Recent Agricultural Price Volatility and the Role of Grain Stocks

Brian Wright

Department of Agricultural and Resource Economics
College of Natural Resources
University of California, Berkeley.

IPC Conference on Agricultural Price Volatility: Prospects, Challenges and Possible Solutions
Barcelona, Spain, May 26, 2010
Recent high prices have focused world attention on global food security.

Poorest market-dependent consumers are the most vulnerable.

Widespread urban unrest, political pressure.

Longer-run question: a new regime of scarcity?
Blame Game:
What caused the recent food price crisis?

• Was it the price of crude oil  ?%
• Was it the Australian drought?  ?%
• Was it China’s consumption?  ?%
• Was it US and EU biofuels policy?  ?%
• A bubble: greedy speculators?  ?%
Focus of Study: Market Volatility

Preliminary Question:

When was the last time real grain prices as volatile as they have been recently?
Grains, Soy, All Food, and Crude Oil:
Was 2007/8 an echo of mid-1970s?
Maize price history

[Graph showing the maize price history from Jan-50 to Jul-77 with price in $ per bushel]
Maize price history

Corn, Price, farm, avg. price received $ per bushel
Real prices: Wheat and Maize
Characteristics of Grain Prices

- Long downward *trends*

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

- *Recent real spikes not unprecedented*
Theory of storage implies:

- Storers smooth out troughs in price and low-value consumption after high harvests by “buying low to sell high”
- Storers smooth expected shortages if cash is available:
  - invest in stocks, raise current price, reduce expected shortage
Why price is much more sensitive to shocks when stocks are minimal?

When stocks are low, price becomes very sensitive to disturbances in supply.
Theory of storage implies:

• Storers smooth out peaks after *unexpected* shocks, 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*
World market prices show effects of storage.

- Storers smooth out peaks after *unexpected* shocks, but *only until their stocks run out*
- *When stocks run out, price spikes are required, to force consumers to respond one-for-one to shocks*

**SPIKES OCCUR ONLY IF STOCKS ARE MINIMAL**

- *is this true?*
Stocks-to-use ratios: Maize
If China’s stocks are irrelevant, price spikes are likely in early 1970s, 1982/3, 1996, 2003, 2007
Maize price history
Does Stocks-to-use Ratio identify times of susceptibility to spikes?

1. Stocks-to-use predicts spike years as vulnerable for wheat and maize but adds 2002/03 as vulnerable, too:
   - In that year (in contrast to the others), China made substantial exports.

2. Predicts recent spike times as vulnerable for aggregate of the three grains, given China’s export record.
Figure 5. China's share of world cereal exports

Source: Dawe (2009)
World stocks-to-use ratios: wheat
Stocks-to-use ratios: wheat

If China’s stocks are irrelevant, price spikes are likely in early 1970s, 1996, 2003, 2007
World stock-to-use ratios for calories from wheat, maize and rice
World stock-to-use ratios for calories from wheat, maize and rice
Price of calories from wheat, rice and maize
Revisiting the *Blame Game*:
What caused the recent food price crisis?

- Was it the price of crude oil? %
- Was it the Australian drought? %
- Was it China’s consumption? %
- Was it US and EU biofuels policy? %
- A bubble: greedy speculators? %
The problem with allocating the blame:

• The response is very nonlinear

• What does nonlinearity mean for allocating the “blame” for recent price spikes?
Storage induces *nonlinearity* in demand:

- **Equivalent shocks**
- **Demand for consumption**
- **Market demand, inclusive of stocks**
- **Quantity**
- **Price**

**Different impact on prices**

With stocks:

- When stocks are low, price becomes very sensitive to disturbances in supply.

Without stocks:

**Storage induces nonlinearity in demand:**
Spikes happen when there are:

1. Unpredictable (negative) surprises
2. Minimal staring stocks
Understanding the relation between price and shocks:

- The relation is very nonlinear, so we need to understand what nonlinearity means for allocating the “blame” for recent price spikes

- To illustrate this I go to another technical literature outside economics:
• The boat sank only after the mouse jumped in after the cow, horse, pig etc. were already in the boat

• What percentage of “blame” goes to the mouse?
Illustration: Effect of two low harvests:
1. *Starting with average harvest, and price at mean:*
Effect of two low harvests:

1. starting with average harvest, and price at mean:
2. starting at zero stocks
When trade is blocked and stocks run out, adjustment must be in:

1. **Animal feeding** – more price responsive than human consumption in general
2. **Biofuels** – depends on mandates, oil prices

