

# What are the Enduring Benefits of Fertilizer Subsidies on Household Well-Being? Evidence from Malawi



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## I. Introduction

**Conference theme: “Food and Financial Crisis: The Way Forward”**

**When considering public policies that may guard against food and financial crises, we need to consider:**

1. which policies/programs can achieve the greatest benefit from available scarce public resources?
2. How to make the programs sustainable over time?  
Can programs kick-start the growth process?

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## II. Objective

### Measure impacts of fertilizer subsidies on household livelihood

1. How does receiving subsidized fertilizer in a certain year affect household well-being in that same year?

(CONTEMPORANEOUS EFFECT)

2. How does receiving subsidized fertilizer in past years (or in combinations of past years) affect household well-being in the current year? (DYNAMIC EFFECT)

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## III. Recent Research Themes on Fertilizer Subsidies

### 1. Crowding out

- (Xu et. al. 2009; Ricker-Gilbert & Jayne 2009)

### 2. Effect on yields

- (Ricker-Gilbert, Jayne & Black 2009; Holden & Lunduka 2010; Chibwana 2010)

### 3. Targeting

- (Banful, 2010)

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## **IV. Contribution of this study**

### **Mainly empirical**

- Provides findings on effects of fertilizer subsidies that can help policy makers evaluate potential benefits of subsidy programs.
- Looks beyond the year the subsidy is received, to evaluate longer run (dynamic) impacts.
  - Attempts to address issue of whether or not subsidies can break households out of poverty trap and kick-start growth.

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## **V. Hypotheses Tested**

1.  $H_01$ : Subsidized fertilizer has no significant effect on household well-being in the year it is received (contemporaneous effect).
2.  $H_02$ : Subsidized fertilizer received in past years has no effect on well-being in the current year (dynamic effect).

**Magnitude of the effect matters**

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## VI. Modalities of Subsidy Distribution

- Fertilizer subsidies are not new
- Current wave uses “**Targeted Input Vouchers**”; only available to selected household
- Each selected household entitled two 50kg bags (1 NPK, 1 urea)
  - Recently 2kg bag of seed for free
- Farmers subsidized up to 90% of commercial price in most recent years.
- Coupons for subsidy distributed regional level based on area under cultivation.
- Methods for local coupon allocation had the potential to vary across villages.
  - Village leaders & distribution committee, open forums.
  - Supposed to go to people who could contribute to national level production but could not afford 1-2 50 kg bags of fertilizer at commercial prices

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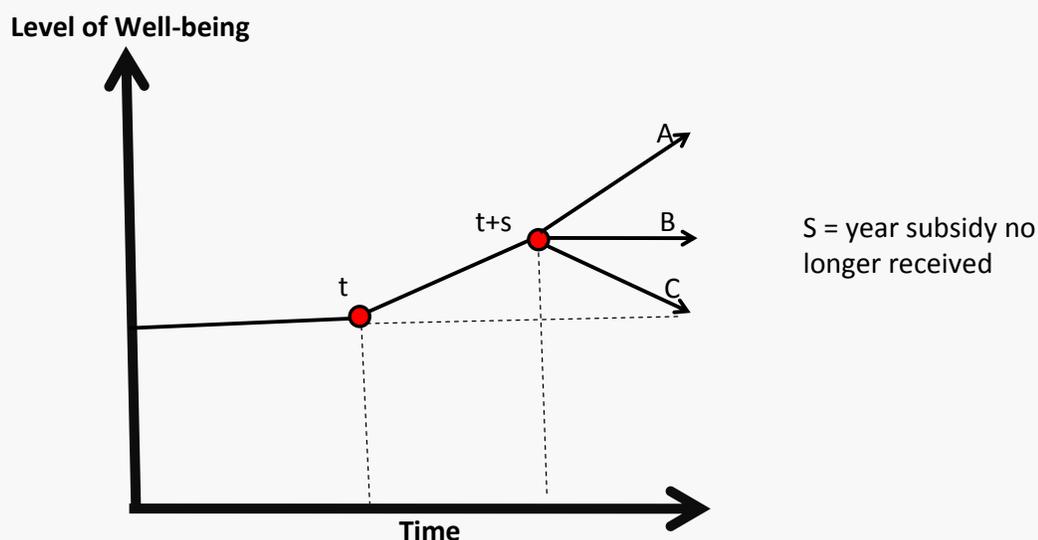
## VI. Implications of Non-Random & Uneven Distribution Process

