The role of maize price risk in technology adoption: Lessons for policies to promote smallholder productivity

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Paper presented at the

4th African Grain Trade Summit

"Accelerating Growth in Grain Trade: Opportunities for Strategic Partnerships and Investment"

Speke Resort, Kampala, Uganda, 13th- 14th October 2011

Outline

- **Introduction**
- **Modeling framework**
- **Modeling downside price risk**
- **Data and data sources**
- **Results**
- **Conclusions and implications for policy**

Introduction

- **Low productivity and productivity growth**
  - **continue to be of concern in our maize sectors**
  - **Due to low fertilizer and seed adoption rates**
- **In addition to low adoption**
  - **Some evidence suggests that farmers switch back and forth from adoption and back to disadoption!**
  - **This is *transient use* of improved technologies**
- **Few studies have addressed this issue of transience of technology adoption:**

Introduction (2)

- **Due to preponderance of cross-sectional data:**
  - **lagged behavior is unobserved**
  - **yet this is <u>crucial for tracking</u> technology adoption**
- **What role for output price risk in this?**

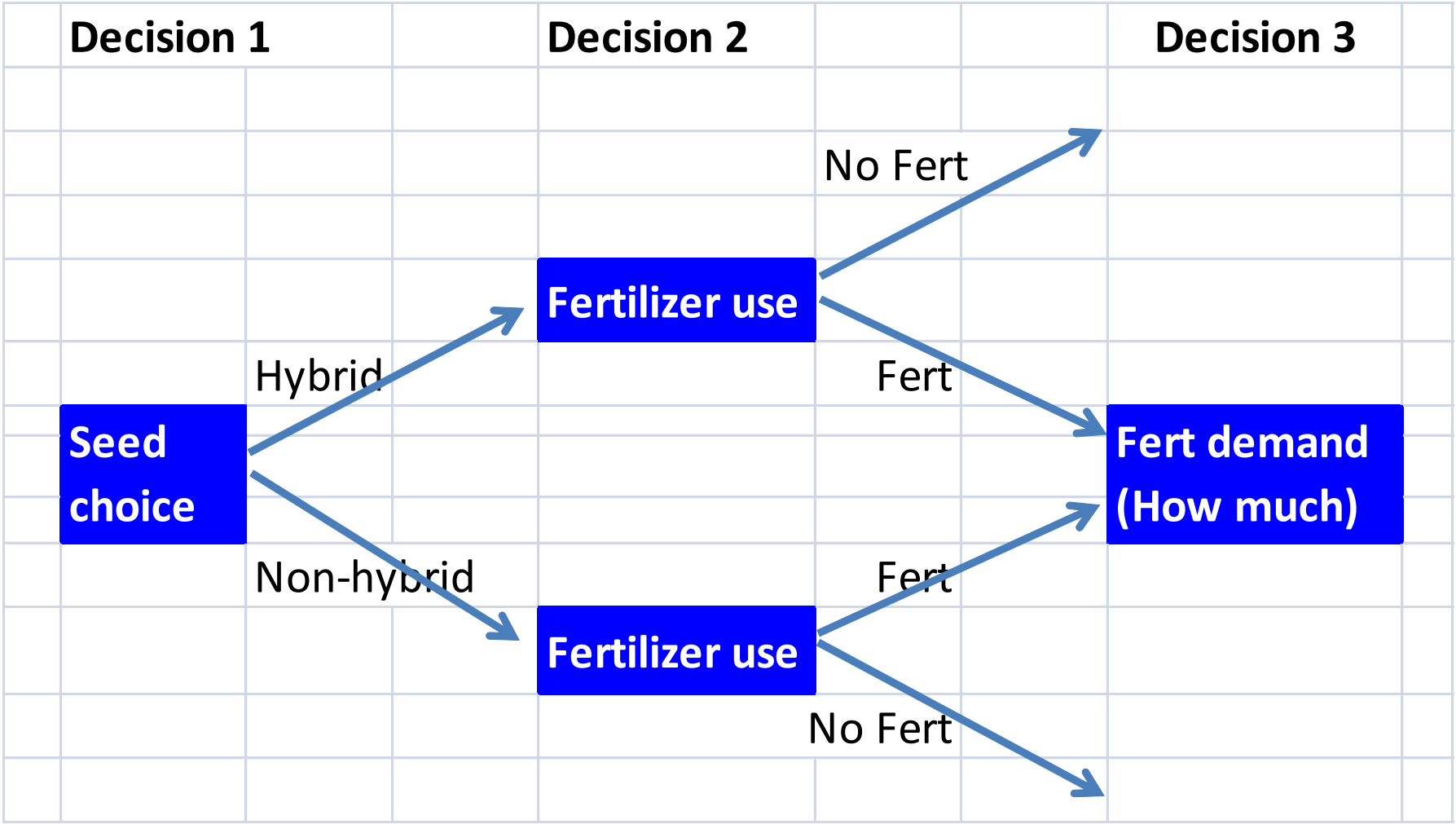
Major objectives

- **Develop a dynamic theoretical model capable of explaining transient use**
- **Apply the framework to a national panel data set from Kenya**
- **Using microeconmetric techniques, empirically test for the importance of downside price risks**

