Savings, Subsidies, and Sustainable Food Security: A Field Experiment in Mozambique

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Research and policy context

- Subsidies for fertilizer have for decades been a popular development policy in Sub-Saharan Africa

- More recently, there has been increased interest in savings interventions in developing countries
  - Provide *formal* savings facilities to the poor, to complement informal savings
  - Savings *match* programs have been attempted in some developed-country contexts (IDAs)

- We examine the *complementarity* between these two types of interventions

Complementarities in theory

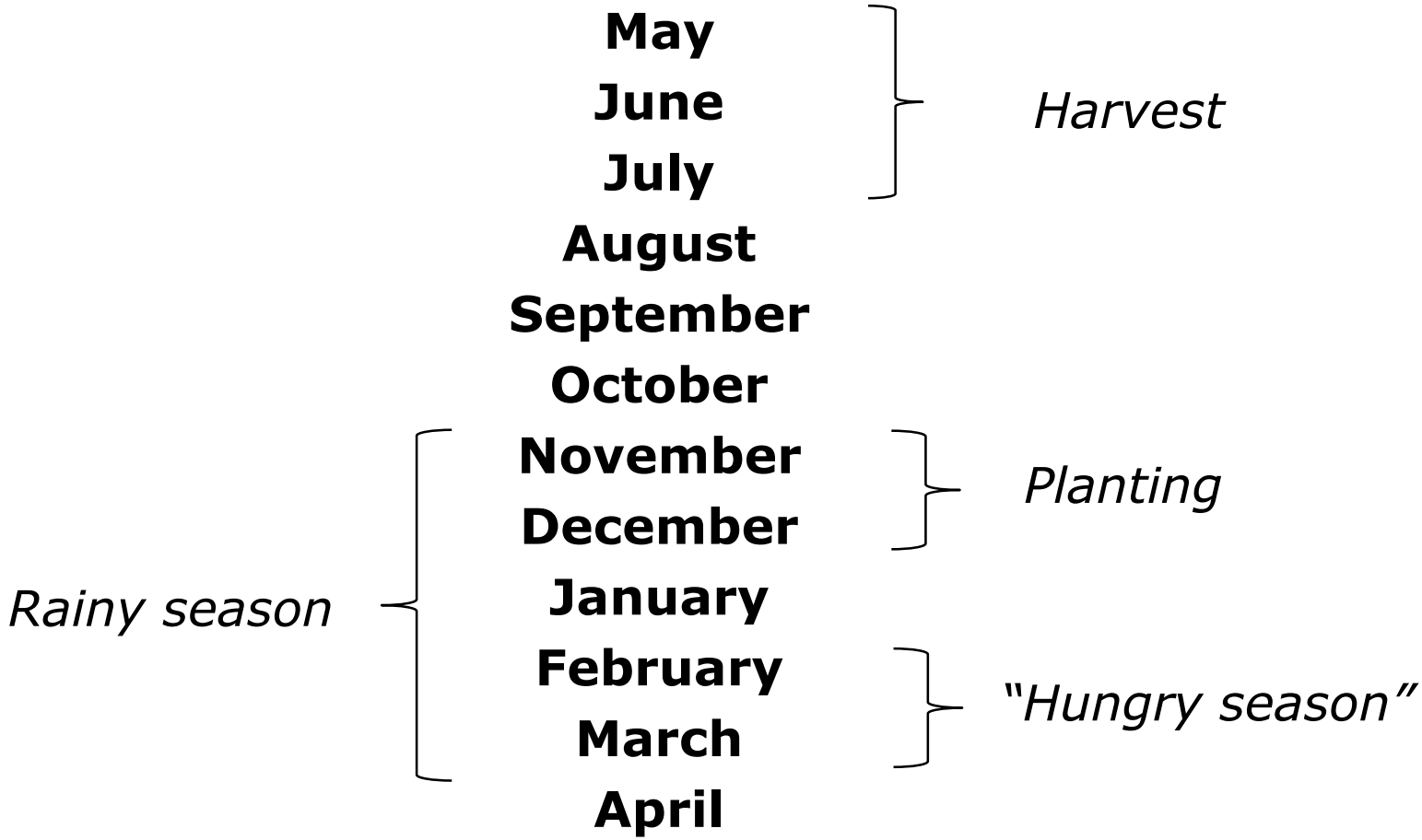
- Credit constraints may lead input subsidies to have a positive, short-run effect on fertilizer use, farm output

- But *savings* constraints may mean impacts are short-lived
  - Higher short-term incomes are not saved and invested in subsequent years

- Particularly important when increased income cannot be immediately re-invested, as is often true in agriculture
  - Due to temporal gap between harvest and next planting

- Formal savings may be better able to preserve funds than informal savings
  - e.g., when individuals have problems with self-control or other-control (demands for sharing from social network)

