Post- “Inside Job” I perceive a need for disclosure:

Recent or current grant support:

- AMIS initiative of G20
- Energy Biosciences Initiative (UC Berkeley, UIUC, LBL, BP, funded by BP) – researches cellulosic biofuels
- NSF
- NIH
- USPTO
- Giannini Foundation
Disclosure (contd.)

- Consultant, World Bank
- No recent positions in commodity markets
- No investments in agricultural input or service providers, or significant grain market participants.
Sources of Price Volatility

• Harvest shortfalls?

• Demand shocks?

• Global catastrophe?
Harvest shortfalls

Historically, predominantly *local/regional*, and *temporary*:

- Weather related: drought, floods, freezes, hail, fires
- Disease related: e.g. potato blight
- Crop contamination

- Political/military disruptions
  - Embargoes
  - Military requisitioning
  - Sieges
Demand shocks

• Demand increases due to supply shock in substitute

• Policy Shocks

• Political/military disruptions
Demand increases due to supply shock in substitute

- Weather related: drought, floods, freezes, hail, fires in substitute crops
- Disease related: e.g. Indian wheat shortfall affects rice demand
- Contamination of part of crop:
  - Chernobyl in Europe
  - melamine in Chinese baby formula
Policy shocks

• Unforeseen Government policy to divert supply or inputs to a different market
  – Forced exports (Soviet Ukraine?)
  – US, EU announced diversion of food/feed to biofuels
  – Great Leap Forward in China?
Political/military disruptions

• Mass Immigration of refugees
• Wastage associated with war provisioning
• Great Leap Forward and consumption misallocation in communes?
• Failed state?
Global Catastrophe

• The Perfect Storm?

• Beyond historical experience? Far more costly?

• Threat to human existence, not just to “most vulnerable.”

• Worth some planning?
If shocks are local/regional, trade can be crucial

For example: crop yield shocks

*Inter-regional arbitrage* can alleviate a regional shortfall
This Conference:
Focus on Trade as Inter-regional Arbitrage

If shocks are local/regional, trade can be crucial

For example: crop yield shocks
Why grain trade is crucial to food security:

World wheat production

- Europe
- Northern America
- China
- World

C.V. is \[\text{Mean}/(\text{Standard deviation})\]
Recent *global* harvest shortfalls have been modest:

Year-to-year differences
Open trade can be crucial to world food security

• See Martin and Anderson (2013)

• Panics: export controls and removal of import restrictions can in important cases exacerbate a *regional* crisis
Storage:
Role of Intertemporal Arbitrage

If global shocks are temporary, storage is crucial.

For example: global crop yield shocks, with little persistence.

Inter-temporal arbitrage can alleviate a temporary shortfall, and smooth prices.
Complementarity: If global shocks are *temporary*, storage is crucial.

For example: crop yield shocks

Inter-temporal arbitrage can alleviate a temporary shortfall, and smooth prices.
Example:
Wheat price deflated by MUV

MUV: ManufacturesUnit Value
Characteristics of Grain Prices

• Long downward trends
• Generally moderate, smooth movements around trend, interspersed by occasional steep spikes

• Recent real spikes not unprecedented
Co-movement:
Real prices of wheat, rice, maize and calories
(natural logarithm scale)
## Correlations:
### Real Detrended Price

<table>
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<tr>
<th></th>
<th>Wheat</th>
<th>Maize</th>
<th>Rice</th>
<th>Calories</th>
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</table>
World Index of real price of calories from 3 major grains

World calorie real price index (1960/61-2013/14)
World Calorie Price Index, Detrended

World calorie detrended price index (1960/61-2013/14)

Exponential trend estimated through 2004/05
Summary of recent grain price behavior: One Trend, 2 Spikes and a Shift

• Clear long run downtrend
• What, maize and rice prices highly correlated
• Sporadic price spikes relative to trend
• Since 2005 there has been a pronounced upward shift in the level of prices relative to trend
Summary of recent grain price behavior: One Trend, 2 Spikes and a Shift (cont’d.)