Why Maize

- **Kenya presents a good case study:**
  - **large maize sub-sector**
  - **input use is relatively high in some agro-ecozones (by SSA averages)**
  - **political concern that sustainable intensification may be compromised by maize price instability**
  - **these concerns give rise to policy responses (NCPB support prices, import tariffs, etc) with uncertain economy-wide effects**

Sequential decision modeling framework



Modeling downside price risk

$$\text{Risk} = \text{Prob}\left(\begin{array}{l}\text{Expected}\\ \text{output price}\end{array} < \begin{array}{l}\text{Break - even}\\ \text{price (unit cost)}\end{array}\right)$$

$$\begin{array}{l}\text{Expected}\\ \text{output price}\end{array} = f\left(\begin{array}{l}\text{Past prices; Farm \& farmer}\\ \text{characteristics}\end{array}\right)$$

$$\begin{array}{l}\text{Break - even}\\ \text{price (unit cost)}\end{array} = \left(\frac{\text{Total Variable Costs (Kshs/ha)}}{\text{Estimated yield (kg/ha)}}\right)$$

Data and data sources

- **Balanced panel data from nationally representative surveys**

  — **4 waves - 1997, 2000, 2004, 2007**

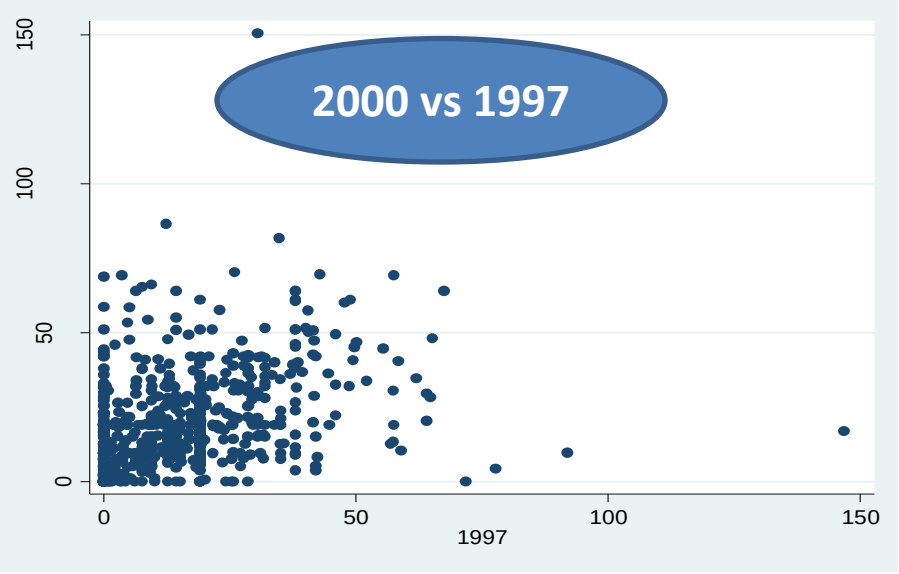
  —**Consistent maize growing households**