- **Non-random distribution process.**
    - Unobservable factors (to the researcher) probably affect quantity of subsidy received by households (**ie: ability**)
    - Those same unobservable factors probably affect the dependent variables in our models of well-being
- Endogeneity problem** – can not just add quantity of subsidized fertilizer as an exogenous explanatory variable in model
- **Uneven distribution process**
    - Each targeted household supposed to get two 50kg bags of fertilizer
    - In reality the actual amount of subsidized fertilizer received varied by household
- Subsidized fertilizer not just a binary (zero or one) variable
- Many people got nothing but for those who did the quantity of subsidized fertilizer received was relatively continuous

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## VII. Conceptual Framework

(Jacobson et al. 1993; Feder et al. 2003; Kirimi 2008)



- Household gets some qty of subsidized fertilizer in year  $t$ . What happens in that year?
- What happens to household well-being beyond year  $t$ ? Do they move along path<sup>9</sup> A,

## VIII. Indicators of Well-being

How does subsidized fertilizer affect the following household level factors?

### 1. Area & Supply Response (farmer recall)

- Area planted
  - Area planted to maize
  - Household level maize production
- Well-being  $\neq$  Welfare

### 2. Value of Household Assets (real terms)

- Total value of assets (livestock & durables)
  - Productive assets (ie: livestock, equipment)
  - Consumption assets (ie: consumer goods)

### 3. Subjective Measures – (respondent reported)

- Adequacy of food consumption
- Household head's satisfaction with life

**These are the dependent variables use in our analysis**

## IX. Methods. Structural model of well-being for household (i) at time (t)

$$\text{Well-being}_{it} = \beta_0 + \beta_1 \text{Subfert}_{it} + \sum \beta_j \text{Subfert}_{it-j} \\ + \text{Transfer\_costs} \alpha_j + \text{HH\_characteristics} \delta_j + \text{Prices} \delta_j \\ + \text{Rainfall} \rho_j + \omega_j \text{Year} + \zeta_j \text{Region} \quad c_i + \mu_{it}$$

**Red** denotes potentially endogenous variable

**Blue** denotes dummy variable

**H<sub>0</sub>1:**  $\beta_1 = 0$ : Contemporaneous Effect

**H<sub>0</sub>2:**  $\sum \beta_j = 0$ : Dynamic Effect

**Controlling correlation between **Subfert<sub>it</sub>** and error term**

- Correlation between **Subfert<sub>it</sub>** and  $c_i$ 
  - Fixed effects in linear model
  - Correlated random effects in non-linear model
- Correlation between **Subfert<sub>it</sub>** and  $\mu_{it}$ 
  - Instrumental Variable (IV) methods

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## IX. Methods

### Subsidized fertilizer acquisition (reduced form)

$$\text{Subfert}_{it} = \beta_0 + \text{variables from structural model} \\ + \beta_j \text{MP\_in\_village}_{it} + b_i + v_{it}$$

**Green** indicates instrumental variable

- Tobit Estimator used
- Correlated Random Effects to control for ( $b_i$ )
- Residual generated & used in structural model to control for endogeneity (Wooldridge 2002; Papke & Wooldridge 2008)

