Causes and Types of Food Price Volatility

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Conference on Food Price Volatility, Food Security and Trade Policy

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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

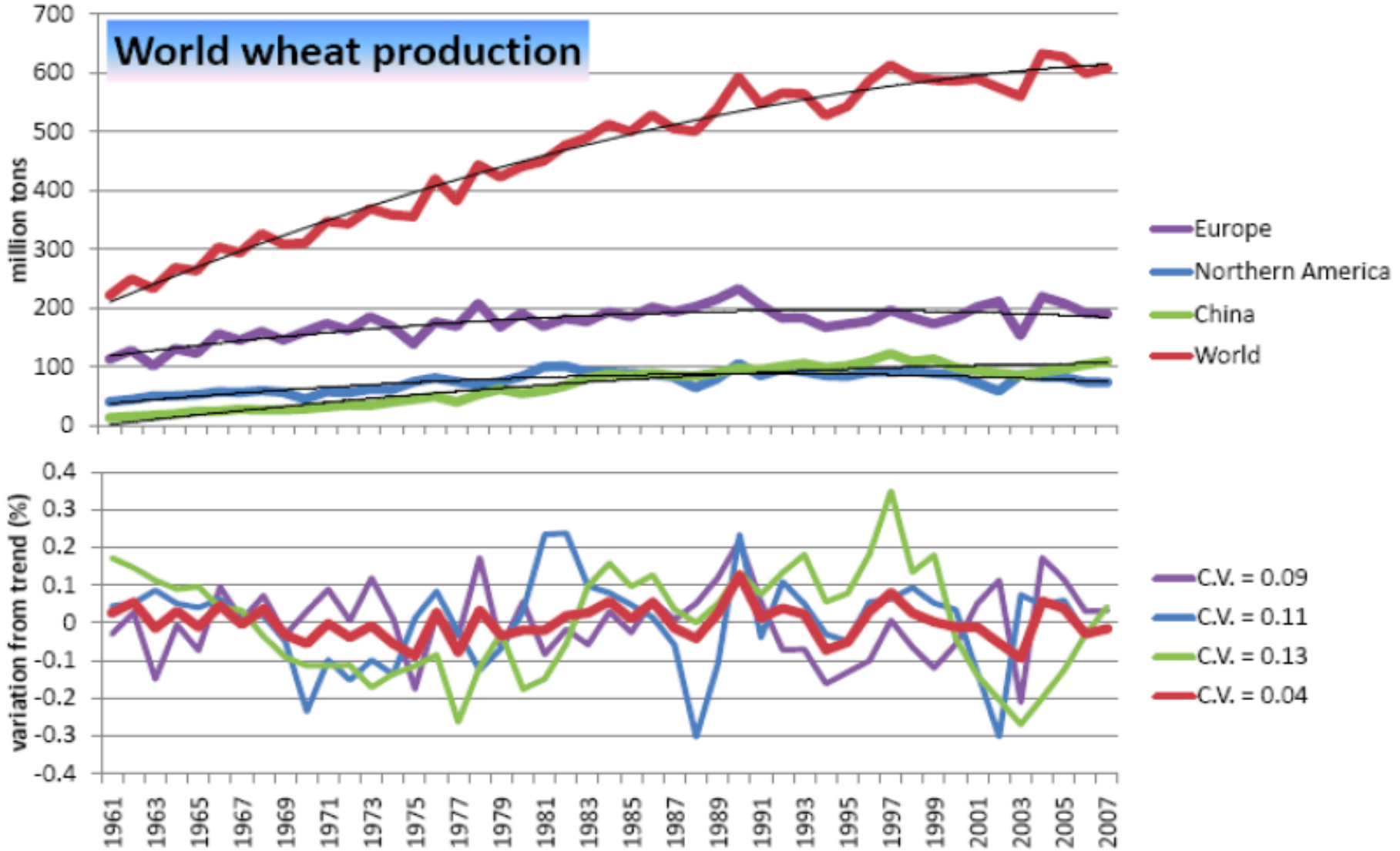
Inter-regional arbitrage can alleviate a regional shortfall