The agricultural cycle in Mozambique



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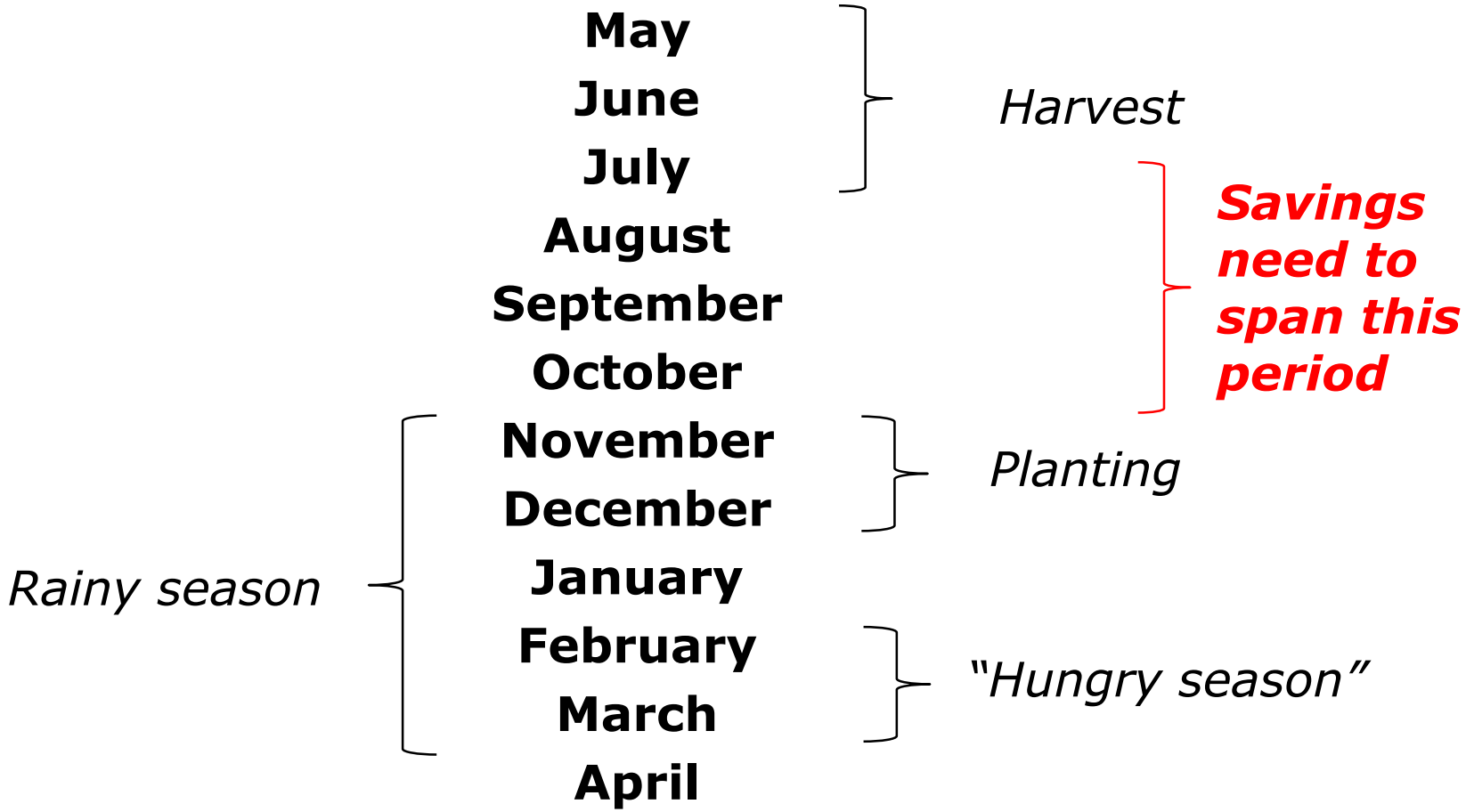
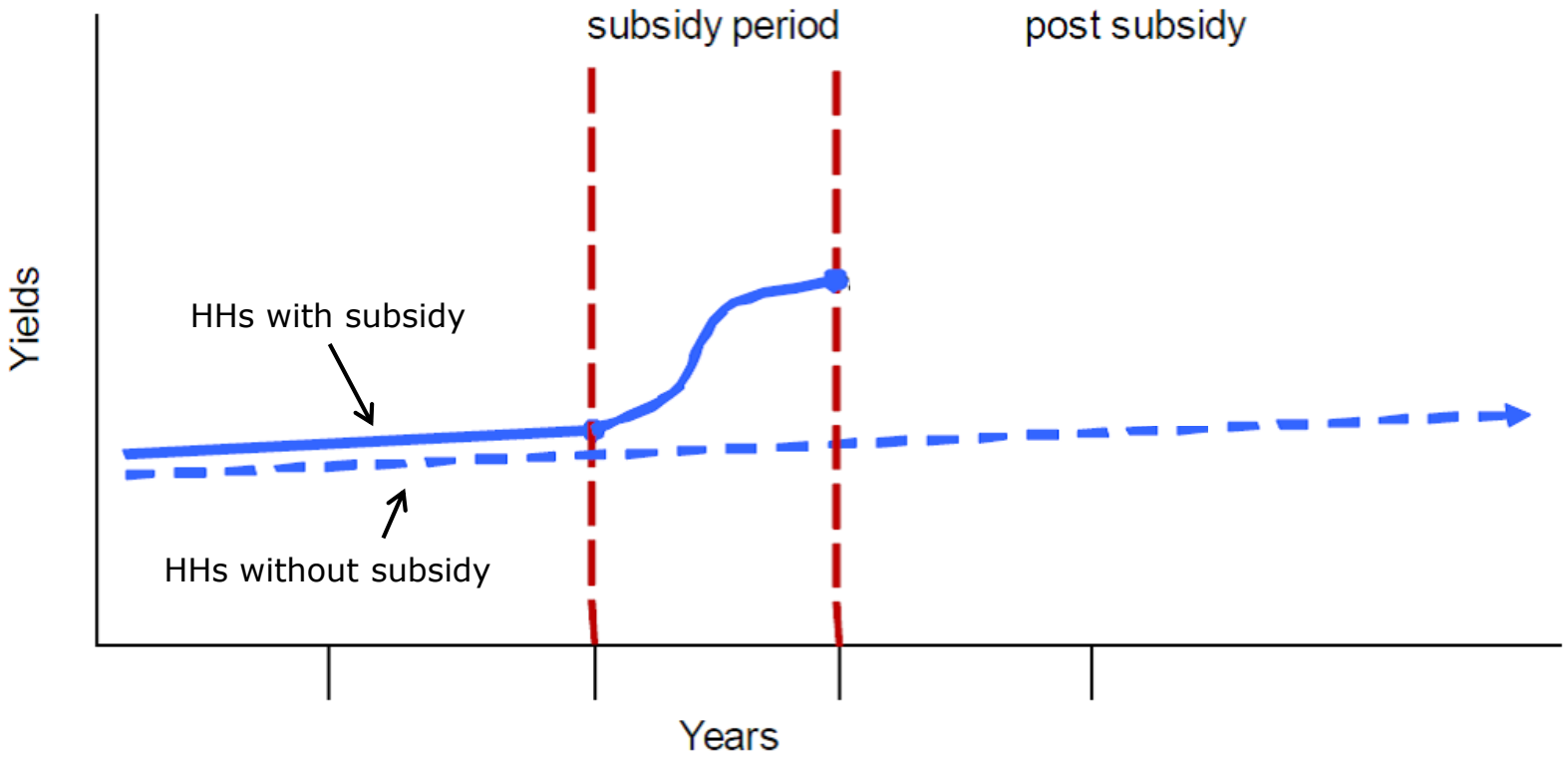