1. If little domestic animal feeding and biofuels:
   Consumers must bear adjustment burden
   – to adjust direct grain consumption a little, price must rise a lot

**Poorest adjust most, at great cost**
Explaining the recent spikes
Unpredictable changes in a market
*with minimal stocks:*

• Further *boots in corn and oilseed ethanol and biodiesel mandates*
• Spike in petroleum boosted biofuel demand
• Unprecedented extension of Australian drought
• Demands for rice, wheat induced by substitution in use, and competition for land, water and fertilizer
Key to 2007: Exporter/Importer Panic
Starting with Indian rice export ban, other exporters also limited exports

Source: See Mitchell 2008
Why not leave stabilization to the Free Market?

• Two observations:

  1. This is not fundamentally just a problem of market failure:

     Even in a free market, *the poor can starve when prices soar*, while others buy up stocks and have ample food

  2. The market is not free: Public always intervenes in emergency – question is not if but how.
Living with biofuels: Stabilization imperatives

Three Facts:

• Surging grain use for biofuels and animal feed have reduced global stock levels

• Grains for food are substitutable with feed uses globally

• Feed and fuel uses are less essential than minimum food needs in a crisis
Living with biofuels:

New emergency stabilization initiative:

Opportunity for nations with biofuels or animal feeding industries:

• Governments could buy call options from domestic biofuels producers or animal feeders to guarantee mutually advantageous diversion of grain from biofuels production to human food or animal feed in specified severe food crises.

• Target consumption of poor, not market price
• If severe crises are relatively infrequent, biofuel diversion options might be more cost-effective than food storage or creation of a production reserve.

• Similar options exist for irrigation water diversion to domestic use.
Other initiatives for consideration

1. Strengthening of WTO disciplines on export controls and extend them to export taxes could encourage market access in a shortage.

2. Better collection and sharing of information on global grain stocks and production prospects could improve market transparency, and help prevent the onset of unjustified market panic.

3. Consumption-targeted emergency food stocks - Food for work?
Other initiatives to avoid

1. Price-targeted public storage schemes
   - See UNCTAD NIEO history, and history of buffer stock schemes

2. Naked futures market speculation as “cheaper” than stocks
   - tried by US in the 1930’s, unhappy consequence
Conclusions

1. No evidence of a new regime of greater volatility.

2. As before, spikes occur only when stocks have run down and market is fragile.

3. **Govt. shocks are crucial**: exporters cannot guarantee access even in “non-emergencies”.
Conclusions (contd.)

4. Importers need strategic stocks to protect the poor:
   — target consumption, not price

5. Better than stocks or production reserves?
   Use options or modify mandates, to divert grain to food uses in rare, specified emergencies.
Thanks to my colleagues:

• Carlo Cafiero, University Naples, Portici
• Eugenio Bobenrieth, Universidad de Concepcion, Chile
• Juan Bobenrieth, Universidad de Concepcion, Chile
• DI Zeng, University of California, Berkeley

Also to IPC for inviting me to this conference
Conclusions

4. Importers need strategic stocks to protect the poor:
   – target consumption, not price

5. Better than stocks or production reserves?
   Buy options/modify mandates, to divert grain to food uses in rare, specified emergencies.
Why not leave stabilization to the Free Market?

• Two problems:
  2. The markets for grain storage and trade are not free
Why isn’t the world storage market free?

Public commitment not to intervene: impossible?

a) To protect poor consumers with insufficient resources, all governments intervene in the storage market when prices are high and supplies are low, at the expense of *storers*.

b) Anticipating storage intervention, *private storers store too little*.

c) So governments might have to intervene when prices are lower, to increase total storage.
Storage proposals

1. An obvious proposal is to impose the “social planner” solution by replacing private distorted storage with optimal storage.

2. A second class of storage policies tries to ensure a minimum consumption level for the most vulnerable.

2. A third class of policies aims to limit price volatility.
Public Reserves targeting price volatility (contd.)

2) More popular: **Price band with public reserves**
   - open offer to buy at the floor price (below mean), *as long as money is available*
   - offer to sell at ceiling price (above mean), *as long as stocks are available*
   - effects on price are not intuitive
Effects of Price Band

a) in theory

b) confirmed in practice in many commodity programs using price bands or similar rules, all now failed

1. *Price bands do reduce* occurrences of price spikes, given sufficient resources
3)  **Variant: Price Band with “virtual” reserve**

- Uses *naked short futures* contracts to increase private stocks if a *designated group of experts* sees a bubble forming.