This Conference:
Focus on **Trade as Inter-regional Arbitrage**

If shocks are **local/regional**, trade can be crucial

For example: crop yield shocks

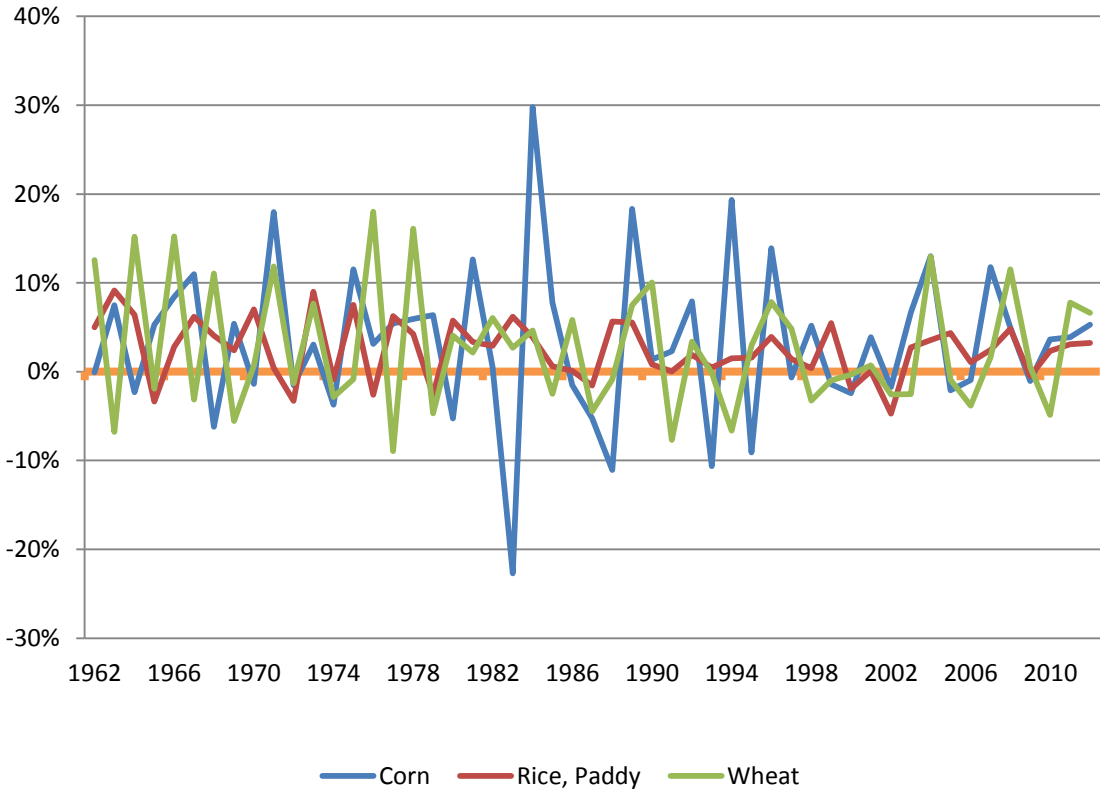
Why grain trade is crucial to food security:



C.V. is [Mean/(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

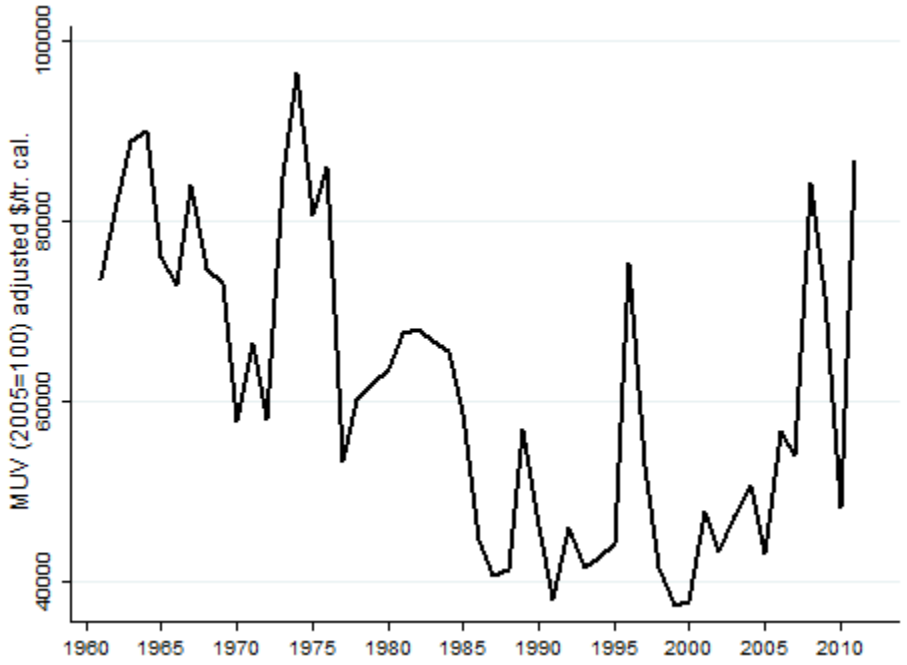
Inter-temporal arbitrage can alleviate a temporary shortfall, and smooth prices