Possible trajectories of a subsidy program



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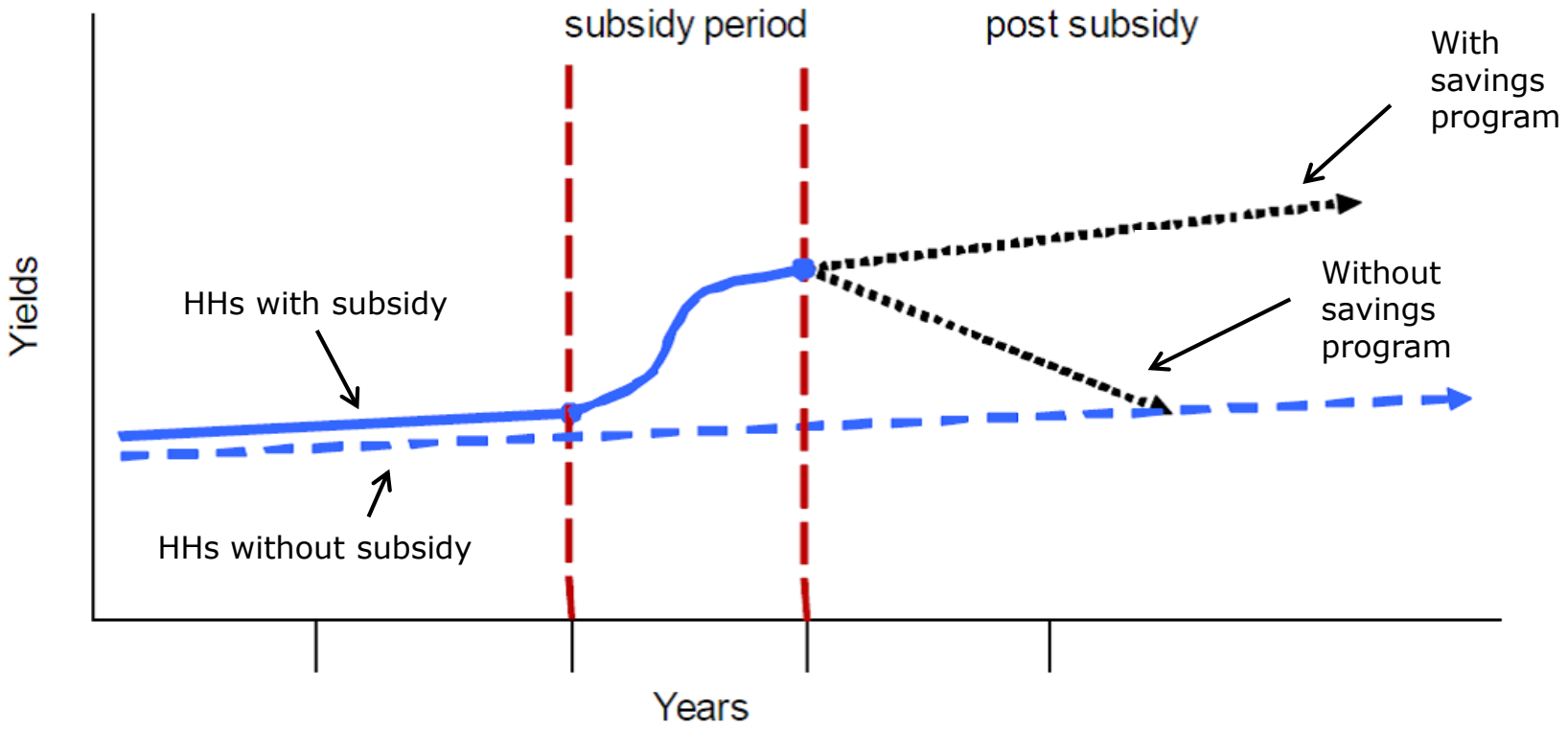


Potential for negative complementarities

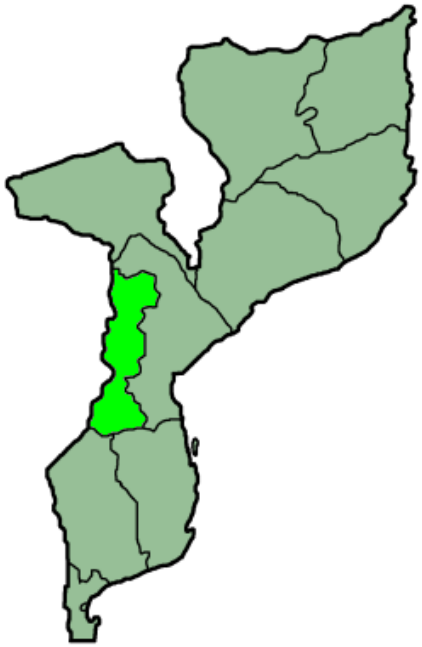
- Nonconvexities in investment response to aid receipt
  - Self-control problems (temptation spending) that increase with amount of aid receipt
  - Other-control problems may rise with aid receipt
  - Discouragement effects of aid?
    - Some aid (e.g., one program) may lead to positive effects
    - But too much aid (e.g., both matched savings and voucher programs) may discourage effort

- Highly overlapping operative mechanisms
  - E.g., if *encouragement* to invest in ag inputs is important mechanism for both voucher and savings programs, effect of both programs may not be additive

Key questions

- What is the impact of fertilizer subsidies?
- What is the impact of a formal savings program?
  - Compare a “basic” with a “matched savings” program
- Are there complementarities between fertilizer subsidies and savings programs?
- Outcomes of interest:
  - Savings
  - Fertilizer utilization
  - Farm (maize) output
  - Assets, consumption

This project



- ~1,500 rural maize-producing households in central Mozambique (Manica province)
- Random assignment of fertilizer subsidies
- Random assignment of savings interventions
  - Basic savings access
  - 50% "match" of savings in period between harvest and planting
- All study participants (including control group) offered initial education session on saving for fertilizer
  - Helps distinguish savings treatments from "encouragement" to save for fertilizer

Educational material on savings and fertilizer

Treatments

- Randomization of savings interventions at locality level, across 187 localities
  - Stratified within 32 groupings of nearby localities

- Randomization of fertilizer subsidies at individual level within locality

- 2x3 study design:

	No savings (32 loc.)	**Basic savings** (30 loc.)	**Matched savings** (32 loc.)
No fertilizer subsidy	267 hhs	283 hhs	245 hhs
Fertilizer subsidy	247 hhs	311 hhs	240 hhs

