment	-0.011	-0.008	-0.026***	-0.001	0.033*	-0.000
	(0.022)	(0.007)	(0.007)	(0.011)	(0.018)	(0.024)
B. By treatment						
Cash	-0.004	-0.004	-0.017**	-0.006	0.026	-0.006
	(0.024)	(0.009)	(0.008)	(0.011)	(0.021)	(0.027)
Maize	-0.019	-0.012	-0.034***	0.004	0.039*	0.005
	(0.025)	(0.008)	(0.007)	(0.013)	(0.022)	(0.029)
Control group mean	0.438	0.072	0.066	0.073	0.318	0.200
Observations	3996	3997	3997	3996	3997	3731

Notes: Treatment effects on other consumption smoothing strategies, measured during the long recall (cols 1-5) an short recall (col 6) surveys at year 1 and 2 harvest (omitting villages treated in year 1 in the year 2 data). Outcom variables are: an indicator for whether the household took a formal loan including in-kind inputs (col 1), a lov interest (col 2) or high interest (col 3) informal loan, sold any assets or livestock (col 4 and 5) and consumed an green maize in the past week (col 6). All specifications include baseline controls, geographic controls and time fixe effects, and cluster standard errors at the village level.

Table B.10: Spending on temptation and luxury goods

	Clothing (1)	Beer (2)	Tobacco (3)	Sweets (4)	Tea (5)	Meat (6)
Pooled treatments						
Any loan treatment	0.038*	0.017	-0.012	0.040**	0.013	0.022
	(0.022)	(0.018)	(0.018)	(0.020)	(0.022)	(0.019)
By treatment						
Cash	0.040	0.030	-0.010	0.039*	0.014	0.022
	(0.026)	(0.021)	(0.020)	(0.023)	(0.025)	(0.022)
Maize	0.037	0.003	-0.013	0.041*	0.012	0.021
	(0.024)	(0.021)	(0.020)	(0.023)	(0.026)	(0.022)
Control group mean	0.509	0.196	0.190	0.493	0.432	0.740
Observations	3937	3937	3937	3937	3937	3937

Notes: Treatment effects on indicators of temptation spending over the past two weeks, measured during the and at harvest in year 1 only. All columns are conditional on month fixed effects and include baseline controls, and c errors at the village level.

Table B.11: Grain prices

	Purchase price	Sales price	Any purchase	Any sale
	(1)	(2)	(3)	(4)
Pooled treatments				
Any loan treatment	-0.020	-0.015	0.004	0.001
	(0.068)	(0.032)	(0.011)	(0.012)
By treatment				
Cash	0.075	-0.034	0.009	-0.001
	(0.081)	(0.042)	(0.014)	(0.012)
Maize	-0.130*	0.002	-0.002	0.003
	(0.075)	(0.035)	(0.014)	(0.016)
Control group mean	1.045	0.941	0.050	0.056
Observations	188	200	3035	3035

Notes: Treatment effects on maize market outcomes, measured during the short recall surveys in year 2 only (January to June). Panel A shows effects pooled across years, first for the pooled treatment effect, then by treatment arm, and Panel B shows results by year. Outcome variables are: the price paid per kilogram for maize purchased (col 1) and sold (col 2), and indicators for whether the household made any purchase (col 3) or sale (col 4). All specifications are conditional on month fixed effects and include baseline controls, and cluster standard errors at the village level.

Table B.12: Income effect control

	Hours sold	Hours hired	Family hours on-farm	Log ag output	Adult meals
	(1)	(2)	(3)	(4)	(5)
Cash grant	0.810	-2.687*	-1.141	-0.042	0.014
	(1.233)	(1.348)	(6.349)	(0.085)	(0.061)
Observations	1043	646	1044	1576	633

Notes: Impact of a small (60 Kwacha) cash grant given to 5-6 villages, relative to the pure control group, pooling across both years of the program. Year 2 results excluding villages treated in year 1. Columns 1-3 and 5 are conditional on month fixed effects and include baseline controls, and cluster standard errors at the village level.

Table B.13: Reporting bias

	A. Social desirability bias			
	Labor survey		Endline	
Pooled treatments				
Any loan treatment	-0.041		0.041	
	(0.143)		(0.099)	
By treatment				
Cash		-0.124		-0.024
		(0.156)		(0.123)
Maize		0.043		0.104
		(0.195)		(0.118)
Observations	1387	1387	2992	2992
Control group mean		21.639		20.578

	B. Self-reported maize yields			
	Year 1		Year 2	
Objective measure	0.870***	0.775**	0.051***	0.053***
	(0.316)	(0.384)	(0.011)	(0.009)
Any loan treatment		-31.009		19.513
		(123.080)		(60.638)
Loan treatment x Objective measure		0.150		-0.002
		(0.623)		(0.019)
Share of maize yield from hybrid	292.001***	293.166***	171.017***	171.573***
	(55.952)	(57.899)	(47.567)	(47.920)
Observations	362	362	438	438
Control group mean		563.367		600.645

Notes: Tests for self-reporting bias by treatment. Panel A regresses an index of social desirability bias on treatment, with cross sectional data from two survey rounds: labor survey round 3 (hungry season, immediately after receiving year 2 loans) and endline survey (harvest survey, immediately after repaying year 2 loans). Panel B regresses self reported maize yields on an objective measure of maize productivity, the loan treatment and an interaction of the two, along with a control for the share of the self reported yield that comes from hybrid maize. In year 1 (columns 1 and 2), the objective measure is a measure of maize height during the hungry season. In year 2 (columns 3 and 4), the objective measure is based on the number of maize kernels counted during a systemic on-field sampling. See text for detail. No baseline controls are included in these regressions. Standard errors are clustered at the village level.