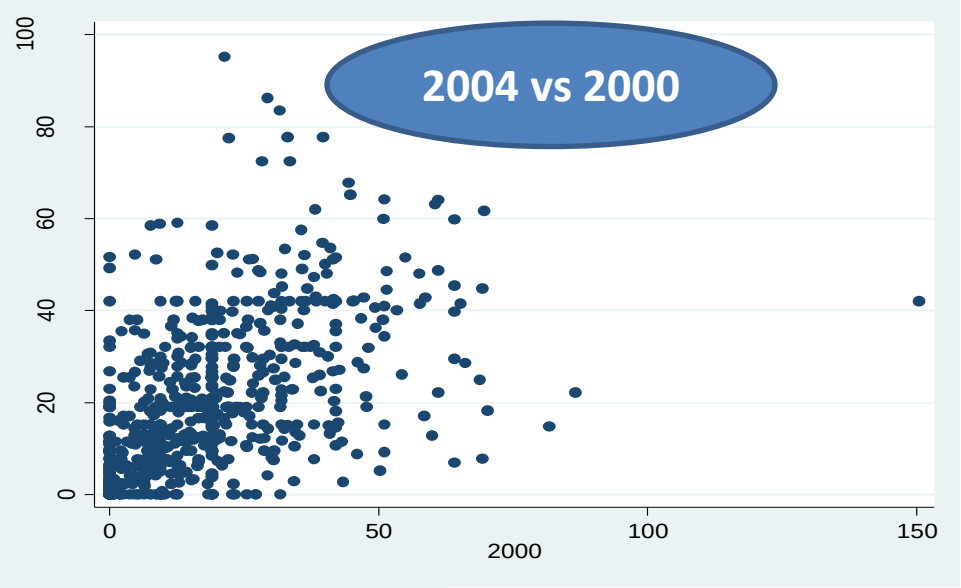
- **Focus Group Discussions**

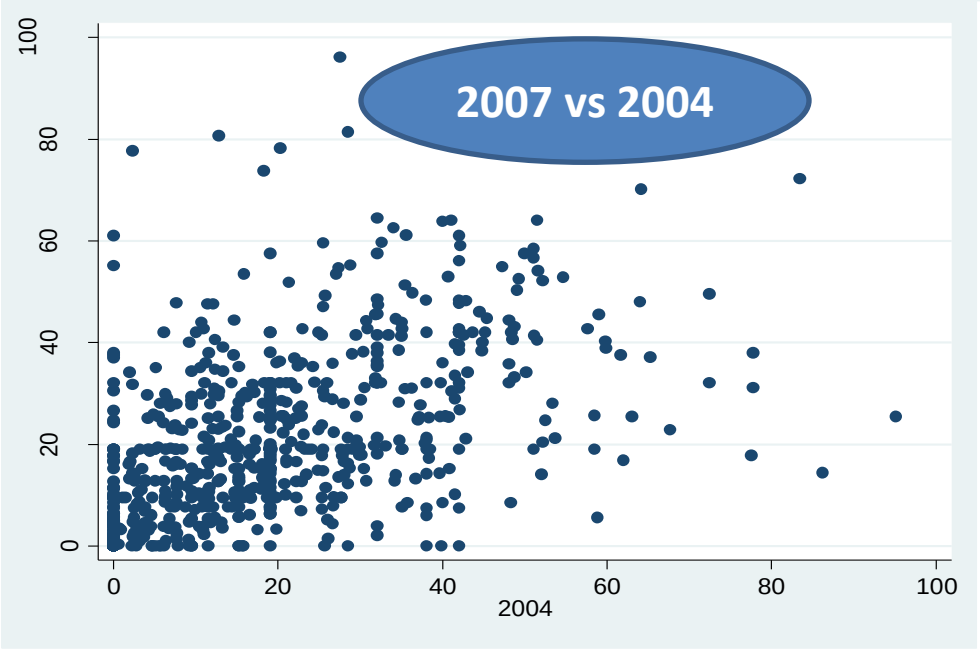
Results: Transient Adoption

	Percent of Households Using:					
	Fertilizer			Hybrid Seed		
	LP Zone	MP Zone	HP Zone	LP Zone	MP Zone	HP Zone
One Round	4.8	9.9	3.0	17.9	8.9	4.0
Two Rounds	6.9	8.9	14.3	9.5	9.7	13.8
Three Rounds	15.9	11.1	14.6	14.8	12.3	15.5
Four Rounds	50.3	50.0	67.7	47.	55.5	66.7
Non-user all 4 rounds	22.1	20.1	2.4	10.8	13.6	3.0