Baseline balance

Table 1 Basic Statistics and Verification of Randomization

	Control		Savings		MS		All treatment groups	p-value of Wald test
	No voucher	Voucher	No voucher	Voucher	No voucher	Voucher		
Hh size	7.45	7.82	7.63	7.87	7.67	7.46	**7.65**	0.62
	[2.86]	[3.60]	[3.34]	[3.86]	[3.38]	[3.26]	**[3.41]**	
Hh head educ (yrs)	4.78	4.71	4.78	4.83	4.67	4.42	**4.70**	0.92
	[3.35]	[3.00]	[3.43]	[3.42]	[3.14]	[3.24]	**[3.27]**	
Hh head male (%)	0.85	0.85	0.86	0.82	0.85	0.82	**0.84**	0.76
	[0.36]	[0.36]	[0.35]	[0.38]	[0.35]	[0.38]	**[0.36]**	
Hh head age	45.89	46.34	46.53	46.18	46.43	45.97	**46.22**	0.98
	[14.06]	[13.74]	[14.18]	[13.90]	[13.68]	[13.94]	**[13.90]**	
Hh head literacy (%)	0.79	0.77	0.74	0.77	0.76	0.73	**0.76**	0.64
	[0.41]	[0.42]	[0.44]	[0.42]	[0.43]	[0.45]	**[0.43]**	
Electricity (%)	0.10	0.11	0.13	0.15	0.10	0.08	**0.11**	0.77
	[0.31]	[0.31]	[0.34]	[0.35]	[0.30]	[0.27]	**[0.32]**	
Total area owned (ha)	9.18	7.91	17.13	9.87	9.32	7.62	**10.28**	0.49
	[20.04]	[9.43]	[126.81]	[26.57]	[18.14]	[10.48]	**[55.69]**	
Maize area (ha)	3	3	3.70	3.76	3.78	3.47	**3.57**	0.89
	[3.09]	[3.93]	[3.95]	[4.72]	[3.74]	[3.20]	**[3.84]**	
Maize fertilizer (kg)	29.06	23.28	22.21	26.00	28.55	19.10	**24.77**	0.76
	[83.83]	[59.12]	[95.44]	[66.77]	[167.25]	[64.90]	**[95.68]**	
Maize Production (kg)$_1$	2,776	2,730	3,039	3,011	3,107	2,595	**2,885**	0.5
	[3034]	[3300]	[3728]	[3648]	[3366]	[3159]	**[3395]**	
Livestock (MZN)1	31,522	35,152	37,380	37,449	38,606	35,877	**36,014**	0.77
	[41945]	[48445]	[49337]	[50625]	[50008]	[47649]	**[48106]**	
Crop Stock (MZN)1	29,973	33,636	36,024	36,115	37,040	34,657	**34,594**	0.65
	[41048]	[48047]	[48332]	[50382]	[49846]	[47101]	**[47578]**	
Durable goods (MZN)1	892	1,065	820	811	971	740	**880**	0.30
	[2034]	[2465]	[2200]	[2010]	[2222]	[1863]	**[2136]**	
Number of observations	269	249	278	303	248	246	**1,593**	

Standard deviations in brackets

1: the top 1% of the values have been replaced by the 99th percentile, to limit the influence of extreme values.

All statistics are from baseline survey, prior to the assignment to savings and Matched Savings treatments; after the distribution of input vouchers, but before the harvest. Information on maize cultivation are based on recalls about the preceeding agricultural campaign (before the assignment to voucher treatment).

A fertilizer subsidy winner

- 50% of study participants within each locality randomly assigned to voucher receipt

Voucher details

- Funded by EU, distributed by FAO/IFDC in November 2010

- Inputs provided in package:
  - 100 kg. of fertilizer (50 kg. urea, 50 kg. NPK)
  - 12.5 kg. of improved maize seeds

- Designed for 1/2 hectare maize plot

- Value of voucher:
  - The total value of package: MT 3,160 (~US$113)
  - Voucher funds MT 2,300 (72.7%)
  - Voucher recipient must fund remainder in cash

Surveys

- First survey administered Mar-May 2011
  - Precedes savings intervention, but after fertilizer randomization
- Three follow up surveys, in September of 2011, 2012, and 2013

Partner bank

- Savings accounts at Banco Oportunidade de Mocambique (BOM)
- Access via 2 branches and scheduled visits by mobile units

Savings accounts and matches

- Accounts offered in "basic savings" treatment are standard savings accounts
  - Normal interest rate

- Savings match:
  - 50% of minimum balance over match period
  - Matching funds capped at MT1500 (~$54)
  - Match period: August 1 – October 31
  - Two years of match promised: 2011 and 2012

  - Designed with agricultural cycle in mind
    - Match period ends immediately prior to start of next planting season
    - If save full amount (MT3000), savings + match can purchase input package sufficient for 3/4 hectare plot

Timeline

	Treatment	Survey
Nov 2010	Fertilizer subsidies randomized	
Apr-May 2011		"Baseline" survey
May 2011	Savings programs announced (post-survey)	
...		
Aug 2011	Savings match period	
Sep 2011	Savings match period	1st follow-up survey
Oct 2011	Savings match period	
...		
Aug 2012	Savings match period	
Sep 2012	Savings match period	2nd follow-up survey
Oct 2012	Savings match period	
...		
Jul-Aug 2013		3rd follow-up survey

Take-up: fertilizer subsidy vouchers

- Voucher redemption rates:
  - Lottery winners: 48.3%
  - Lottery losers: 12.1%
    - Due to imperfect adherence to lottery outcome by government extension workers

  → Effect of lottery winning on voucher use: 36.2 percentage points

- An "encouragement" research design

Take-up: savings

- Account ownership at BOM in 2011 (immediately after savings program initiated):
  - Basic savings treatment: 13%
  - Matched savings treatment: 21%

- Account ownership remains essentially stable throughout project. By 2013...
  - Basic savings treatment: 16%
  - Matched savings treatment: 22%