- Effective only if positions large enough to affect price, inducing *higher real private stocks*.

  - *That is, the program aims to do what critics say index funds are doing!* 
  - *Unlike index funds, long positions not reduced until price reaches the ceiling.*
  - *Huge margin call exposure, and manipulation risk.*
  - *Eventual failure inevitable, as for conventional price band.*
Effects of Price Band (continued):

II. *Price is moved away from the middle of the band: Increases* probability that price is *at or above* ceiling

III. Discourages production and private storage when price rises toward ceiling

IV. Consumption is not smoothed by storage releases *as price rises to ceiling* (in contrast to competitive storage)

V. Budget exhaustion and failure occur *faster* than if only a price floor is used, *often causing a catastrophic price*
Policy for Stabilization:

• What is the objective?
  – Why intervene in the private provision of grain reserves?
  – Governments (for good reasons) leave management of farming to the private sector, even if subsidized
  – Why is storage different?
  – Is storage the problem?
Complementary smoothing roles

1. In the right place → Trade

2. At the right time → Storage
Relevance of storage model


Their conclusions were discouraging regarding the contribution of storage models to our understanding of the nature of commodity price risk. They furnished a body of numerical and empirical evidence (Deaton and Laroque, 1992, 1995, 1996) against the ability of their model to explain commodity price behavior, nicely summarized by Deaton and Laroque (2003, p. 290): “[T]he speculative model, although capable of introducing some autocorrelation into an otherwise i.i.d. process, appears to be incapable of generating the high degree of serial correlation of most commodity prices.”
Problem: numerical inaccuracy
ABSTRACT

The empirical relevance of models of competitive storage arbitrage in explaining commodity price behavior has been seriously challenged in a series of pathbreaking papers by Deaton and Laroque (1992, 1995, 1996). Here we address their major criticism, that the model is in general unable to explain the degree of serial correlation observed in the prices of twelve major commodities. First, we present a simple numerical version of their model which, contrary to Deaton and Laroque (1992), can generate the high levels of serial correlation observed in commodity prices, if it is parameterized to generate realistic levels of price variation. Then, after estimating the Deaton and Laroque (1995, 1996) model using their data set, model specification and econometric approach, we show that the use of a much finer grid to approximate the equilibrium price function yields quite different estimates for most commodities. Results are obtained for coffee, copper, jute, maize, palm oil, sugar and tin that support the specifications of the storage model with positive constant marginal storage cost and no deterioration as in Gustafson (1958a). Consumption demand has a low response to price and, except for sugar, there are infrequent stockouts. The observed magnitudes of serial correlation of price match those implied by the estimated model.
Speculative part of lofty cocoa prices frustrates physical trade
But a Dutch trader who specialises in fine cocoa said speculators have created higher, more volatile prices which means physical traders need greater working capital and can more often be wrong-footed by market moves.

“There are all sorts of players that are not interested in the physicals but have hundreds and hundreds of billions of dollars. They just want to invest in commodities to earn money. My feeling tells me we should be hundreds of pounds a tonne lower. There are always slight worries about the crop; it’s a deficit of 50,000 tonnes not 500,000 tonnes. Two years ago we were at £800 ($1,320) to £900 a tonne, why are we now at £2,200 with the pound where it is?”
A second trader in the Netherlands called speculative inflows “a clear obstruction to business”. “Certainly we need a correction,” he said. “But it’s not coming. The speculators have too much money and too big positions to pull out. Plus the fundamentals, while not extremely bullish, do not point to a lower market. There is not a bumper crop with the weather and political problems in Ivory Coast. If that gets worse we are in deep trouble.”
Was the Dutch Cocoa specialist right?

Trading Chart With Historical Prices

http://www.tradingeconomics.com/Economics/Commodities.aspx?

Tallied 557 dollars or 23.82 percent during the last 12 months. This page includes: Cocoa Futures Trading Chart With Historical Prices chart, historical data and news. Cocoa has a wide variety of uses, from chocolate to cocoa butter to coloring agents for food products. Although cocoa is one of the world’s smallest soft commodity markets, it has global implications on cocoa importers and exporters, food and candy producers, and the retail industry. The size of each contract is 10 metric tons and its commodity code is C. It is financially settled, and the final settlement price will be set at the value of New York Board of Trade cocoa futures contract on the termination day of the contract month, or as specified by the NYMEX Board of Directors.