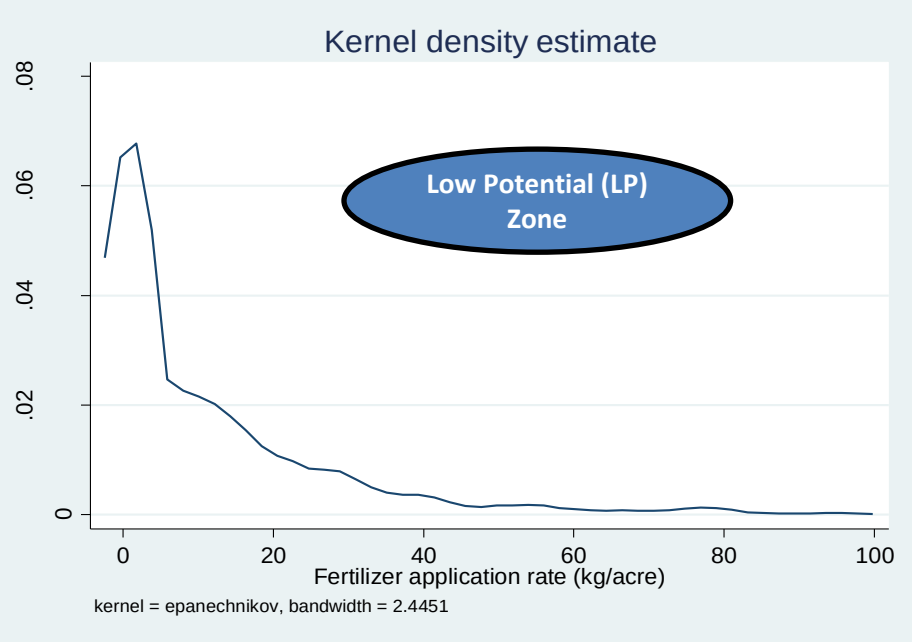
Results: Transient Input Use : Comparing fertilizer use (kg/acre) btw the four waves