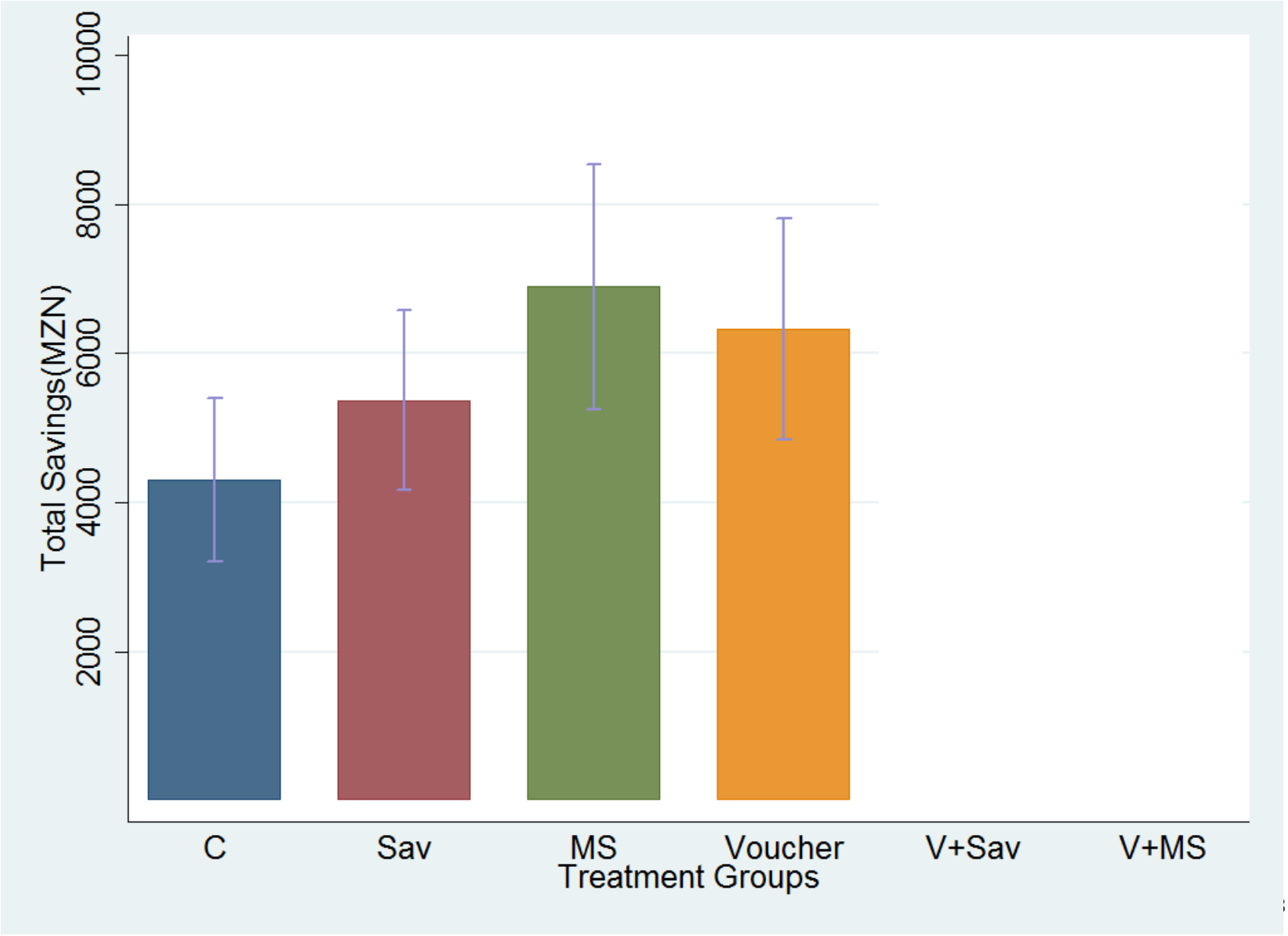
Summary of results

- Both the fertilizer voucher and the matched savings programs – on their own – have substantial positive effects on important outcomes
  - Savings (at BOM and overall)
  - Fertilizer use
  - Maize production
  - Food consumption
  - Assets

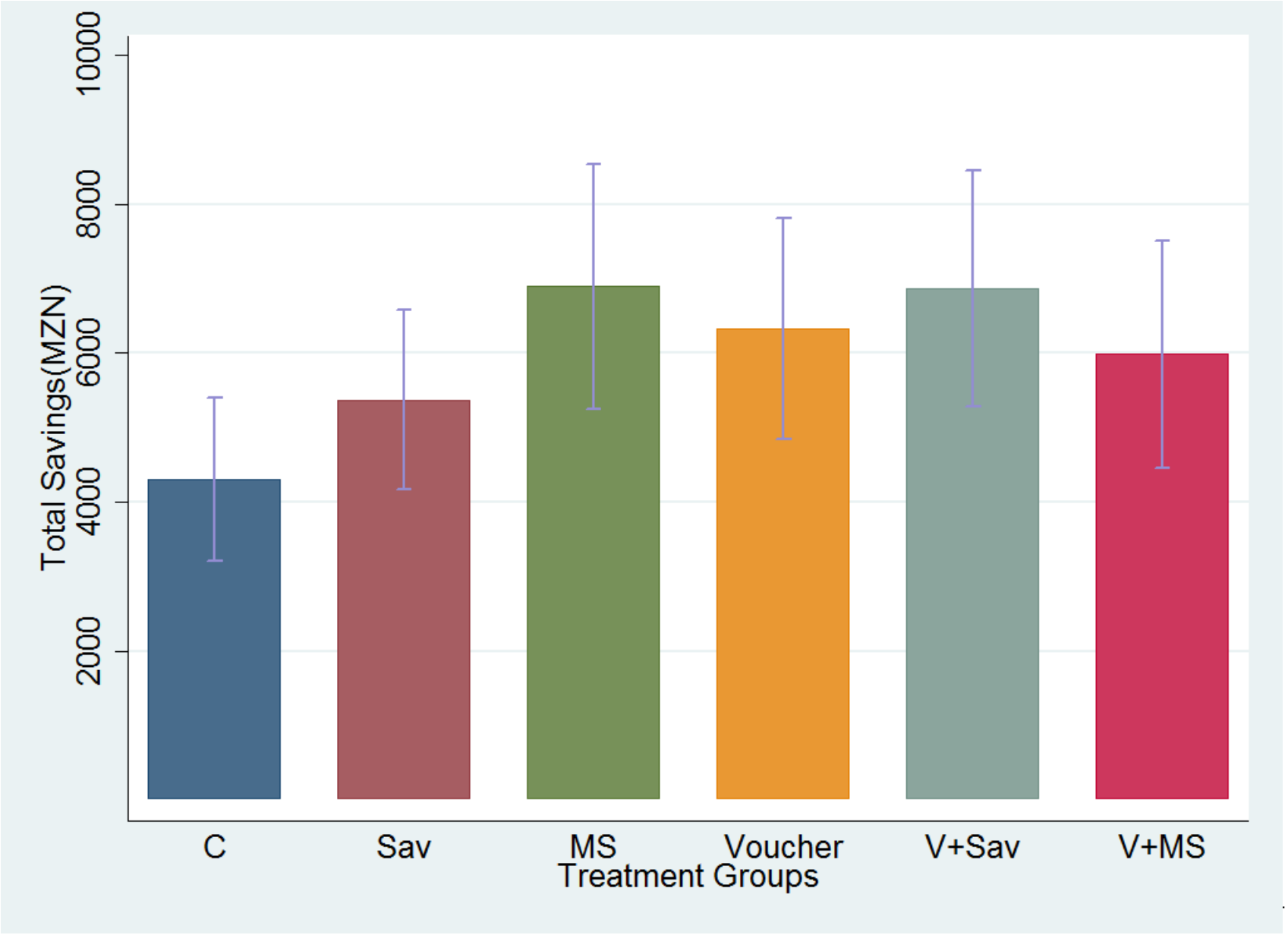
- Estimated impacts of basic savings also positive, but smaller than matched savings and not statistically significant

