Enduring Effects of Fertilizer Subsidies on Commercial Fertilizer Demand and Maize Production?

Panel Data Evidence from Malawi



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Hypotheses:

1) Households acquiring subsidized fertilizer in consecutive previous years do not purchase significantly more fertilizer on the commercial market than do other households
   - Longer-run issues of crowding out / crowding in
   - Extends previous studies examining current year impacts only (e.g., Xu et al. 2009; Ricker-Gilbert et al. 2011; Mason and Jayne 2013; Liverpool-Tasie 2014; Takeshima and Nkonya 2014).

Hypotheses:

2) Households that acquire subsidized fertilizer in consecutive previous years do not produce significantly more maize in the current year than do other households.
   - Estimate impacts on maize area planted and output
   - Distributed lag model following job training and job loss literature (Ashenfelter 1978, and Jacobson et al. 1993).
   - Adds to studies measuring the current year impacts (Holden and Lunduka 2010; Chibwana et al. 2014; Mason et al. 2014)
   - Few studies look at impacts in longer-run (Carter et al. 2014) – external validity issues…

Household Panel Data from Malawi

- 462 households all livelihood zones of Malawi
- Surveyed 4 times (2003/04, 2006/07, 2008/09, 2010/11).
  - Area planted, production, assets, etc.
- With recall data we know their fertilizer use by source for every year between 2003/04 & 2010/11.
- Led by NSO, SOAS, Wadonda consult, and MSU at different times.

Methods

household (i) at time (t)

$$Y_{it} = \alpha + \beta_0 Fert_{it} + \beta_1 Fert_{it-1} + \beta_2 Fert_{it-2} + \beta_3 Fert_{it-3} + \mathbf{HH\_factors}_{it}\boldsymbol{\delta}_j + \mathbf{Prices}_{it}\boldsymbol{б}_j + \mathbf{rainfall}_{it}\boldsymbol{\rho}_j + e_i + v_{it}$$

Y_{it} = Commercial fertilizer demand ($H_0$1); Maize output ($H_0$2)

Contemporaneous effect = β_0 ; **enduring effect =** $\beta_1 + \beta_2 + \beta_3$