Cocoa Futures Trading Chart With Historical Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>3318.80</td>
<td>3020.00</td>
<td>2683.25</td>
<td>3044.40</td>
<td>2902.33</td>
<td>2824.50</td>
<td>2732.60</td>
<td>2846.50</td>
<td>3036.50</td>
<td>3235.80</td>
<td>3184.00</td>
<td>3223.00</td>
</tr>
<tr>
<td>2009</td>
<td>2604.00</td>
<td>2654.00</td>
<td>2464.75</td>
<td>2543.25</td>
<td>2427.00</td>
<td>2624.50</td>
<td>2732.60</td>
<td>2846.50</td>
<td>3036.50</td>
<td>3235.80</td>
<td>3184.00</td>
<td>3223.00</td>
</tr>
<tr>
<td>2008</td>
<td>2153.25</td>
<td>2503.20</td>
<td>2568.75</td>
<td>2589.50</td>
<td>2718.20</td>
<td>3082.50</td>
<td>2956.25</td>
<td>2787.00</td>
<td>2669.00</td>
<td>2173.00</td>
<td>2129.50</td>
<td>2463.25</td>
</tr>
<tr>
<td>2007</td>
<td>1602.50</td>
<td>1720.00</td>
<td>1847.20</td>
<td>1876.75</td>
<td>1927.00</td>
<td>1924.20</td>
<td>2059.50</td>
<td>1840.80</td>
<td>1933.25</td>
<td>1871.50</td>
<td>1938.00</td>
<td>2094.25</td>
</tr>
</tbody>
</table>

* The table above displays the monthly average.
Cocoa Futures Trading Chart With Historical Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>3318.80</td>
<td>3020.00</td>
<td>2863.25</td>
<td>3044.40</td>
<td>2902.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>2604.00</td>
<td>2654.00</td>
<td>2464.75</td>
<td>2543.25</td>
<td>2427.00</td>
<td>2624.50</td>
<td>2732.60</td>
<td>2846.50</td>
<td>3036.50</td>
<td>3235.80</td>
<td>3184.00</td>
<td>3323.00</td>
</tr>
<tr>
<td>2008</td>
<td>2153.25</td>
<td>2503.20</td>
<td>2569.75</td>
<td>2589.50</td>
<td>2718.20</td>
<td>3082.50</td>
<td>2956.25</td>
<td>2787.00</td>
<td>2659.00</td>
<td>2173.00</td>
<td>2129.50</td>
<td>2463.25</td>
</tr>
<tr>
<td>2007</td>
<td>1602.50</td>
<td>1720.00</td>
<td>1847.20</td>
<td>1876.75</td>
<td>1927.00</td>
<td>1924.20</td>
<td>2059.50</td>
<td>1840.80</td>
<td>1933.25</td>
<td>1871.50</td>
<td>1938.00</td>
<td>2094.25</td>
</tr>
</tbody>
</table>

* The table above displays the monthly average.
Was the Dutch Cocoa specialist right?
World grain calorie prices and stock-to-use ratios

![Graph showing real price index (ex. China) and Without China stocks-to-use ratio (wheat + maize + rice in kcal)]
The smoothing potential of trading: rice

World Rice Production Trends and Variation 1961-2007

(Source: FAO)
1. An international grain reserve controlled jointly by national governments

Aim: perform the optimal storage role not achieved by the private sector anticipating public intervention in crises

This would be great if feasible, but assumes away the key problem:

- Countries cannot commit to international collaboration during food emergencies
- Evidence: rice market in 2007/08 “non-emergency”
2. National Strategic Reserves targeting consumption

Aim: ensure minimum consumption needs met in emergencies

• Given exporters cannot commit to keep markets open, strategic reserves may be necessary as part of an importer country’s policy for domestic food security.

• If designed to meet *quantitative* targets and only in severe emergencies, disincentive effects will be reduced, but still might be significant.

• Distribution of stored food on the basis of need, such as properly-designed “food for work” and targeted feeding

• Challenge: how much to store?
3. Public Reserves targeting price volatility

For transparency of operation, clear operational rules usually chosen.

1) Simplest: **Price floor**
   - open offer to buy or sell at the floor price, as long as stocks available

2) More common: **Price band**:
   - offer to buy at floor, and sell only when a higher ceiling price is reached
Public Reserves targeting price volatility (Contd.)

1) Simplest: **Price floor**
   - open offer to buy or sell at the floor price, as long as stocks available

   - Price floor exhausts budget eventually, even if no trend in demand or supply (this is a *theorem*)
   - In addition, trend hard to identify, over-optimism leads to faster failure
   - Competitive storage has an effect similar to an adjustable “soft floor” in practice