- But interaction of the voucher and savings is *negative*
  - Effect of receiving both types of programs is less than the sum of the effects when offered on their own

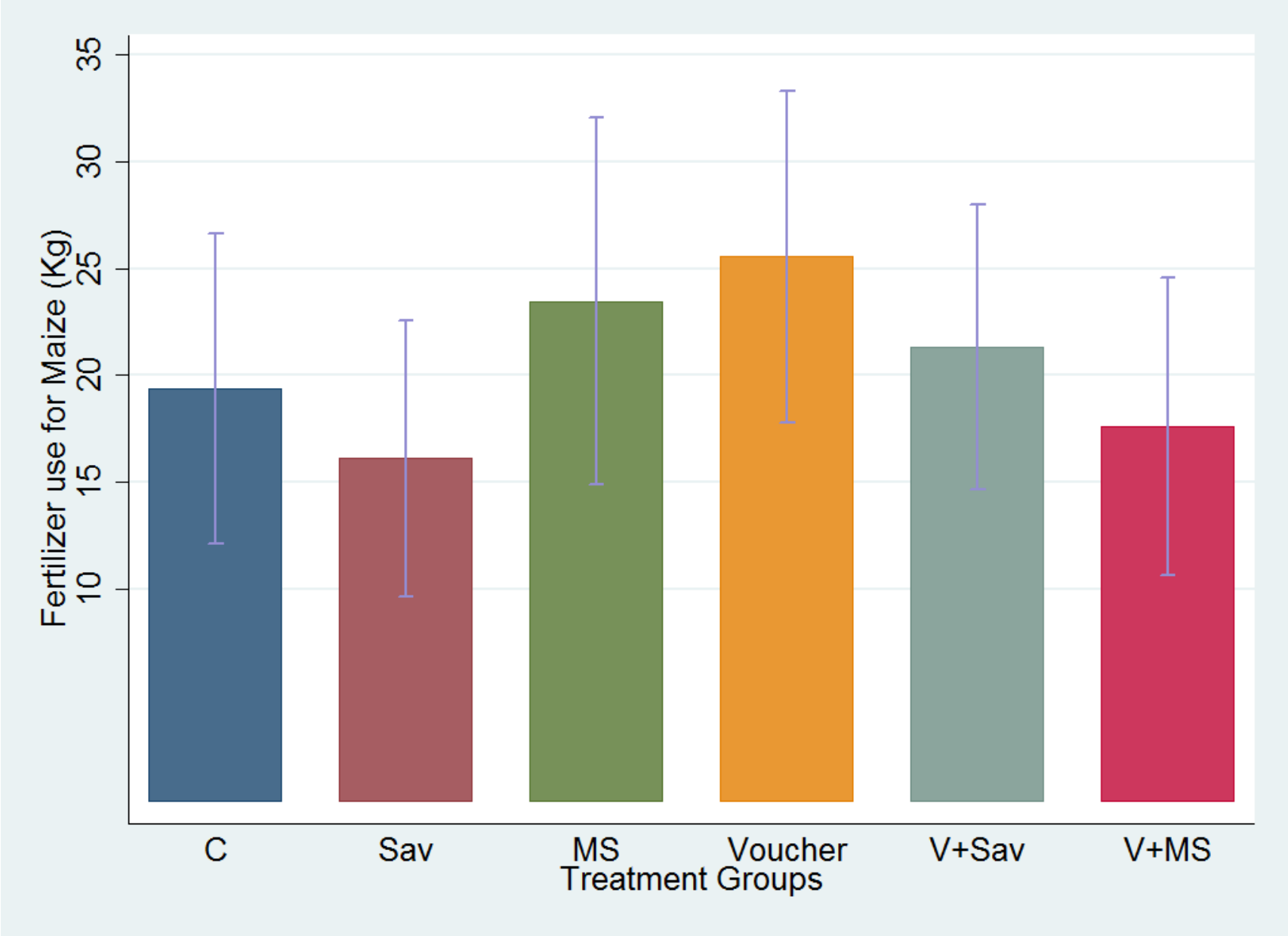
Total savings (MT)



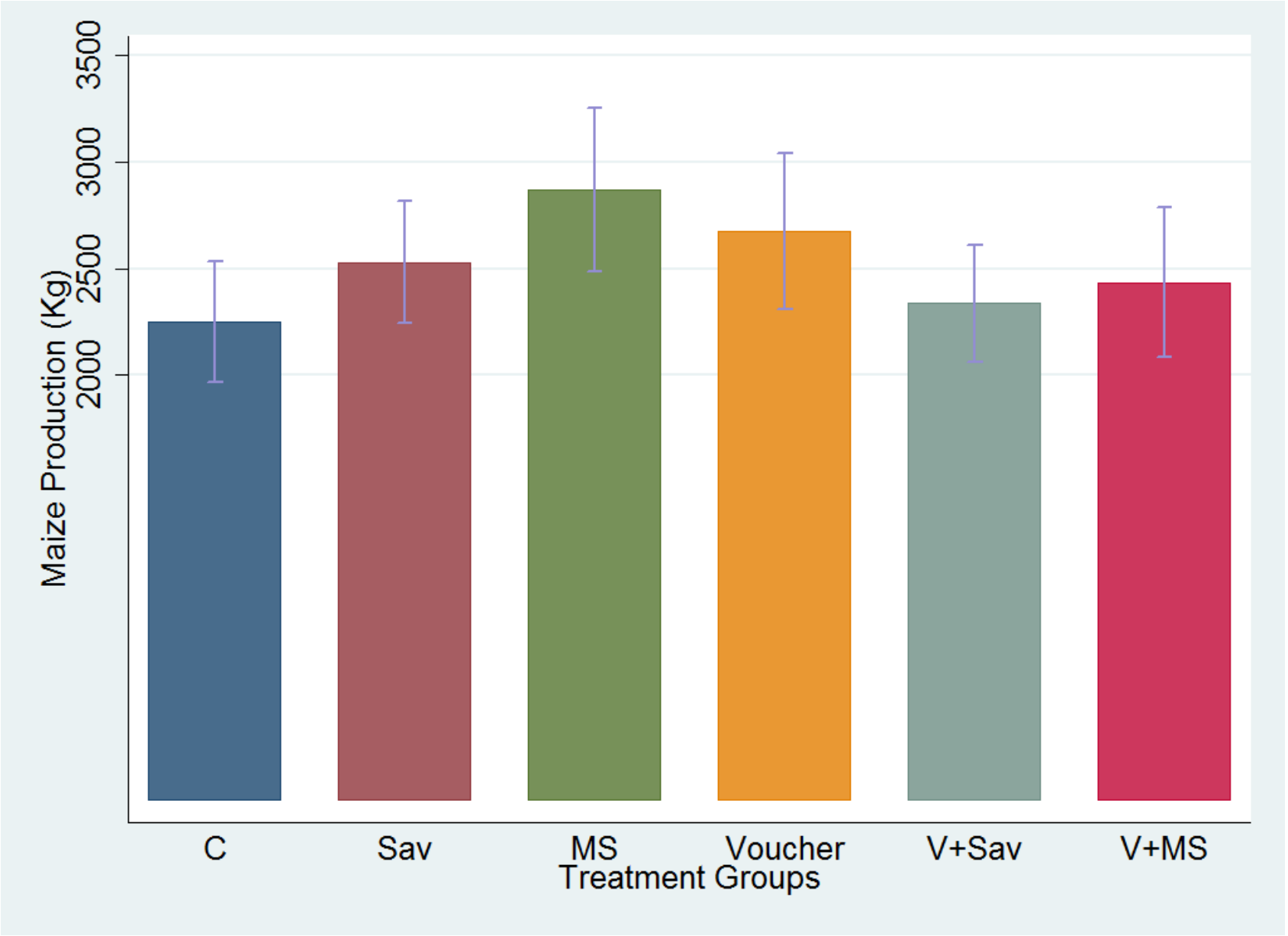
Total savings (MT)