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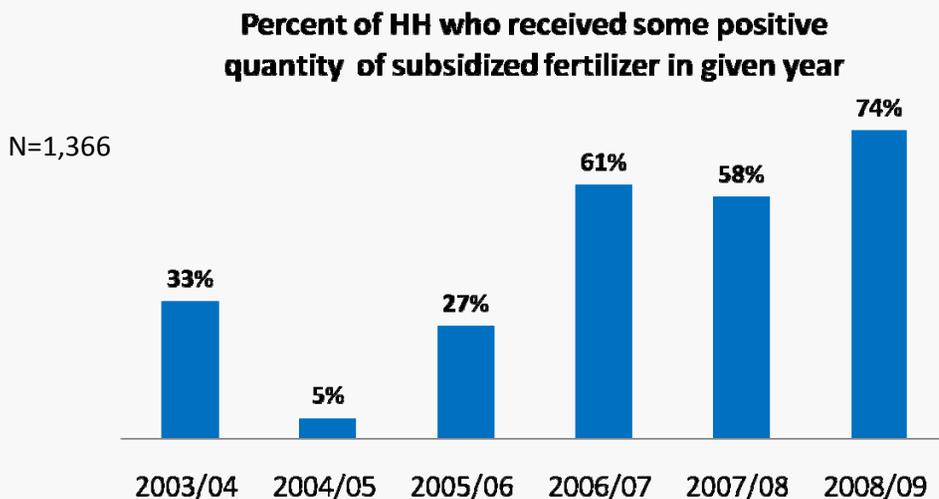
## IX. Methods & Data

- Two waves of household panel data in Malawi (2006/07 & 2008/09) – in total 1,366 HH
  - Recall data on fertilizer use between waves
- Three year lagged quantities of subsidized fertilizer. Can look at fertilizer use going back six seasons
- Model's dynamic effect tested using F-test
- Account for effect of receiving subsidy in consecutive years

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## X. Results

### When people got the subsidy

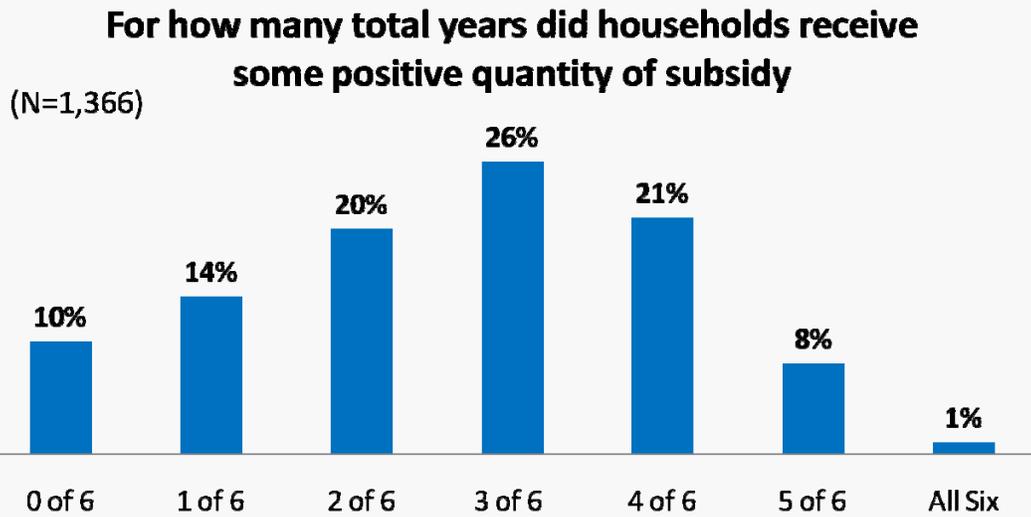


- In 2003/04 small subsidy in place (1/3) received by quantity received was small 9kgs on average
- Subsidy scaled up from 2005/06 onward