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

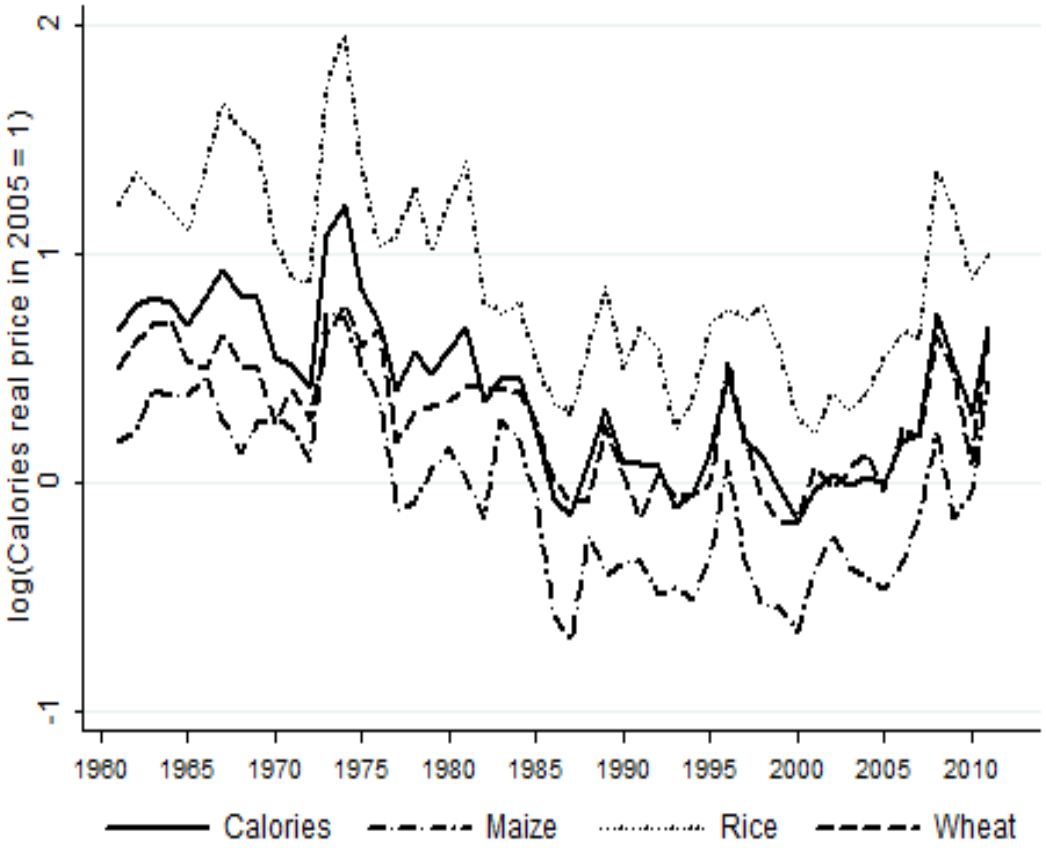
- Long downward ***trends***
- Generally moderate, smooth movements around trend, interspersed by occasional steep ***spikes***

- ***Recent real spikes not unprecedented***

Co-movement:

Real prices of wheat, rice, maize and calories

(natural logarithm scale)