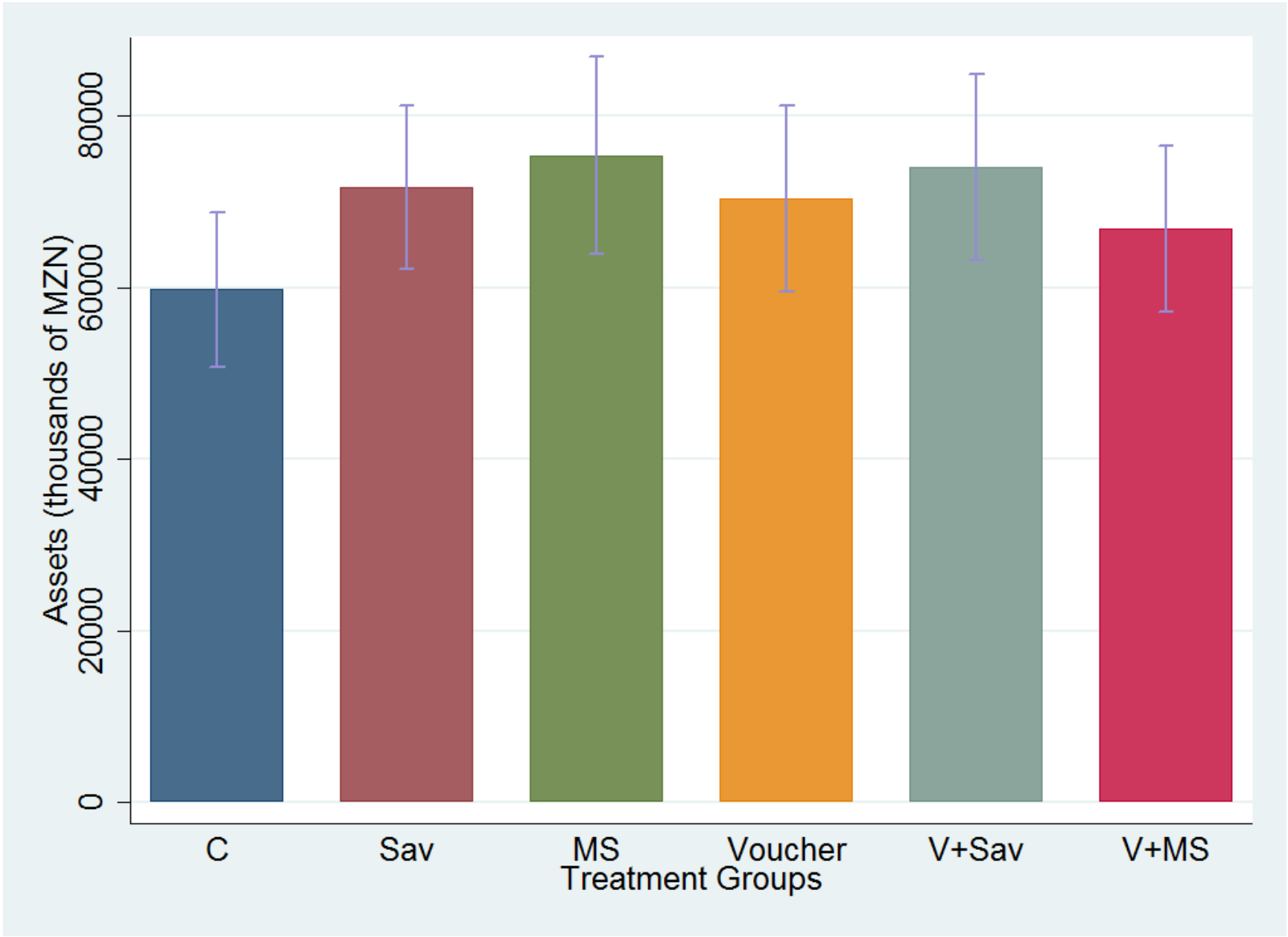
Fertilizer use (kg.)



