

Production Variability and Adoption of New Technology: An Economic Framework

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First Question:

Do producers benefit from stabilization of their production?

- *To answer, we need to establish some facts:*
 1. Are production-relevant variables (rain, diseases, temperature) stochastic?
 2. How do disturbances affect production?
 - Additively?
 - Multiplicatively? (more plausible usually)
 3. Are disturbances shared by regional farmers?

Do producers benefit from stabilization of their production?

- *More facts to consider:*
 4. Are prices stochastic?
 5. Must farmers commit some inputs (e.g. buy seed and plant) before they know disturbance values and prices?
 6. Can farmers adjust some inputs after they know the disturbances and prices?
 7. Can output be stored from year to year?
 8. Are imports into and/or exports out of the region feasible economically?

Do producers benefit from stabilization of their production?

Simple Example

Assume:

- Resource commitment at planting only
- One harvest disturbance:
 - ✓ Stochastic
 - ✓ Multiplicative
 - ✓ Unpredictable at planting
 - ✓ Regionally shared
- Stochastic, unpredictable prices
- No imports/exports from region, no storage

Do producers benefit from stabilization of their production?

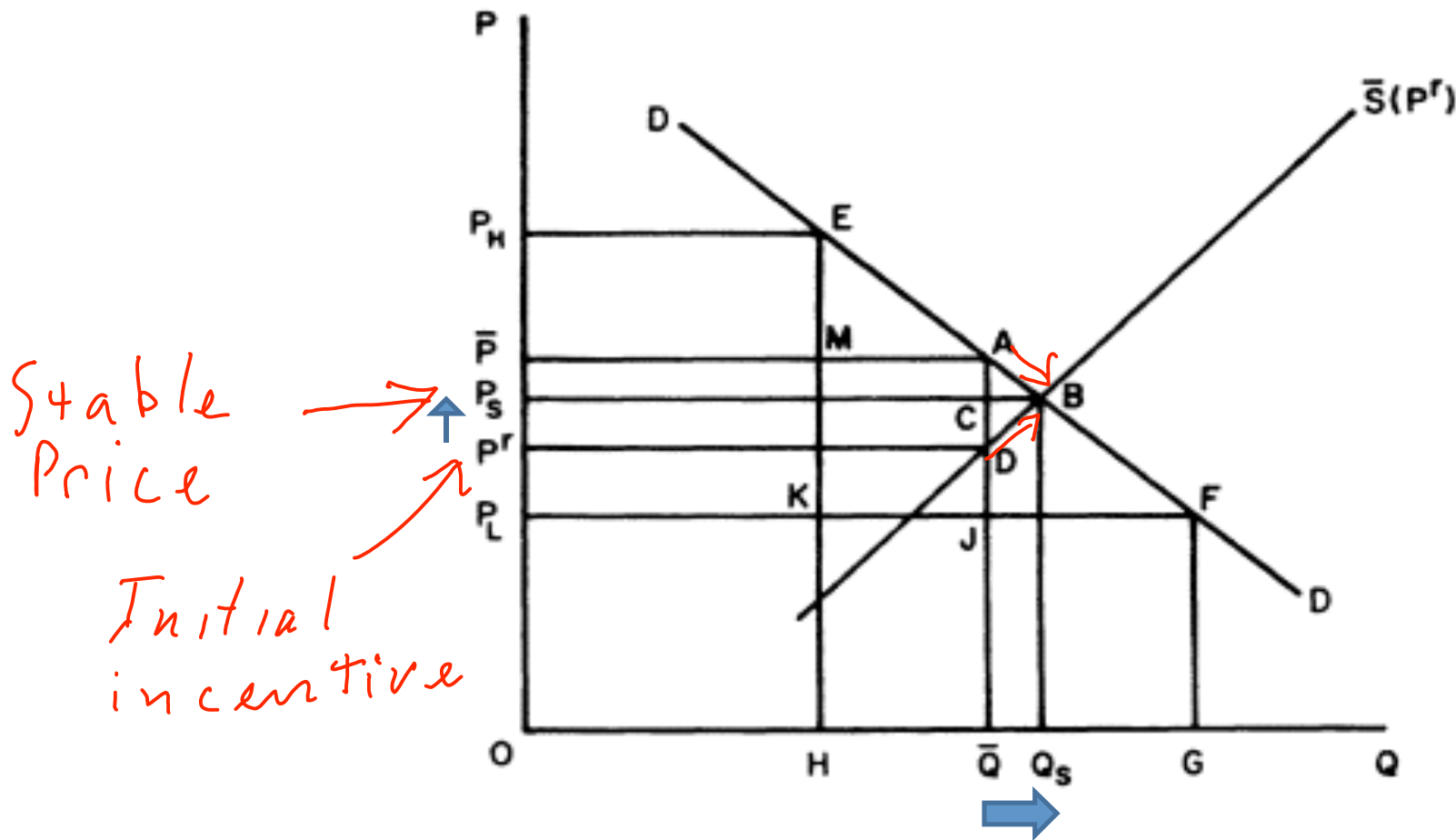
- **Define “ideal stabilization:”**
 - **Stabilization of a single symmetric multiplicative harvest disturbance at its mean**