• Two apparent “spikes” since 2005

• Post-2005 “Spikes” may be more correctly characterized as a shift with a drop in 2008

• 2008 drop appears largely due to effect of financial crisis on trade finance
  • Seen in petroleum - huge contango – nearby spike foreseen by market, but not smoothed
Role of storage arbitrage

Key relations: *Buy when low, sell when high*

\[
P(t) + \text{cost of storage} = \frac{E[P(t+1)]}{1+r} \quad \text{if stocks} > 0
\]

\[
P(t) + \text{cost of storage} \geq \frac{E[P(t+1)]}{1+r} \quad \text{if stocks} = 0
\]
The rational expectations competitive storage model of commodity prices

- Inverse consumption demand function
- Equilibrium price function

How much to store depends on:
1. Availability today
2. *Expectation about the future*
The rational expectations competitive storage model of commodity prices

Inverse consumption demand function
Equilibrium price function

How much to store depends on
1. Availability today
2. *Expectation about the future*

Price

consumption

storage

Quantity
Role of storers

When harvest is large or consumption demand curve unexpectedly shifts in:

As long as cash is available* storers:

- smooth out troughs in price and low-value consumption by “buying low to sell high”

- invest in stocks, raise current price, reduce current glut

*see mid-2008
Role of storers

When harvest is low or consumption demand curve unexpectedly shifts out:

As long as stocks are available:

• Storers smooth out peaks during unexpected shocks by selling stocks to consumers

• When discretionary stocks run out, shocks must be matched by imports, drops in consumption of animals, biofuels processors, or (poor) people
Spikes happen when there are:

1. Unpredictable (negative) transient surprises

2. Minimal starting stocks
Theory of storage implies:

• Price behavior is highly nonlinear
• After *unexpected* shocks, storers smooth out peaks, but *only until their stocks run out*
• *When stocks run out, shocks must be matched by imports, drops in consumption of animals, biofuels processors, or (poor) people*
Implications of storage arbitrage

Spikes occur ONLY if stocks are at minimal levels of “working stocks” necessary for market operations

Is this true?
Detrended calorie price and ratio of stocks to use of grain calories:
Inverse relation exc. from ‘06 to ‘09
Trade and Storage: Potential Complements in Stabilization

• Storage makes free trade more efficient in smoothing regional supply or demand price shocks

• Free trade makes storage more efficient
  – Generally cheaper to store at source vs. destination
Caveat:
Storage cannot smooth persistent demand shocks

• Intertemporal arbitrage ineffective if new shock expected to persist
Total demand shifts at the introduction of a permanent shock.
Distinguish Temporary Demand Shift from Permanent Demand Shift
Caveat:
Storage cannot smooth persistent demand shocks

• Intertemporal arbitrage ineffective if new shock expected to persist

• Could not prevent persistent price rise after biofuels policy shocks

• Not much help for persistent global catastrophe
Double Caveat:
Commitment to unfettered arbitrage *can* *in some cases* exacerbate a famine

In societies with high social inequity and a local shortfall in a staple crop:

- “Efficient” rational storage by wealthy or powerful can reduce grain for the starving poor

- “Efficient” exports of staple or a substitute food by wealthy or powerful can reduce calories available for the indigent
  - Large grain exports while peasants dying in 1846/47 during Irish potato famine

- “Efficient” diversion of food to nonfood use by the wealthy can reduce calories to the starving
  - Biofuels use if oil price very high?
Conclusions

Commodity price behavior reflects:

- Trends in productivity
- Trends in consumer demand
- Spatial arbitrage via trade
- Intertemporal arbitrage via storage
Conclusions

Optimal responses to market shocks reflect:

• Intertemporal and spatial dispersion of shocks of shocks
• Available policy instruments
• Degree of social and economic inequality
• Weight given to interests of poorest
• Intertemporal arbitrage via storage
• Magnitude of overall emergency
• Capacity to control corruption

Appropriate responses must take account of all of above ....
References