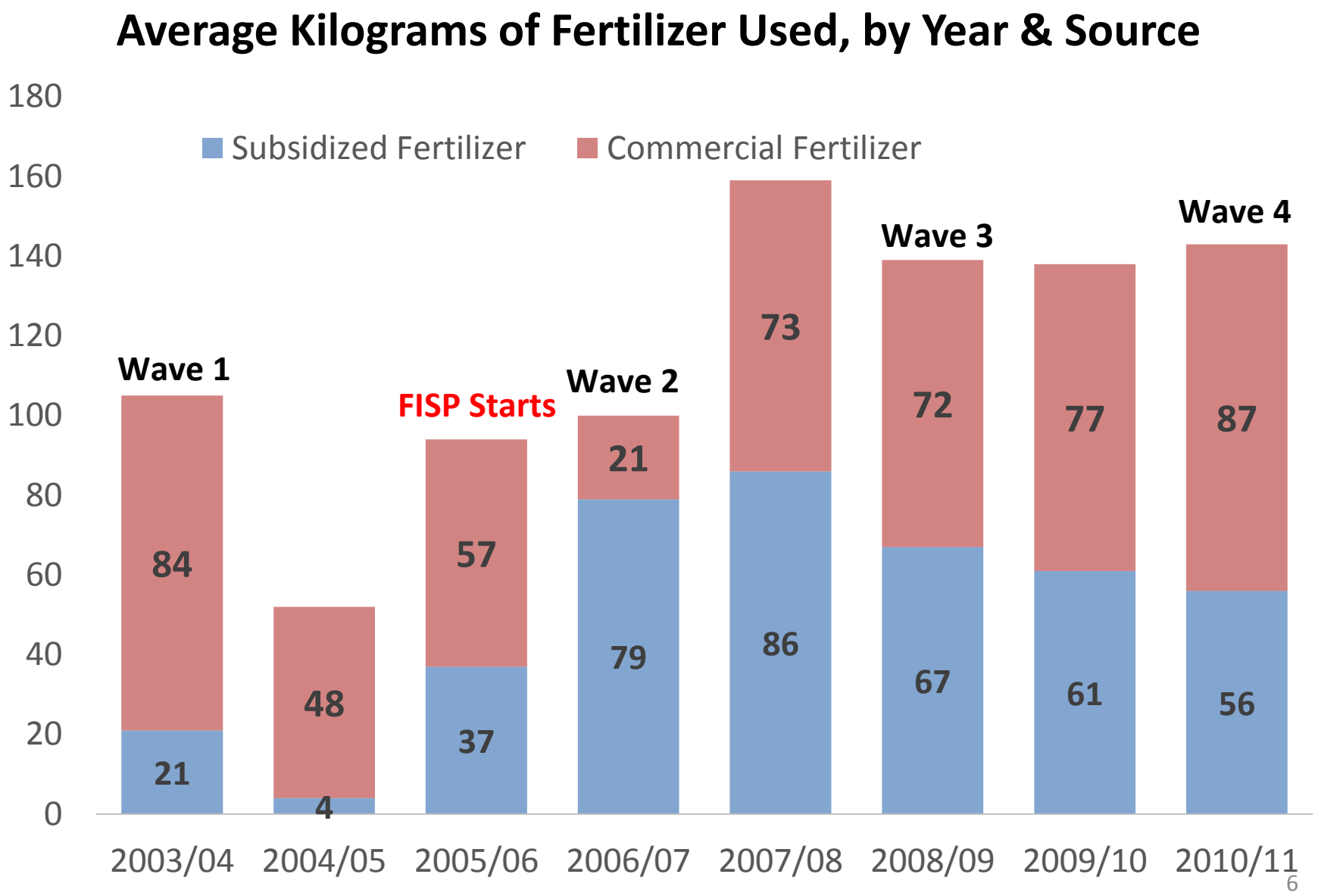
Fertilizer kgs = (**Subsidized kgs** + Commercial kgs)

Problem Subsidized kgs may be correlated with error.
need to control this issue to make case for causal effect