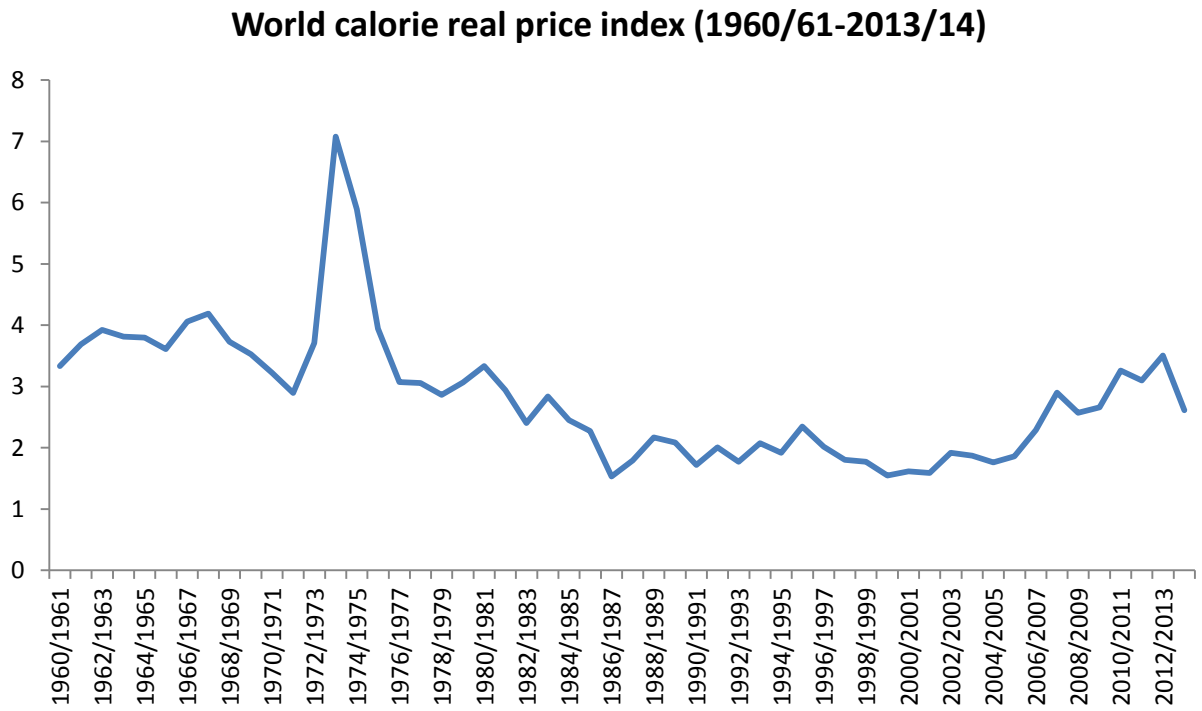


Correlations:
Real Detrended Price

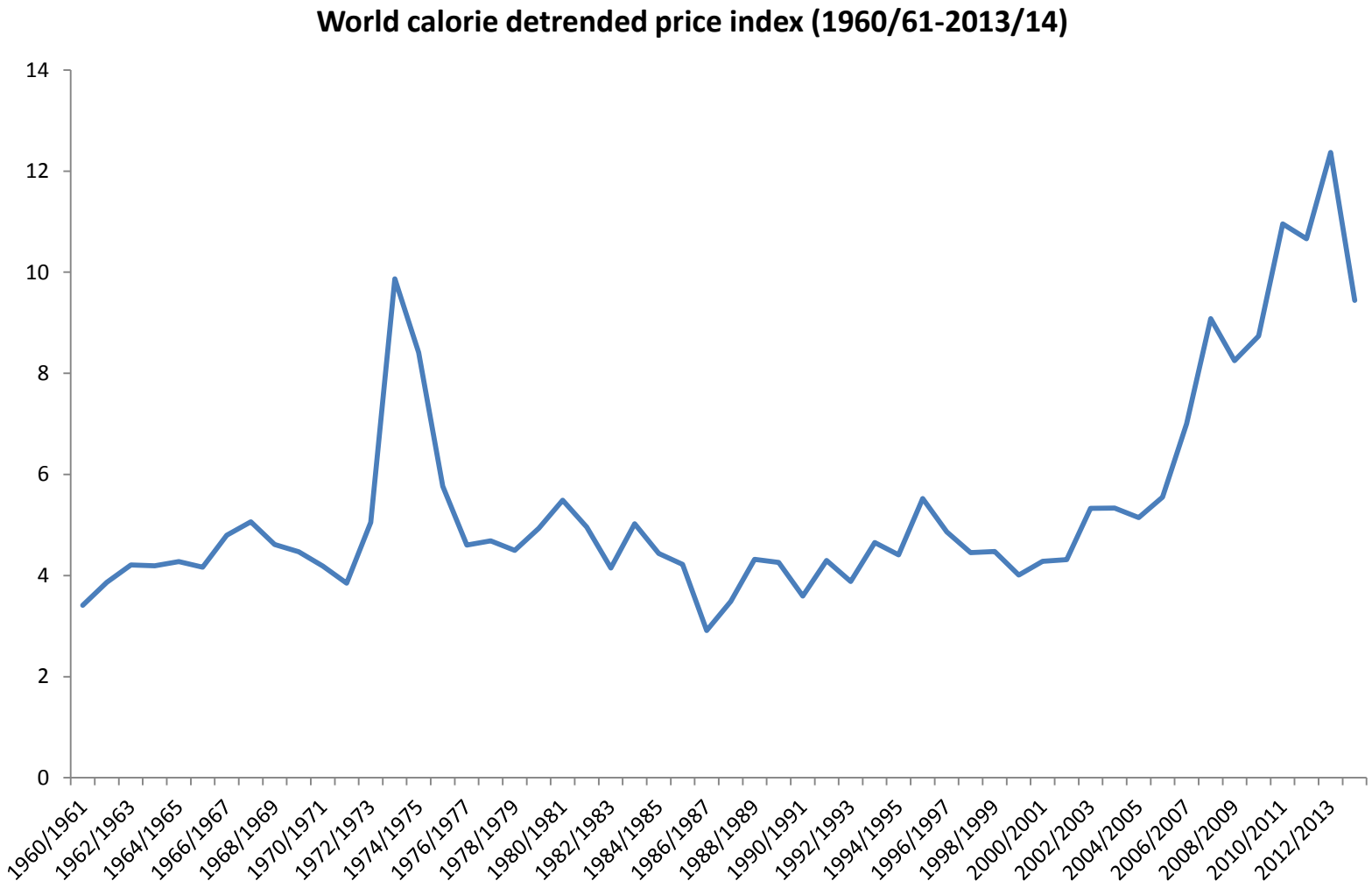
	Wheat	Maize	Rice	Calories
Wheat	1.0000			
Maize	0.7875	1.0000		
Rice	0.5803	0.6280	1.0000	
Calories	**0.8318**	**0.8598**	**0.9133**	1.0000

?