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## X. Results

### When people got the subsidy



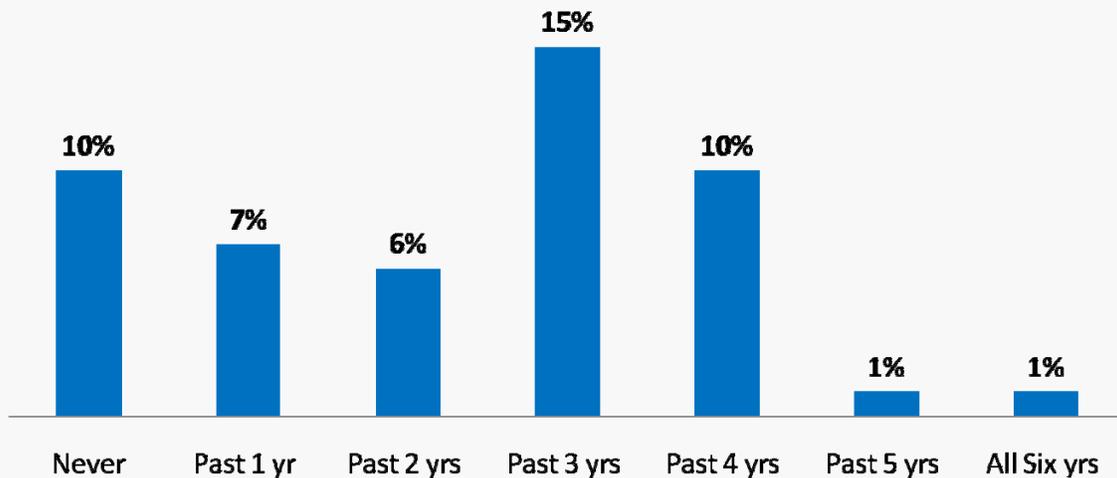
- 2/3 of households received subsidy in two, three or four of the past six years
- 10% never received the subsidy while only 1% received it in all six years
- No evidence of a large group who always received the subsidy.

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## X. Results

### When people got the subsidy

**How Many Households Received Subsidized Fertilizer Continuously for How Many Years (Going back from 2008/09)?**



- 51% of households had no continuous pattern of receiving the subsidy (ie: A household may not have received the subsidy last year but may have received it the two years before that).
- Overall there is no clearly discernable pattern of subsidy receipt at household level.

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## X. Results

### Kgs of subsidy received by household (reduced form)

#### Key findings of statistically significant variables

Dep. Var.: Quantity of subsidized fertilizer acquired by the household in year t

| Key Independent Variables                                 | Coeff.      | P-value       |
|---|-------------|---------------|
| (I.V.) <b>Member of parliament resides in community</b>   | <b>7.39</b> | <b>(0.06)</b> |
| Dynamic effect of subsidized fertilizer (t-1 + t-2 + t-3) | -0.28       | (0.00)        |
| Area cultivated by household                              | <b>5.15</b> | <b>(0.01)</b> |
| # of females over 65 in the household                     | -13.86      | (0.00)        |

Tobit estimator used; coefficients are average partial effects (APE)

Number of observations=2,732

R-squared = 0.12

I.V. statistically significant and indicates that political connections affect qty of subsidized fertilizer received at household level (fits with Banful 2010 finding in Ghana)

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## X. Results:

### Factors affecting area & supply response

#### Key findings of statistically significant variables

| Key Independent Variable   | (1)<br>Dependent var:<br>Hectares<br>Cultivated by HH | (2)<br>Dependent var:<br>Hectares of Maize<br>Cultivated by HH | (3)<br>Dependent var:<br>Maize Production<br>by HH (in kg) |
|--|---|--|--|
| Kgs. sub. Fert.; yr. t (100 kg)  | <b>0.2 (0.00)</b>                                     | <b>0.1 (0.03)</b>  | <b>237 (0.01)</b>  |
| Dynamic effect of<br>subsidized fertilizer (100 kg)<br>(t-1 + t-2 + t-3) | -0.1 (0.48)   | -0.1 (0.49)  | <b>242 (0.02)</b>  |
| Area cultivated by the<br>household (in ha)                              | -   | -  | <b>105 (0.01)</b>  |
| Female headed HH   | <b>-0.24 (0.00)</b>                                   | <b>-0.15 (0.00)</b>  | 37 (0.44)  |
| Expected maize price (naive)   | <b>0.01 (0.00)</b>                                    | <b>0.01 (0.00)</b>   | -4.32 (0.21)   |
| Expected rainfall (naïve)  | <b>0.02 (0.00)</b>                                    | <b>0.01 (0.00)</b>   | -6.4 (0.34)  |

N=2,372

R<sup>2</sup>=0.08

N=2,372

R<sup>2</sup>=0.08

N=2616

R<sup>2</sup>=0.10

Red denotes statistically significant; Fixed effects estimator used; P-values in parentheses