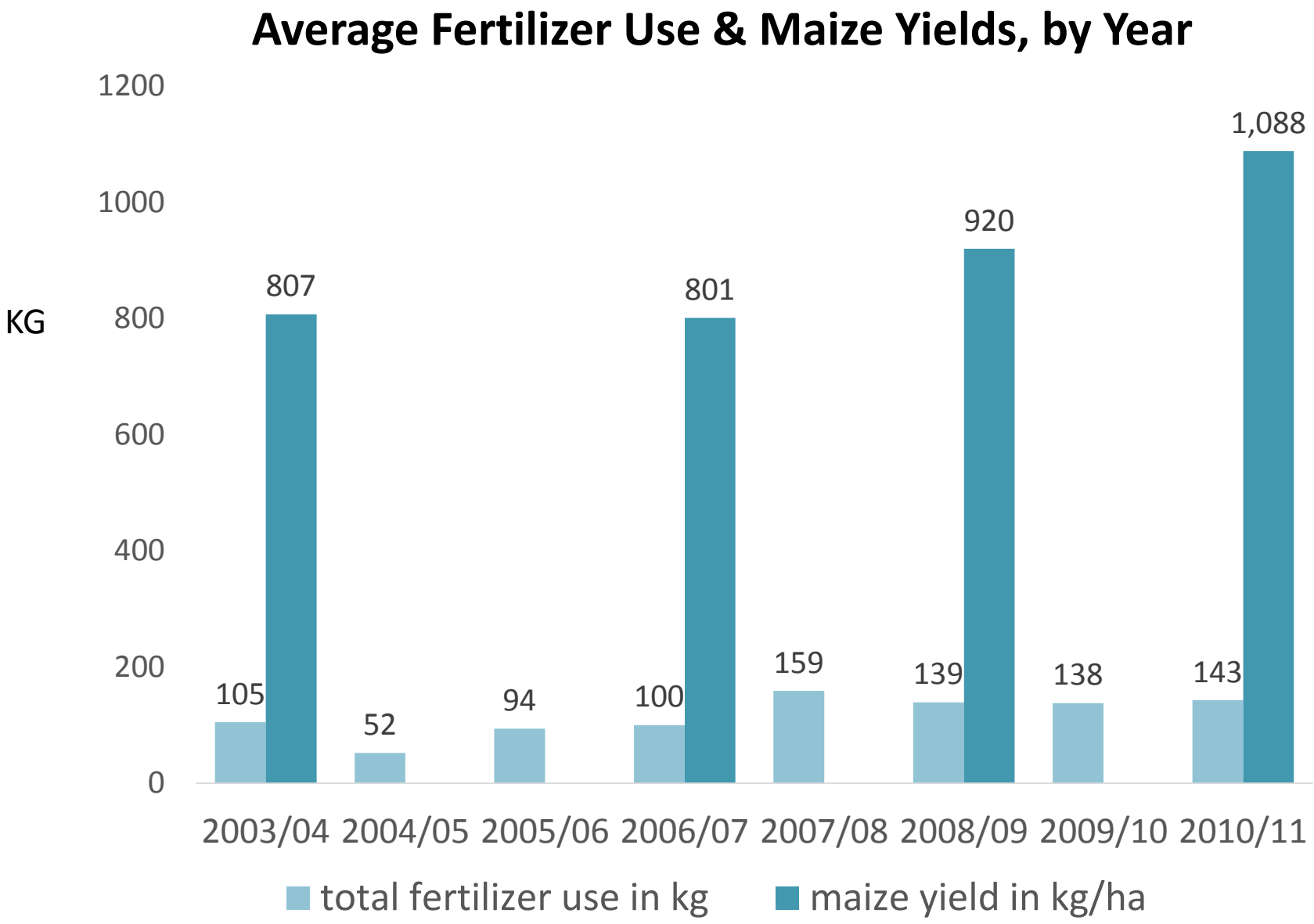
Controlling correlation between Subsidized kgs and error term

- first-difference: controls for e_i
- show parsimonious specification to deal with remaining omitted variables that may be associated with Δv_{it}.

Descriptive Results



Descriptive Results



$H_0 1$: Factors affecting kgs of commercial fertilizer purchased in year t

Dep. Var.: Kilograms of commercial fertilizer purchased	(1) contemporaneous			(2) year t-1		(3) year t-2		(4) year t-3		
Covariates	Coeff.		P-value	Coeff.	P-value	Coeff.	P-value	Coeff.		P-value
Kg sub. fert. acquired in yr t	-0.286	*	(0.06)	-0.149	(0.28)	-0.158	(0.146)	-0.073		(0.46)
Kg sub. fert. acquired in yr t-1				0.038	(0.245)	0.036	(0.363)	0.130	**	(0.03)
Kg sub. fert. acquired in yr t-2						-0.021	(0.770)	-0.014		(0.81)
Kg sub. fert. acquired in yr t-3								0.084	**	(0.04)
Other controls included	Y			Y		Y		Y		
Joint enduring effect (Subsidized Fertilizer t-1 + t-2)						0.015	(0.83)			
Joint enduring effect (Subsidized Fertilizer t-1 + t-2 + t-3)								0.20	**	(0.041)

- Evidence of current year crowding out. Consistent with other studies.
- Statistically significant, and small evidence of crowding in over time. Annualized over 3 year period crowding in rate is 0.067.
  - May be partially due to credit constraint relief from subsidy or some wealth generation.
- Larger current year crowding out effects only partially mitigated by longer-run crowding in