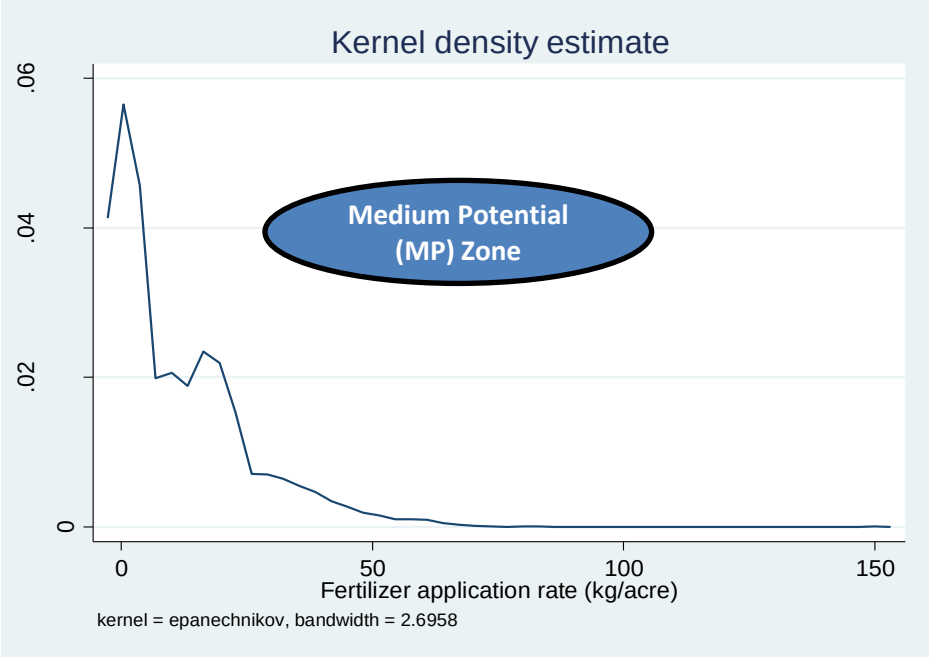


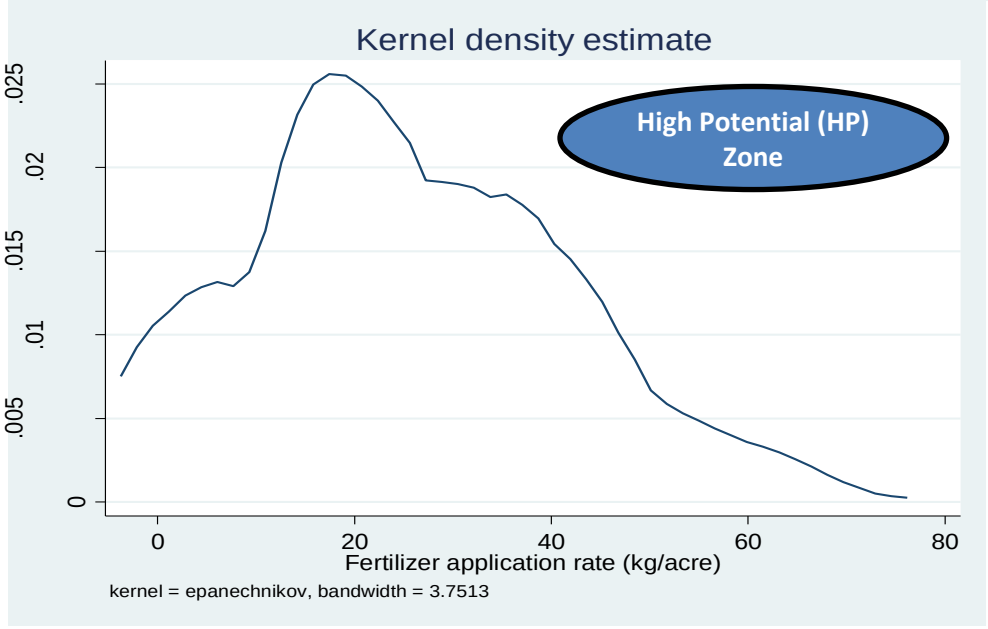




Results: Distribution of fertilizer rates (kg/acre) 1997-2007



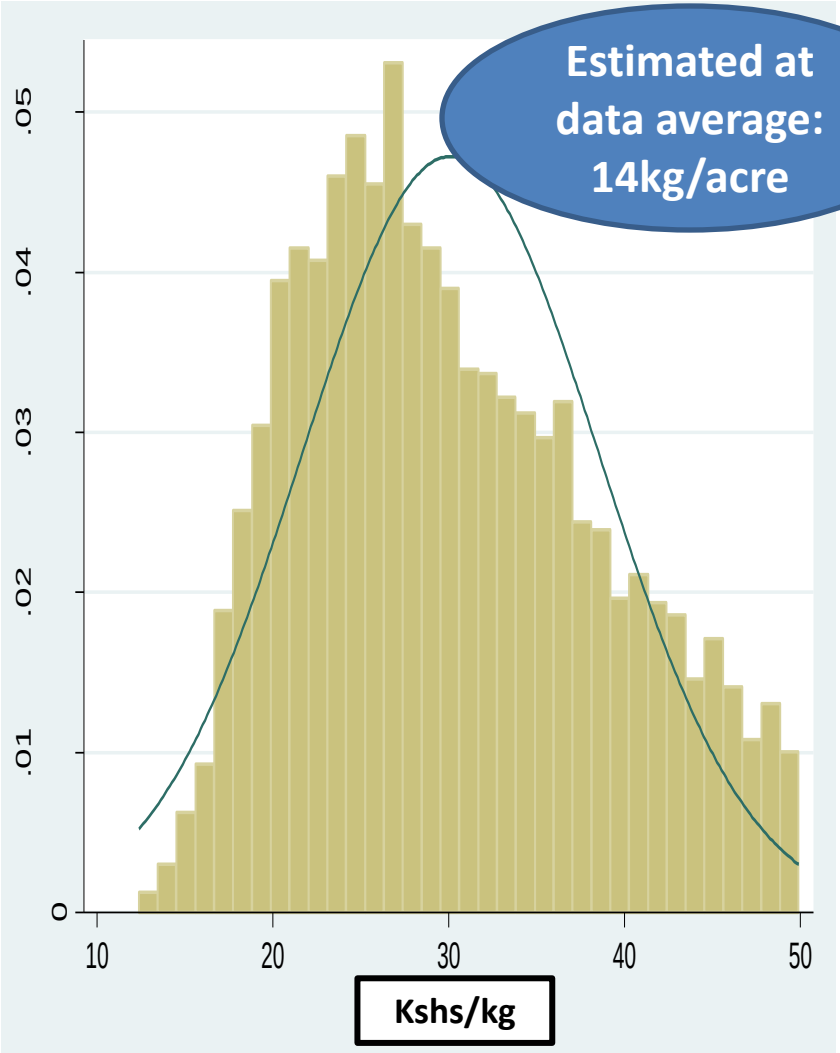


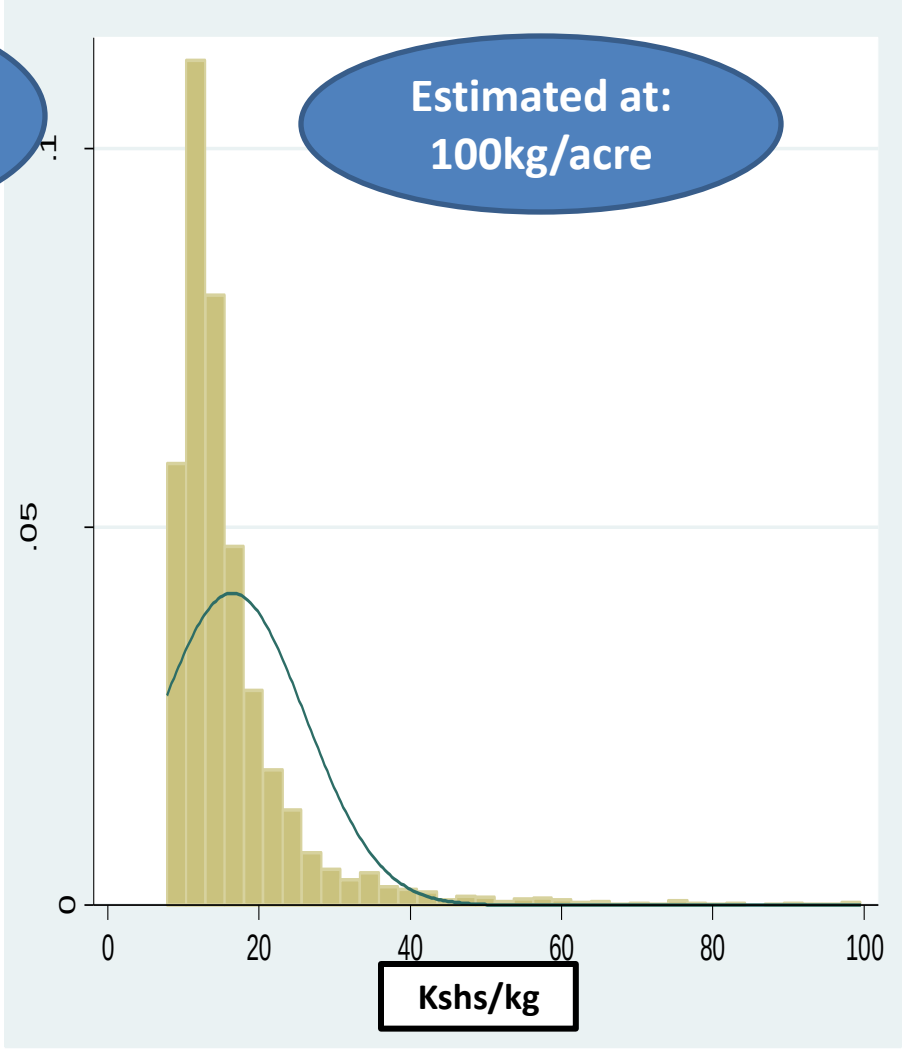