World Index of real price of calories from 3 major grains



World Calorie Price Index, Detrended



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

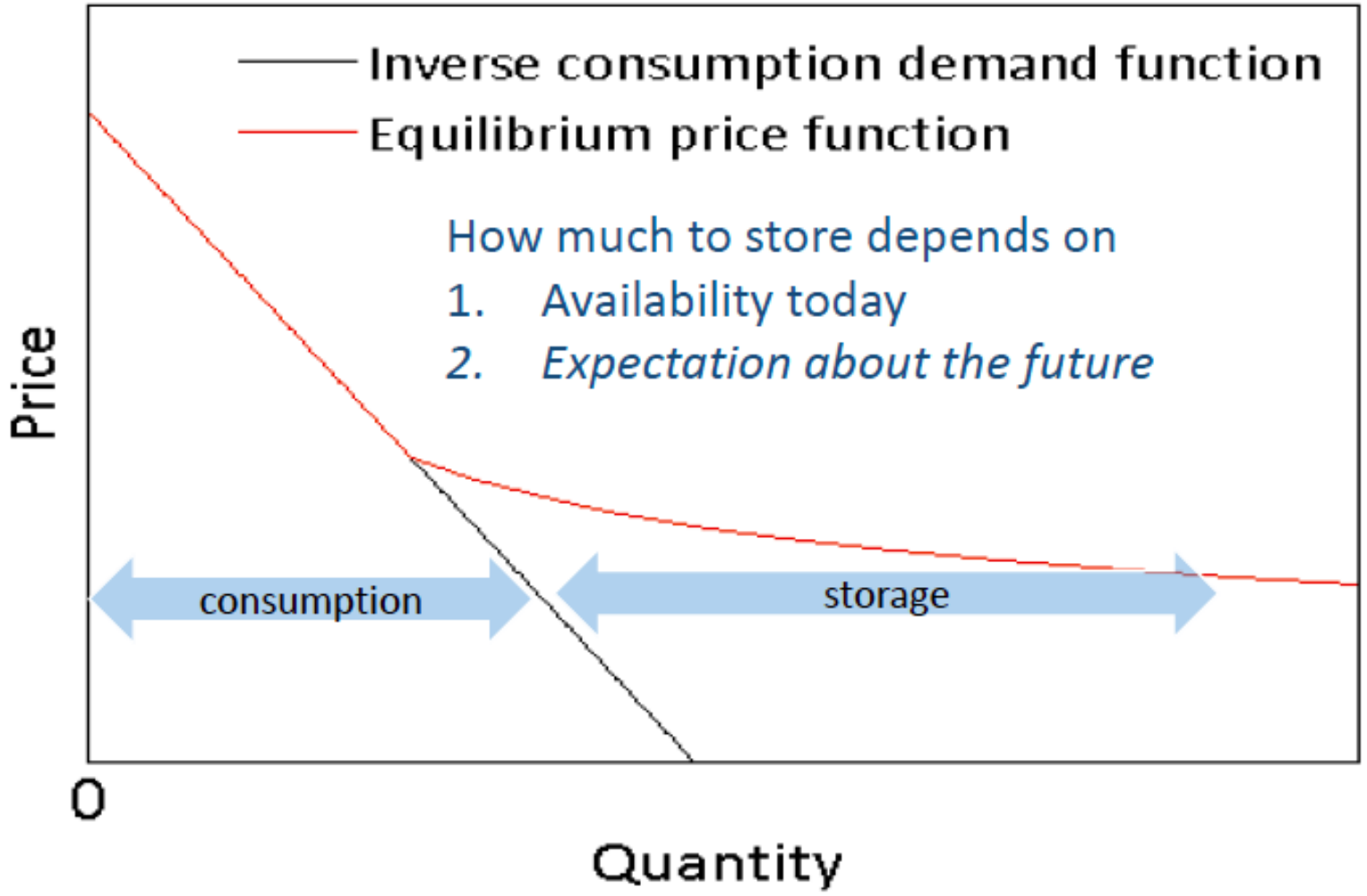
Role of storage arbitrage

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

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

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