Do producers benefit from stabilization of their production?

- Seems obvious
- But if producers must commit before knowing the environment, results of “ideal stabilization” (stabilization of a multiplicative price shifter at its mean) are ambiguous
- If the disturbances are shared by regional farmers, the effects of ideal stabilization on profits depends on demand curvature
 - (Wright “Effects of Ideal Production Stabilization” *JPE* 87 no. 5, 1979)

Ideal Stabilization of a 2-point multiplicative disturbance:

Response of planned production and welfare effects depend on demand curvature



Second Question:

Will stabilization be main effect of hardier technology?

- **Obviously, likely to stabilize production where maize now grown**
- **Will there be a mean yield penalty?**
- **Conceivably could encourage more fertilizer use, for example, perhaps reducing stability advantage**

Second Question: Will stabilization be main effect of hardier technology?

- **Brazil example: Proposed research on frost tolerant coffee**
- **Proposed research not pursued**
- **Why not?**

What will be main effects of drought-tolerant maize?

- **Likely outcome: expansion or relocation of maize growing areas**
- **In more droughty areas:**
 - Tolerant maize might be *more unstable* than less tolerant maize in existing growing areas

What will be main effects of drought-tolerant maize?

- **Depends on the technology and environment.
Possible results:**

- 1) Higher aggregate maize production**
- 2) More stable/less stable aggregate maize output**
- 3) More economical water use**
- 4) More or less aggregate water use**
- 5) Environmental effects on new more fragile (e.g. sandy?) growing areas**

Is adoption risk a big problem?

- May be riskier where environment more variable
 - Benefits of investment are stochastic
- Less risky where environment ***stable but adverse*** (e.g. steady but inadequate or saline water supply)
 - Risk can be handled because farmers can adopt on just a fraction of their land
 - However information costs not divisible, depend on institutions
 - Problem: identity preservation?

Will insurance help?

- US example: Some pest-tolerant corn varieties qualify for reduction in subsidized crop insurance premia: trait is substitute for insurance
- Subsidized insurance is costly, and discourages adoption on existing corn land

Questions

- What will be main effect of drought tolerance?
 - Stabilization, a net benefit with ambiguous distributional effects?
 - Or expansion and relocation?
 - Will it reduce water demand via less need per plant?
 - Will it increase water demand via greater area or density of planting?

Predictions

- Aggregate stabilizing effects of drought tolerance will be secondary, and not necessarily positive
- Main effects will be relocation/expansion of production, changed crop mix, greater aggregate supply on average
- Market access and infrastructure will (as usual) be important in adoption and distributive effects

