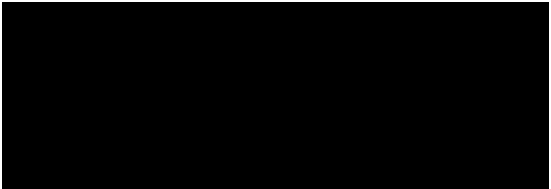


QUANTIFYING BIOTECH ADOPTION AND DIFFUSION PROCESSES

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Adoption vs Diffusion

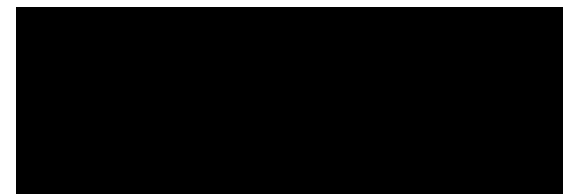


- Adoption choice of a technology by individual
 - Diffusion= aggregate adoption
- Adoption may involve
- ▣ Discrete choices – adopt a technology
 - ▣ Variable choices- what percentage of land to allocate to a divisible technology -seed
- 

Measures of diffusion

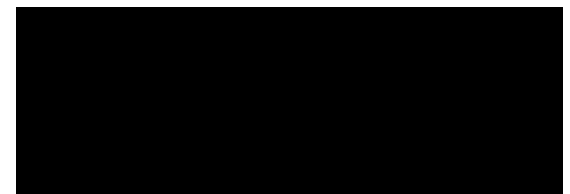


- proportion of land in practice
- proportion of farmers in practice
- Both measures may be S shaped functions of time. But...
 - If large farmers adopt first, diffusion over land will occur more quickly; if small farmers adopt first, diffusion over land will occur more slowly.



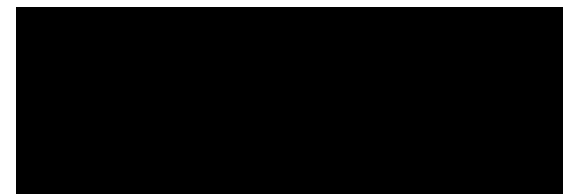
Measures of Adoption

- Yes/No
 - ▣ Can be used for Logit/ Probit
- Share of land with technology
 - ▣ Can be used for Tobit
 - ▣ Can be used with Heckman procedure
- Time of adoption
 - ▣ Can be used with Tobit or other methods
 - ▣ Knowledge of time adoption allow constructing the dynamics of adoption from cross section data



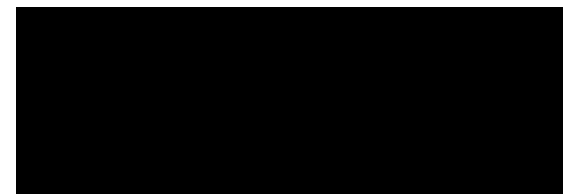
Four Key Questions to Answer- right hand side variables

- Where
- How
- Why
- Who



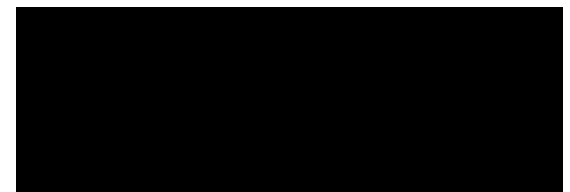
Where?

- Distance from critical locations- adoption occurs earlier near cities
 - ▣ It occurs where it is most profitable
- Land quality
- Climate



How?

- Technology only; or
- Technology and complimentary input
 - i.e. if a farmer adopts irrigation, does he also adopt precision farming?
 - Leads to estimation of a system of simultaneous equations- adoption measures and input sue levels



Why? Yield effect

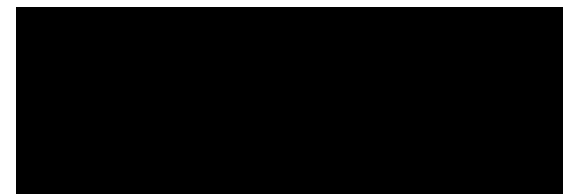
- Mechanism
 - ▣ Damage control $Y=Y_0[1-D(X)]$
 - ▣ Increases input use efficiency

$$\Delta Y = f'[\alpha X]X\Delta\alpha$$

- ▣ Increased input use

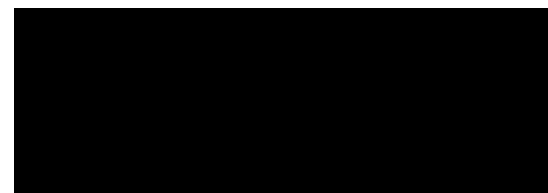
$$\Delta Y = f'(X\alpha)(\alpha\Delta X)$$