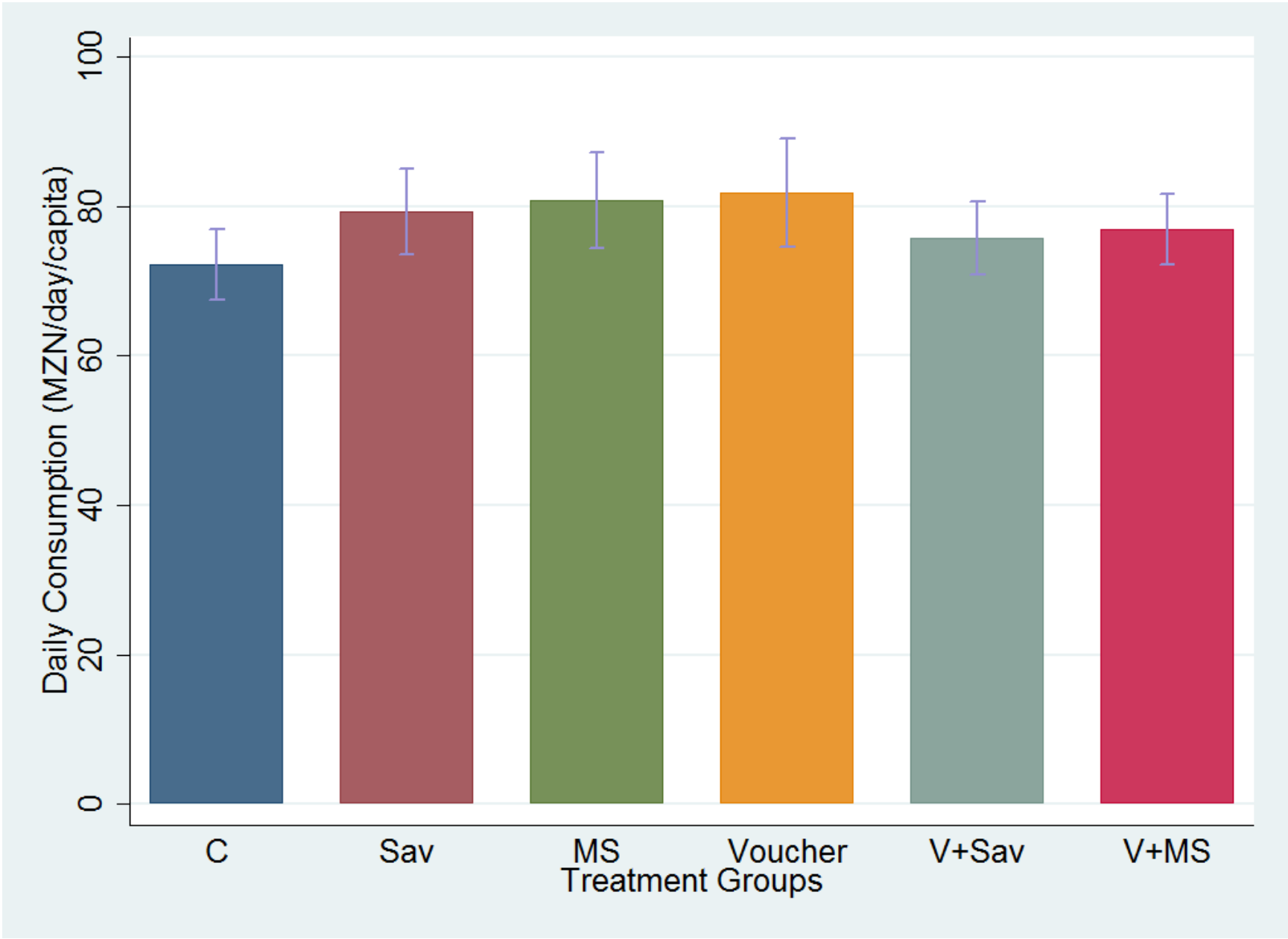
Maize production (kg.)



Assets (MT)


Assets (thousands of MZN)
0
20000
40000
60000
80000
C
Sav
MS
Voucher
V+Sav
V+MS
Treatment Groups

Daily consumption per capita (MT)



Regression analysis

For respondent *i* in locality *j*, locality group *k*:

$$y_{ijk} = \zeta + \alpha V_{ijk} + \beta B_{jk} + \gamma M_{jk} + \delta V_{ijk} B_{jk} + \lambda V_{ijk} M_{jk} + \theta_k + \varepsilon_{ijk}$$

- y_{ijk} = outcome variable (inverse hyperbolic sine transformation)

- V_{ijk} = indicator: voucher recipient
- B_{jk} = indicator: basic savings treatment
- M_{jk} = indicator: matched savings treatment

- θ_k = fixed effect for stratification cell (locality group)

- OLS with standard errors clustered by locality

- Focus on average of 2012 and 2013 outcomes, which improves power (McKenzie 2012)

Regression results

Dependent variables:	Total Savings	Fertilizer (kg)	Maize Production (kg)	Total Assets	Daily consumption per capita
Basic savings	0.33	0.11	0.06	0.19	0.08*
	[0.22]	[0.19]	[0.08]	[0.14]	[0.04]
Matched savings	1.17***	0.31*	0.16**	0.22*	0.10**
	[0.22]	[0.16]	[0.08]	[0.13]	[0.04]
Fertilizer voucher	0.55***	0.36***	0.11*	0.23*	0.09**
	[0.19]	[0.12]	[0.06]	[0.14]	[0.03]
Voucher * Basic savings	-0.09	-0.16	-0.19**	-0.28	-0.12**
	[0.28]	[0.16]	[0.09]	[0.18]	[0.05]
Voucher * Matched savings	-0.91***	-0.54***	-0.29***	-0.30	-0.12**
	[0.29]	[0.20]	[0.10]	[0.18]	[0.06]
Constant	5.69***	0.59***	7.31***	9.99***	4.26***
	[0.13]	[0.09]	[0.05]	[0.09]	[0.03]
Observations	1,534	1,456	1,523	1,534	1,531
R-squared	0.05	0.19	0.13	0.11	0.07
p-value: sav = MS	0.0011	0.3387	0.2014	0.8296	0.6554
p-val: sav + V*sav = MS + V*MS	0.9349	0.3183	0.9573	0.8011	0.5719
p-val: vouch + sav + V*sav = 0	0.0001	0.0761	0.7977	0.2467	0.2212
p-val: vouch + ms + V*ms = 0	0.0000	0.4351	0.8195	0.3952	0.0657

Levels of significance: *** 1%, ** 5%, * 10%. Standard errors in brackets, clustered by locality. Dependent variables are inverse hyperbolic sine transformation of averages of values from follow up surveys in 2012 and 2013. All regressions include stratification cell fixed effects.

In sum

- Results suggest that the voucher and matched savings programs – standing on their own – had positive effects

- But for some reason the programs interact negatively when offered simultaneously

- Next steps
  - Try to shed light on reasons for observed negative complementarities
  - Expand analysis to other types of investments and outcomes (ag and non-ag) that may have been affected as well

Rationales for matched savings programs

- Saving behavior may be subject to habituation
  - Match "jump starts" savings habit
- Saving in formal institutions may have costly learning-by-doing component. Match eases cost of learning.
- Formal institutions may not initially be trusted
  - Some perceived likelihood that savings will be lost
  - Match gets individuals to use and trust formal institutions
- Nonconvexities in returns to investment, combined with self-control problems
  - Investing a "lump" more attractive than investing a little, but hard to accumulate the lump