$H_0$2: Factors affecting maize production in year t

Dep. Var.: kilograms of maize produced	(1) contemporaneous		(2) year t-1	
Covariates	(parsimonious)	(full)	(parsimonious)	(full)
kg of total fertilizer acquired in yr t	1.53*** (0.000)	1.40*** (0.000)	1.33*** (0.002)	1.26*** (0.003)
kg of total fertilizer acquired in yr t-1			-0.35 (0.220)	-0.37 (0.187)
kg of total fertilizer acquired in yr t-2				
kg of total fertilizer acquired in yr t-3				
Other controls included	No	Yes	No	Yes
Joint enduring effect of total fert. acquired in yr t-1 + t-2¥				
Joint enduring effect of tot. fert acquired in yr t-1 + t-2 + t-3¥				
Subsidized fertilizer indirect partial effect¥				
Kg subsidized fertilizer acquired in yr t		1.00*** (0.000)		1.07** (0.029)
Kg subsidized fertilizer acquired in yr t-1				-0.38 (0.385)
Kg subsidized fertilizer acquired in yr t-2				
Kg subsidized fertilizer acquired in yr t-3				
Joint enduring effect of subsidized fertilizer in yr t-1 + t-2¥				
Joint enduring effect of subsidized fertilizer in yr t-1 + t-2 + t-3¥				
Observations	1,386	1,386	924	924
R-squared		0.141		0.106

$H_0$2: Factors affecting maize production in year t

Dep. Var.: kilograms of maize produced	(3) year t-2				(4) year t-3			
Covariates	(parsimonious)		(full)		(parsimonious)		(full)	
kg of total fertilizer acquired in yr t	1.61***	(0.000)	1.55***	(0.000)	1.65***	(0.000)	1.58***	(0.001)
kg of total fertilizer acquired in yr t-1	-0.35	(0.213)	-0.37	(0.177)	-0.40	(0.195)	-0.42	(0.173)
kg of total fertilizer acquired in yr t-2	0.70**	(0.030)	0.70**	(0.041)	0.75**	(0.038)	0.75*	(0.051)
kg of total fertilizer acquired in yr t-3					-0.10	(0.550)	-0.09	(0.611)
Other controls included	No		Yes		No		Yes	
Joint enduring effect of total fert. acquired in yr t-1 + t-2¥	0.35	(0.370)	0.34	(0.414)				
Joint enduring effect of tot. fert acquired in yr t-1 + t-2 + t-3¥					0.24	(0.595)	0.24	(0.601)
Subsidized fertilizer indirect partial effect¥								
Kg subsidized fertilizer acquired in yr t			1.31***	(0.009)			1.46***	(0.007)
Kg subsidized fertilizer acquired in yr t-1			-0.38	(0.335)			-0.47	(0.310)
Kg subsidized fertilizer acquired in yr t-2			0.069*	(0.050)			0.074*	(0.090)
Kg subsidized fertilizer acquired in yr t-3							-0.09	(0.702)
Joint enduring effect of subsidized fertilizer in yr t-1 + t-2¥	0.31	(xxx)	0.31	(0.551)				
Joint enduring effect of subsidized fertilizer in yr t-1 + t-2 + t-3¥					0.17	(xxx)	0.18	(0.781)
Observations			924				924	
R-squared			0.107					

Conclusions

- Distinguish between current year and enduring effects of input subsidy programs
- **$H_0$1 no crowding in/out:** some evidence of a small enduring effect of crowding in. Annual rate of 0.067.
- **$H_0$2 Production**: fail to reject null of no enduring production impacts.
  - Some small current year impacts
  - Mainly through increased output. Consistent with other studies, and likely for Malawi with limited area expansion potential.

Conclusions Policy Implications

- Low response rates raise questions about how subsidies can be cost-effective.
- From policy perspective need to provide complimentary inputs for boosting response rates.
  - Response rates can be improved through timely delivery of fertilizer, soil management, weeding etc.
- Develop better targeting mechanisms to locate farmers who can obtain higher response rates (self targeting?).
  - Raise required farmer contribution (currently < 5% in Malawi).
  - Conditional subsidy (requires adoption of soil fertility management practices to participate).

Thank you for your time!

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