- ▣ Increased precision
- ▣ Lags



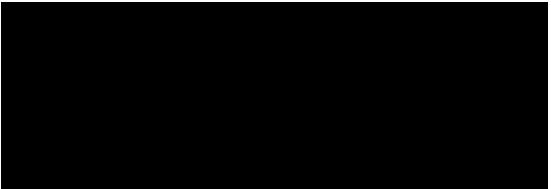
Why? Other

- Cost savings: what costs?
 - ▣ Variable Input use-water
 - (Bt and Ht provide 33%-77% savings on pesticides (Qaim 2005)).
 - ▣ Fixed cost saving
- Risk reduction
 - ▣ What measures
 - Variance
 - Entropy
 - Physical measures
- Effort savings
- Quality effect
- Incentives-Subsidies/taxes
- Regulations



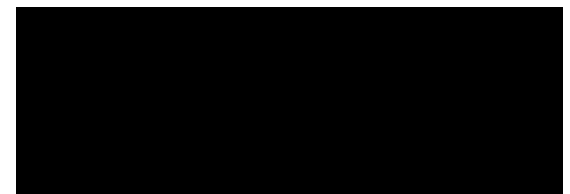
Who?



- Scale of adopter: large farm or small?
 - Human capital: do better educated or more productive farmers adopt more quickly?
 - Age
 - Institutions (and the role of credit, contracts)
 - Intergenerational transitions
- 

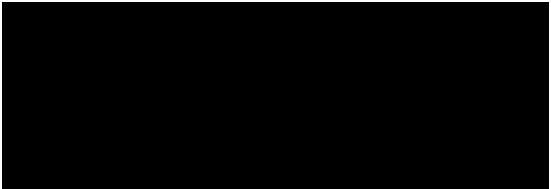
Modeling-aggreagate adoption

- Imitation model
- $P(t) = K / (1 + \exp\{-(a+bt)\})$
- $\text{Log}\{P(t)/[K-p(t)]\} = a+bt$
- K, a, b function of decision variables
- Threshold model-
- $P(t) = \text{Probability measure of heterogeneity (farm size)} > \text{critical level}$



Modeling-micro data



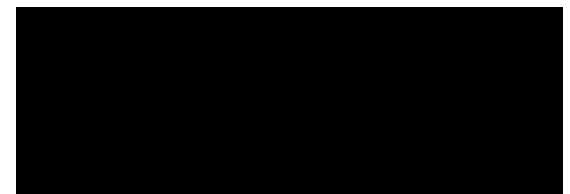
- Derive decision rules for
 - ▣ Profit maximizing
 - ▣ Expected discounted benefits
 - ▣ Household model { maximize benefit from food, income, leisure }
 - ▣ Satisfysing- adopt if gain above threshold level of performance
- 

Risk Aversion

- Let L_1 be land share with new technology, Δvar be change in variance, i.e. $Var_1 - Var_0$, and Δcov and ΔM are similarly defined for change in covariance and change in mean, respectively. Then:

$$L_1 = \frac{\Delta M}{\Delta Var} - \beta \frac{\Delta Cov}{\Delta Var}$$

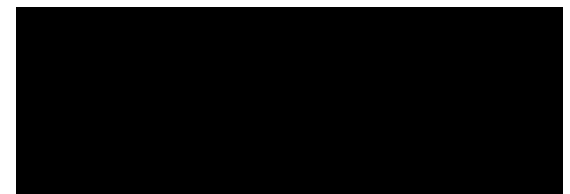
- Estimation of β suggests risk aversion is possible. Studies show it declines with farm size and education



Risk Aversion (cont'd)



- Adoption increases with:
 - ▣ Gain in yield
 - ▣ Reduction in variance
 - ▣ Lower correlation
- Prospect theory



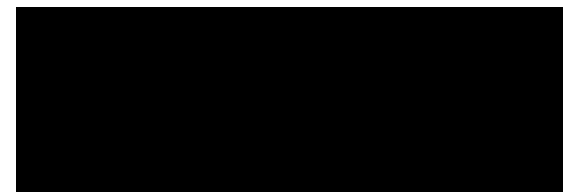
Empirical Strategies- what type of data to collect- assessing impact

- -Data from the same farms using using different technologies at the same period
- Examine farm-level observations over time under different technologies (i.e. pre and post-adoption)
- Look at different farms under different technologies (exploit cross-sectional variation in adoption)
 - ▣ Must separate technology effect from farm effect
- Different regions regions under technologies

Empirical Strategies- estimating adoption



- Actual data
 - ▣ Individual choices same period
 - different periods
 - ▣ Regional shares –the same period
 - Different period
- Hypothetical data
 - ▣ WTP for new technologies
 - ▣ Will you adopt if



Special opportunities



- Natural experiments
 - Before/ after drought regions affected vs not affected
- Controlled experiments
 - Give one group incentives or make it subject the policy and compare behavior to control group