C.1 Survey descriptions

1. Baseline survey (November-December 2013, N=3139): Survey of up to 22 households per village, conducted with household heads. The baseline survey includes sections on household demographics (including individual roster, employment roster of working household members, general household information about assets owned and food insecurity faced, farming information for 2012-2013 season, expected farming activity for 2013-2014 season, risk and time preferences).

2. Labor surveys (January 2014-August 2015, N=4679): Rolling survey of ~70 households per week (7 of the baseline households in 2 villages per day). The list of baseline households for each village were randomized and the first ~7 households interviewed, in cases where a household can't be interviewed (temporarily busy, moved, etc.), the household is skipped and the next household on list visited. Survey asks one week and one to two day recall questions on household labor allocation, ganyu earnings, and consumption. Four rounds of labor surveys were conducted (a new round started once all villages were visited). The third round coincided with the hungry season in year 2 and serves as a midline survey.

3. Employer survey (January 2014-August 2015): Rolling survey of ~10 ganyu employers per week. Sampling is based on Labor survey records of where households in a village report doing ganyu. Additional sampling is done in a snowball method where employers interviewed then provide names of other employers of ganyu that they know. The employer survey tracks the labor survey by geographic block and rotates through villages rather than targeting an explicit sample.

4. Midline maize assessment (February-March 2014, N=380): On-field assessments of maize height (measurement) and visual records (photographs) for a sample of 380 households in 64 villages. Only households with their nearest field within a 30 minute walk were eligible.

5. Midline survey (February-March 2014, N=1193): Hungry season survey of 1200 randomly selected households, stratified on treatment. One week and one month recall questions on labor supply, ganyu earnings, consumption, basic strength and anthropometric measurement.

6. Harvest survey, year 1 (July-September 2014, N=3028): Survey of all baseline households. Includes sections on changes to household composition, shocks experienced by the household, agricultural productivity. Includes anthropometric measures for adults and children.

7. Endline survey, year 2 (July-September 2015, N=3005): Survey of all baseline households. Similar structure to harvest survey.

C.2 Choice experiments

Hypothetical choice experiments were conducted on a convenience sample of participants in November and December 2013. In the initial wave of questions, 72 respondents were interviewed, one-third of which were female. The surveys took place in villages in and around the study area, but not eligible for the study either because they were too large (>100 households) or they had participated in the pilot program. Respondents were approached by an enumerator who explained the exercise, emphasizing that the offers were hypothetical and that responses would not affect any future programs they might be offered. In spite of these disclaimers, which were intended to minimize strategic responses and avoid building expectations, respondents took the decision tasks seriously.

Six scenarios were presented to respondents, involving different dichotomous choices that varied a relevant parameter of the loan offer. The ordering of the parameter set were varied across respondents.

Scenario 1: Maize loan versus cash loan

Script: *Suppose that we had two loans available that would start in January. The first would offer three (3) bags of [50 kg maize] in January that you have to repay in June. The second would offer cash that you would have to repay in June. Please take your time to make your choice, as I will be going through different categories. Would you prefer a cash loan that paid ____ Kwacha that you would pay back in June or would you prefer the [maize] loan that you would pay back in June?*

Parameters: 50, 110, 150, 175, 250, 275, 350, 375, 425, 450, 600 Kwacha

Scenario 2: Cash repayment

Script: *Now, supposed the loan changed so that you could still receive three (3) bags of [mealie meal / maize] in January. But instead of repaying in maize in June, you had to repay in cash. I'm going to go through some different repayment amounts. You should tell me whether you would choose to take up a loan that gave you [maize] in January and had to repay that amount of cash in June. Would you be willing to take up a loan that gave you 3 bags of [maize] in January and required that you repay ___ Kwacha in June?*

Parameters: 600, 450, 400, 325, 275, 250, 200, 175, 125, 100, 75, 50 Kwacha

Scenario 3: Cash gift vs. maize loan

Script: *Again, suppose, we were to offer a loan that offered three (3) bags of [maize] in January that you had to repay in June. Would you prefer to take that loan or would you prefer to receive ____ Kwacha in January, which you would not require to pay back?*

Parameters: 10, 30, 60, 80, 100, 110, 130, 150, 175, 200, 250 Kwacha

Scenario 4: Cash gift vs. cash loan

Script: *Suppose now that the loan was cash instead and we were to offer a loan that provided 200 Kwacha in January that you had to repay in June without any interest (repay 200 Kwacha in June). Would you prefer to take that loan or would you prefer to receive ____ Kwacha in January which you would not require to pay back.*

Parameters: 10, 30, 60, 80, 100, 110, 130, 150, 175, 200, 250 Kwacha

Scenario 5: Maize loan repayment month

Script: *Suppose, we were to offer a loan that offered three (3) bags of [maize] in January that required you to repay four (4) bags. I'd like you to think about whether you would choose to take that loan. I will list different months when the repayment would be due. Would you be willing to take a loan of three bags of [mealie meal / maize] in June that required you repay 4 bags if the repayment were due in ______?*

Parameters: February, March, April, May, June, July, August, September, October, November, December

Scenario 6: Cash loan repayment month

Script: *Again, let's look at this activity but considering a loan in cash instead of maize: Suppose, we were to offer a loan that offered 200 Kwacha in cash in January that required you to repay 330 Kwacha in cash. Would you be willing to take that loan for 200 Kwacha in cash that repaid 265 Kwacha if the repayment were due in ______?*

Parameters: February, March, April, May, June, July, August, September, October, November, December