The rational expectations competitive storage model of commodity prices



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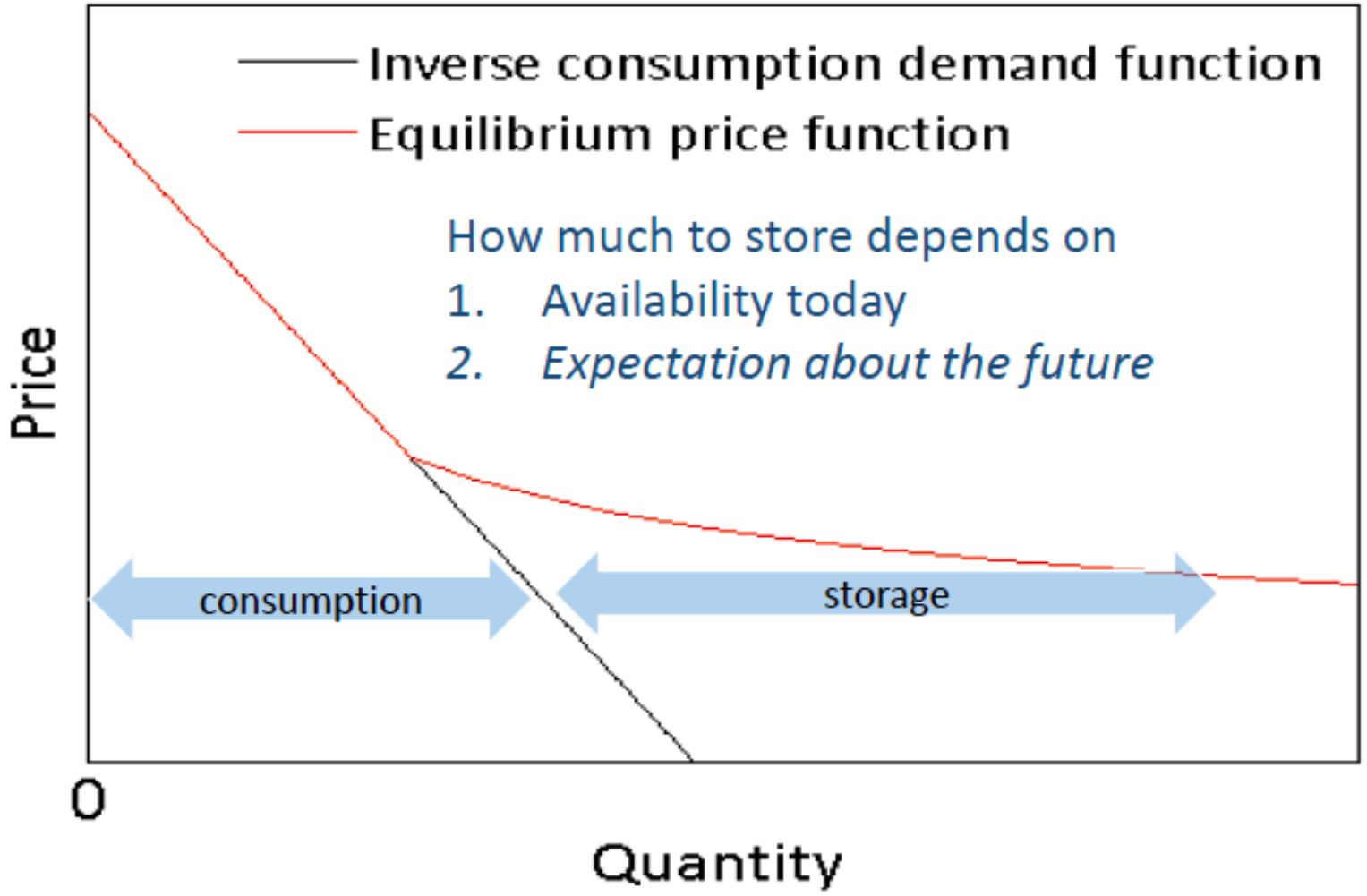


Role of storers

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:

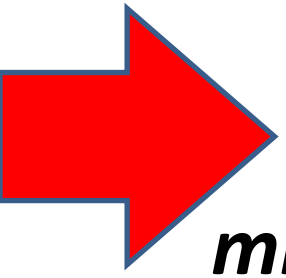
1. **Unpredictable (negative) *transient* surprises**