## X. Results

### Factors affecting HH assets

Key findings of statistically significant variables

|   | 1  | 2  | 3   |
|---|--|--|---|
|   | =  |  | +   |
| Key Independent Variables                                 | (1)<br>Dependent var:<br>Total HH Assets in Kwacha | (2)<br>Dependent var:<br>HH Consumption Assets in Kwacha | (3)<br>Dependent var:<br>HH Productive Assets in Kwacha |
| Kgs. sub. fert. in yr. t                                  | 31 (0.89)  | 86 (0.32)  | -55 (0.74)  |
| Dynamic effect of subsidized fertilizer (t-1 + t-2 + t-3) | 626 (0.12)   | 75 (0.36)  | 552 (0.16)  |
| Area cultivated by the household (in ha)                  | <b>14,183 (0.03)</b>                               | 5,497 (0.11)   | 8,686 (0.11)  |
| # of working age males, Under 65 years                    | <b>12,242 (0.00)</b>                               | 1,537 (0.47)   | <b>10,705 (0.01)</b>                                    |
| Expected maize price (naive)                              | <b>-1,399 (0.04)</b>                               | -315 (0.26)  | <b>-1,083 (0.08)</b>                                    |
|   | N=2,372<br>R <sup>2</sup> =0.01                    | N=2,372<br>R <sup>2</sup> =0.03                          | N=2,372<br>R <sup>2</sup> =0.01 <sup>19</sup>           |

Red denotes statistically significant; P-values in parentheses; Fixed effects estimator used.

## X. Results

### Subjective Factors

Key findings of statistically significant variables

|   | (1)<br>Dependent var:<br>Adequacy of Food Consumption | (2)<br>Dependent var:<br>Satisfaction with Life |
|---|---|---|
| Key Independent Variable                                  |   |   |
| Kgs. sub. fert. in yr. t                                  | - -   | <b>0.002 (0.06)</b>                             |
| Dynamic effect of subsidized fertilizer (t-1 + t-2 + t-3) | -0.003 (0.17)   | 0.001 (0.65)                                    |
| Area cultivated by the household (in ha)                  | 0.01 (0.53)   | <b>0.13 (0.01)</b>                              |
| Real HH Assets (1,000 Kacha)                              | <b>0.001 (0.00)</b>                                   | <b>0.009 (0.01)</b>                             |
| Expected maize price (naive)                              | <b>-0.002 (0.41)</b>                                  | <b>-0.01 (0.06)</b>                             |

•Red denotes statistically significant

•P-values in parentheses

•Probit estimator with correlated random effects used in food consumption model: Fixed effects estimator used in life satisfaction model.

N=2,372

R<sup>2</sup>=0.07

N=2,372

R<sup>2</sup>=0.05

## XI. Future Work

- Look for more(better) indicators of household well-being.
- Improve the measurement of continuous effects from receiving subsidy in multiple years.
  - See if there is some threshold of subsidized fertilizer receipt over time that kick-starts growth process.
- Look at impacts on households who received subsidized fertilizer for several years but then stopped receiving

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## XII. Conclusions

### Partially reject $H_01$ : (contemporaneous)

- Subsidized fertilizer: positive significant effect
  - 1) Area planted, area planted to maize,
  - 2) Maize production
  - 3) Life satisfaction
- No significant effect on
  - 1) Assets (driven by farm size and working age males)

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### Partially reject $H_02$ : (dynamics)

- Subsidized fertilizer: positive significant effect
  - 1) Maize production – (maybe phosphorus buildup or household's being better off)
- No significant dynamic effect on
  - 1) Assets
  - 2) Area planted, area planted to maize
  - 3) Subjective measures: adequacy of food consumption & life satisfaction

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## XII. Conclusions

### Targeting Issues

Subsidized fertilizer appears to go to areas where members of parliament reside

Households with more land get more subsidized fertilizer.

### To Conclude

Evidence suggests that contemporaneous benefits from subsidized fertilizer are stronger than dynamic benefits.

Is there another way to measure dynamic benefits to see if subsidies kick-start growth process?

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# Thank you for your time!



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