Results: Estimated Impacts of Risk and Prices on hybrid and fertilizer use

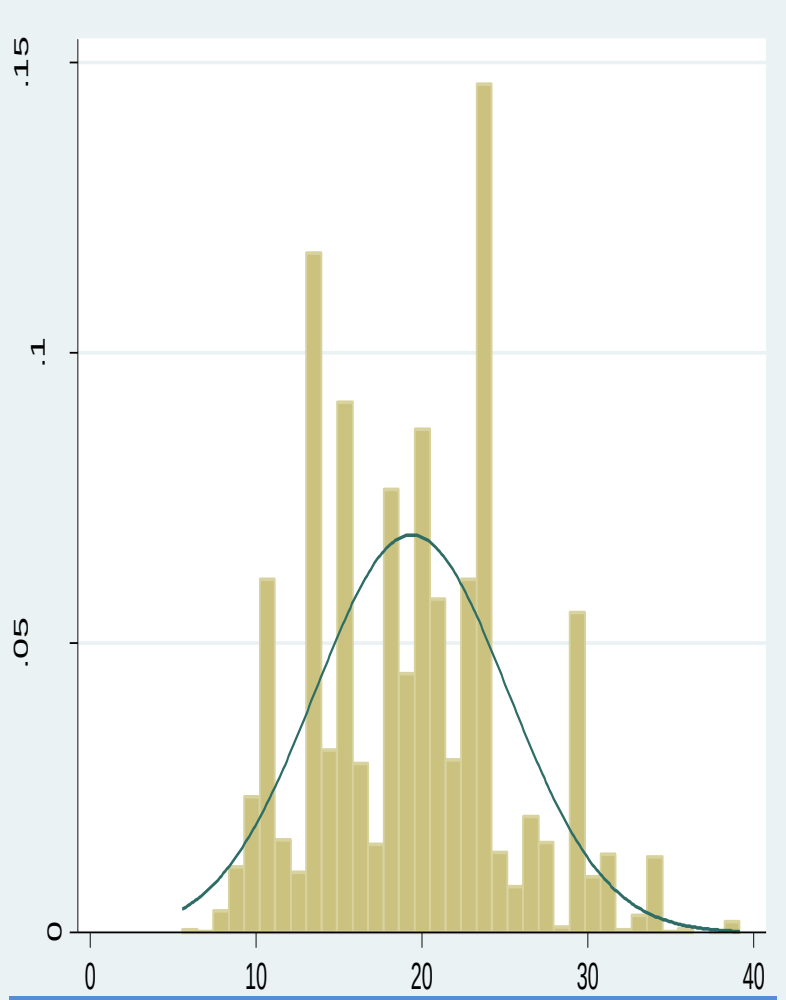
	Coef.	Std. Err.	Significance
	Decision to use Hybrid		
Risk Variable	-0.085	0.134	None
Predicted Maize Price	0.369	0.136	0.100
Fertilizer Price	-0.005	0.006	None
	Decision to adopt fertilizer		
Risk Variable	-0.592	0.052	0.050
Predicted Maize Price	0.592	0.452	None
Fertilizer Price	-0.027	0.007	0.050
	Fertilizer application rate		
Risk Variable	-0.022	1.040	None
Predicted Maize Price	0.510	0.216	0.100
Fertilizer Price	-0.133	0.045	0.001