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***

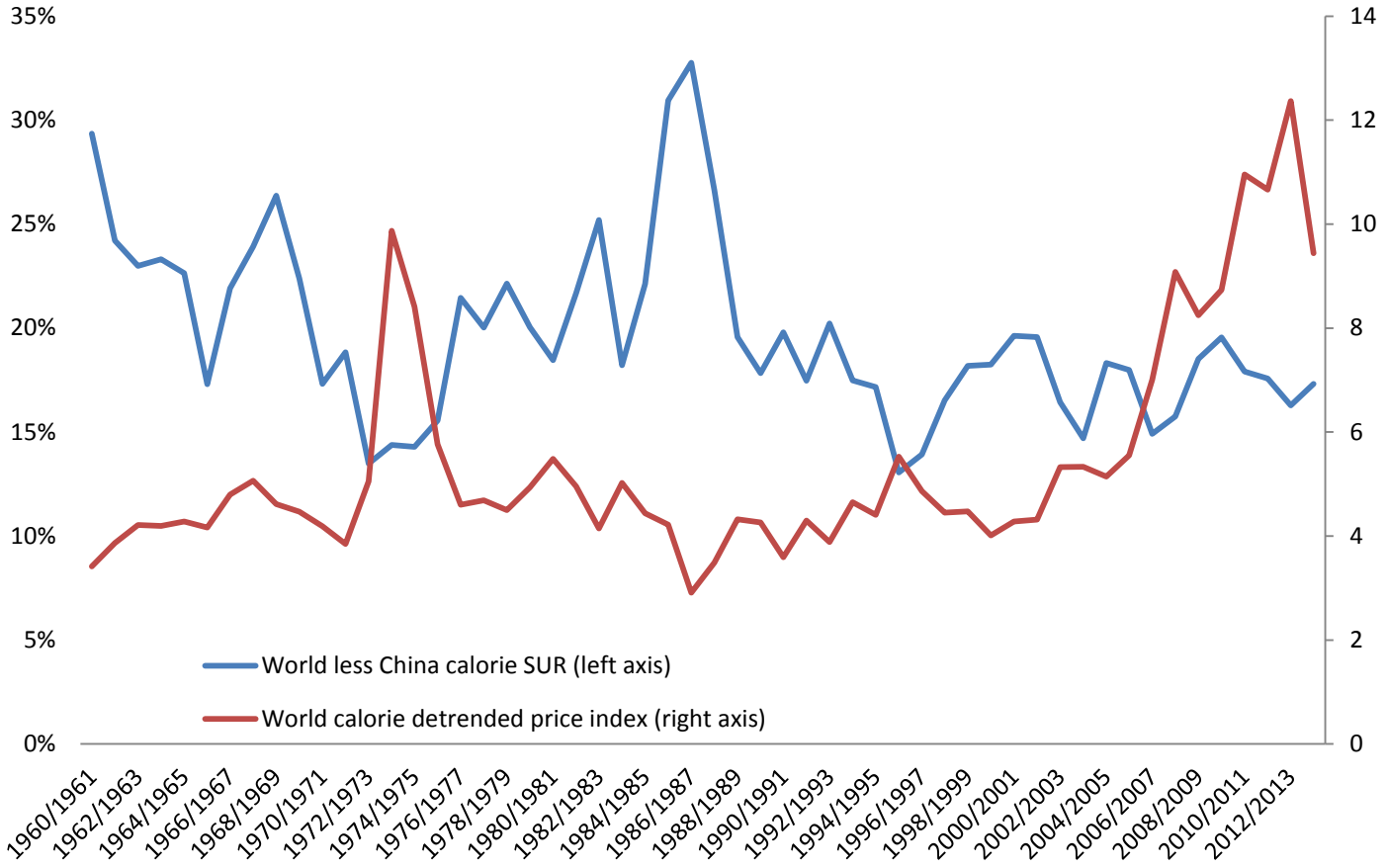
Implications of storage arbitrage



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

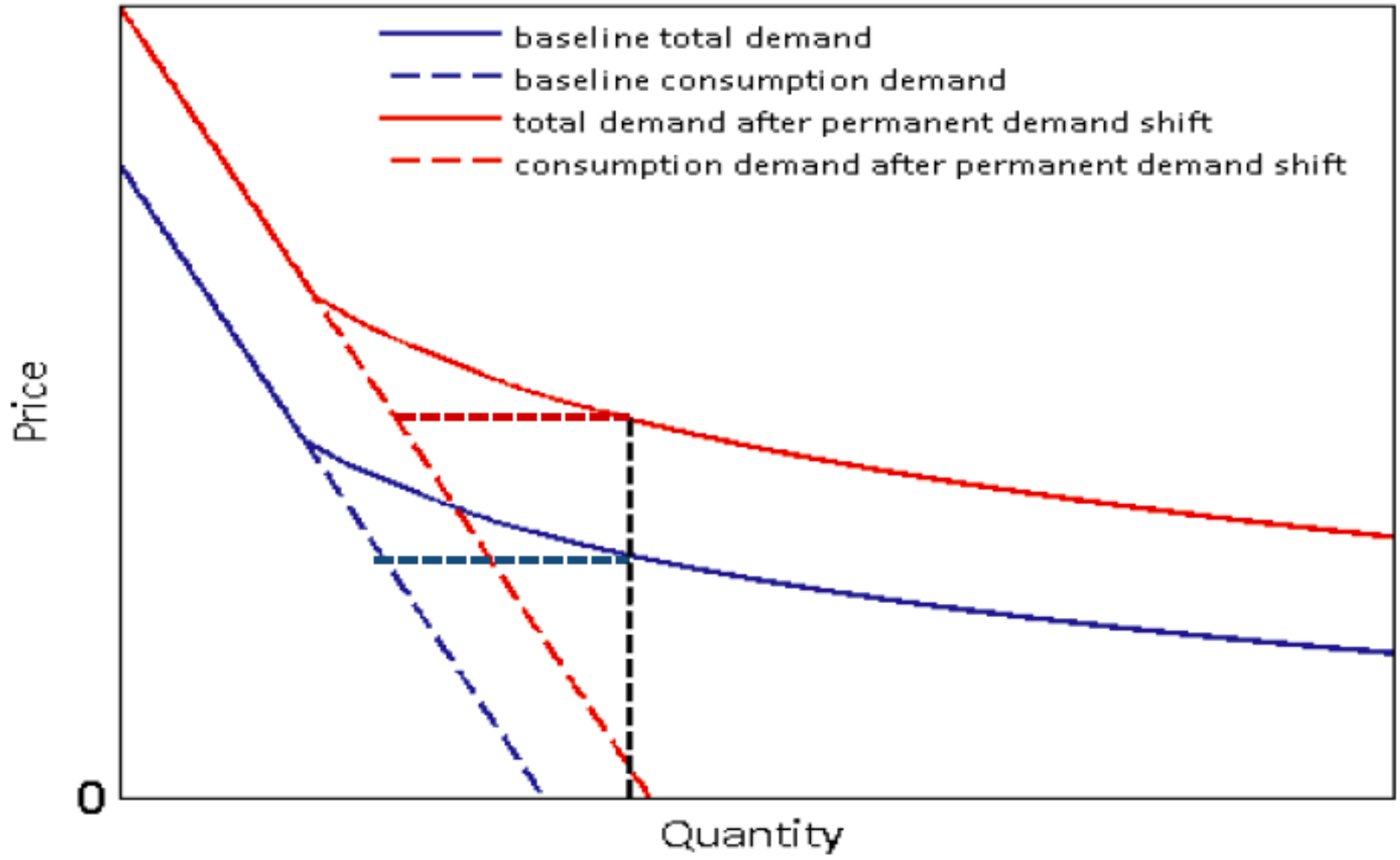
- Storage makes free trade more efficient in smoothing regional supply or demand **price** shocks