Results: Distribution of Breakeven Prices

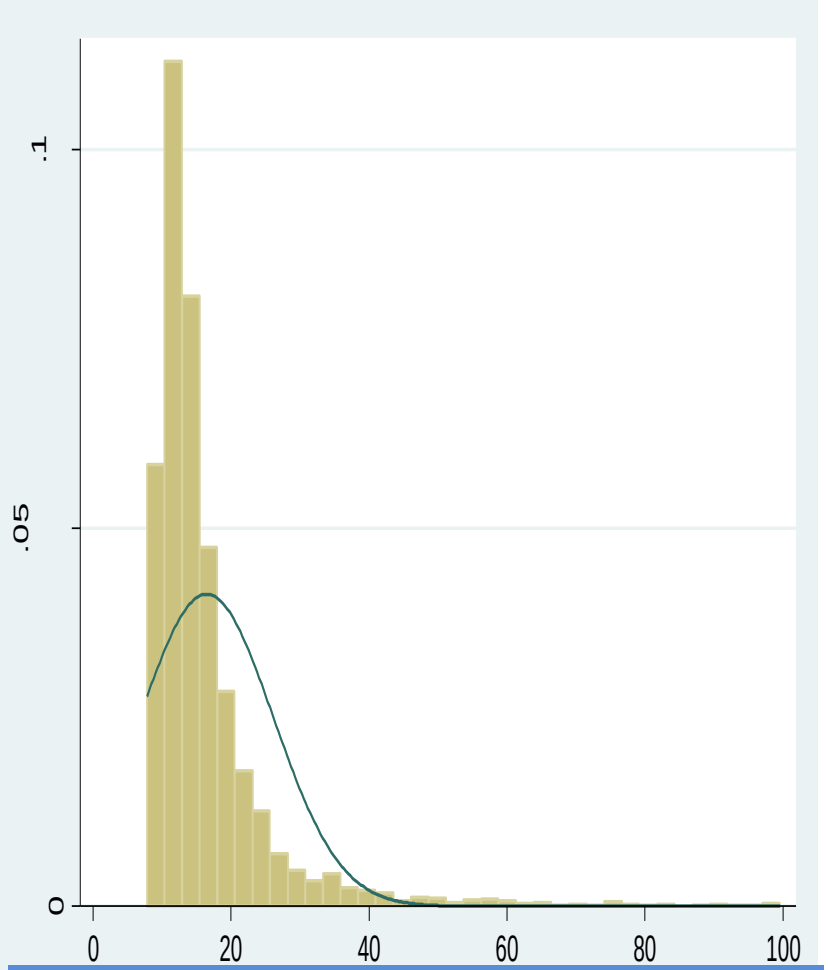




Results: Observed Prices compared to Breakeven Price at 100kg/acre

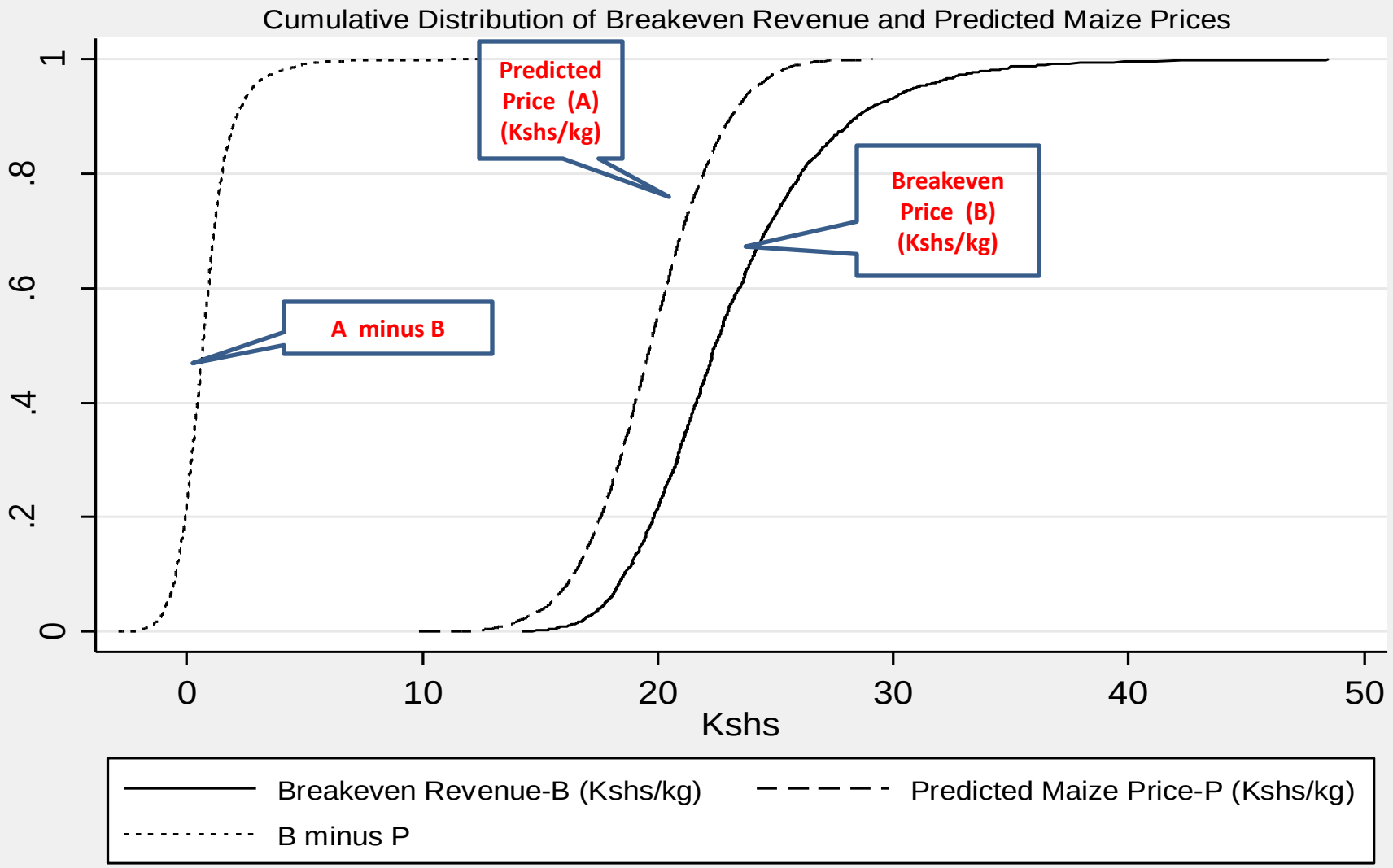


Observed maize prices: Kshs/kg



Estimated breakeven maize prices: Kshs/kg

Results: Comparing Breakeven Price (at 100kg/acre) and Predicted Price



Policy Implications

- **Low input use in subsistence modes comes at a steep cost: in terms of unexploited economic opportunities**
  - **achievable from higher input use**
- **Low fertilizer dosages are unprofitable (esp. for those who can ill afford it)**
- **Granted: in the semi-arid (LP) areas, low fertilizer use reflects low and variable response rates to fertilizer application**

Policy Implications

- **In the majority of cases (esp MP and HP zones):**
  - **raising application rates from low to medium levels reduces maize production costs**
  - **hence using more fertilizer (up to a point):**
    - **will increase the probability to break-even**

- **This suggests one reason why downside maize price risk has small effect on the demand for fertilizer**
  - **As can be seen from previous econometric results**

Conclusions

- **Capital constraints (fertilizer price) rather than overwhelming concern with downside price risk**
  - **may constrain sustained technology adoption**
- **Once investments to lower the costs or improve efficiency of fertilizers are made:**
  - **The importance of downside maize price risk will recede even further, i.e.**
  - **maize production could be more profitable at increased levels of fertilizer**
- **We argue this (increased input use) should be predicated on expanding the reach of grain markets**