- Free trade makes storage more efficient
  - Generally cheaper to store at source vs. destination

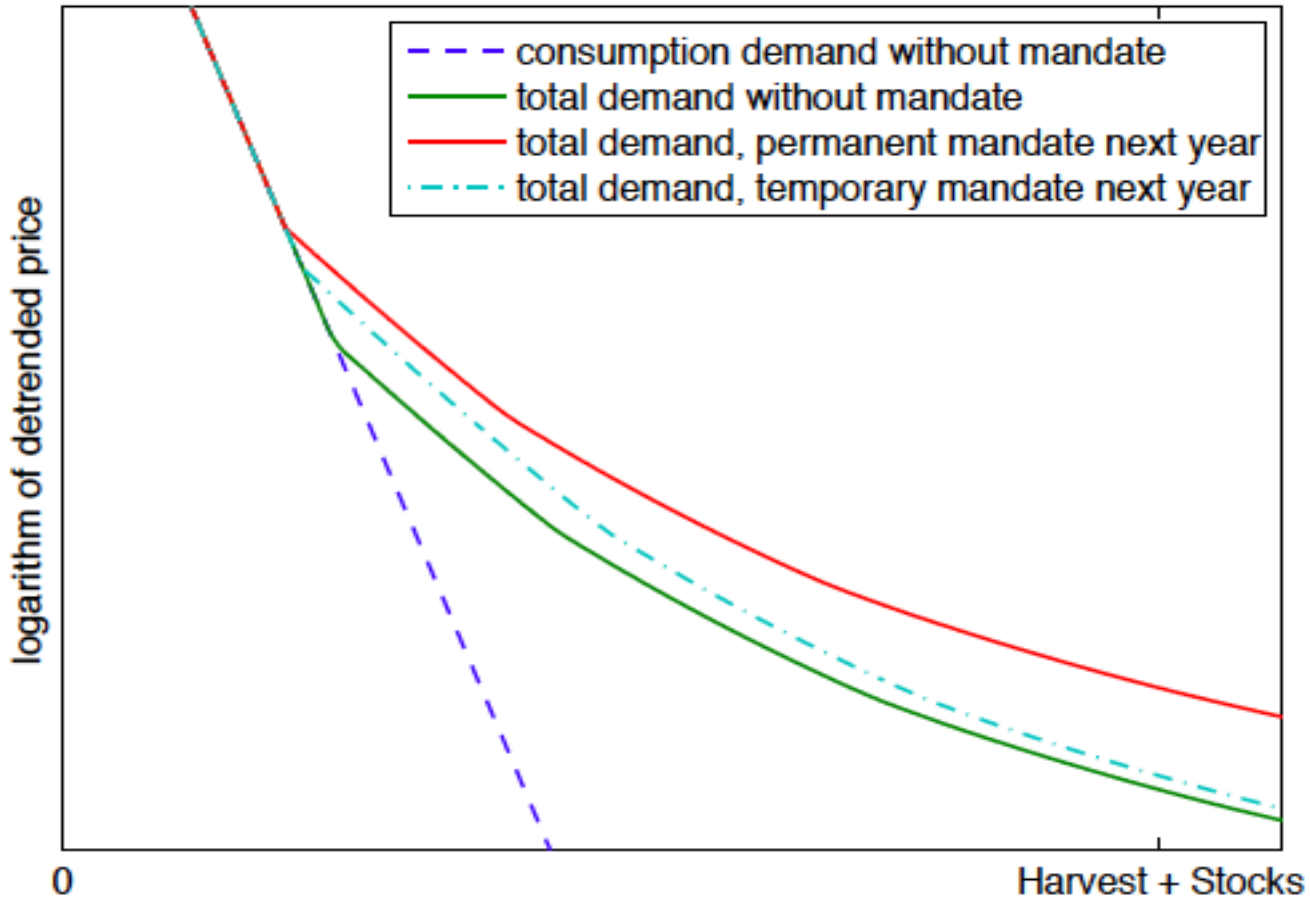
Caveat:
Storage cannot smooth persistent demand shocks

- 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 ….

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