Food Price Volatility in Food and Agricultural Markets: Policy Responses

Maximo Torero

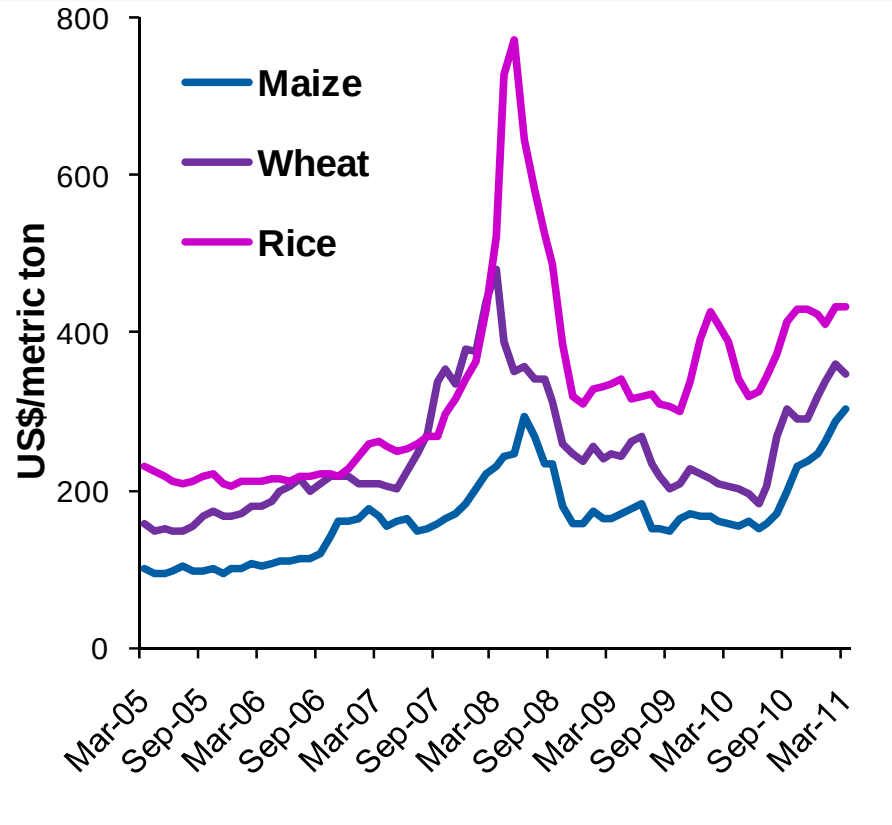
m.torero@cgiar.org

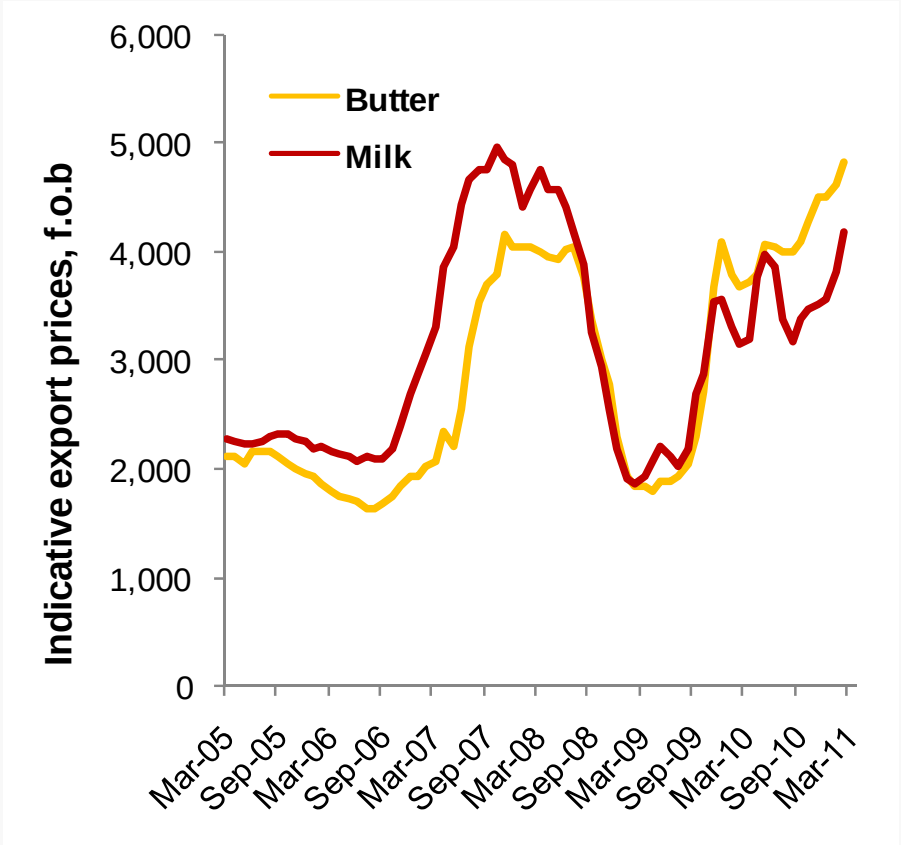
Forum on Food Price Increases: Causes, Impacts and Response
September 30th , 2011
Institute for International Economic Policy, Elliott School of International Affairs, GWU

We have FOUR crises

- **Slow motion food crisis:**
  - Still no clear progress.
- **Still persistent financial crisis:**
  - "This is not a recovery", Paul Krugman, 8/28/2010 NYT
- **Latent fuel crises:** rise and fall of price of oil (variability), impact of food for fuel.
- **Eminent climate change!** More pressure over price variability

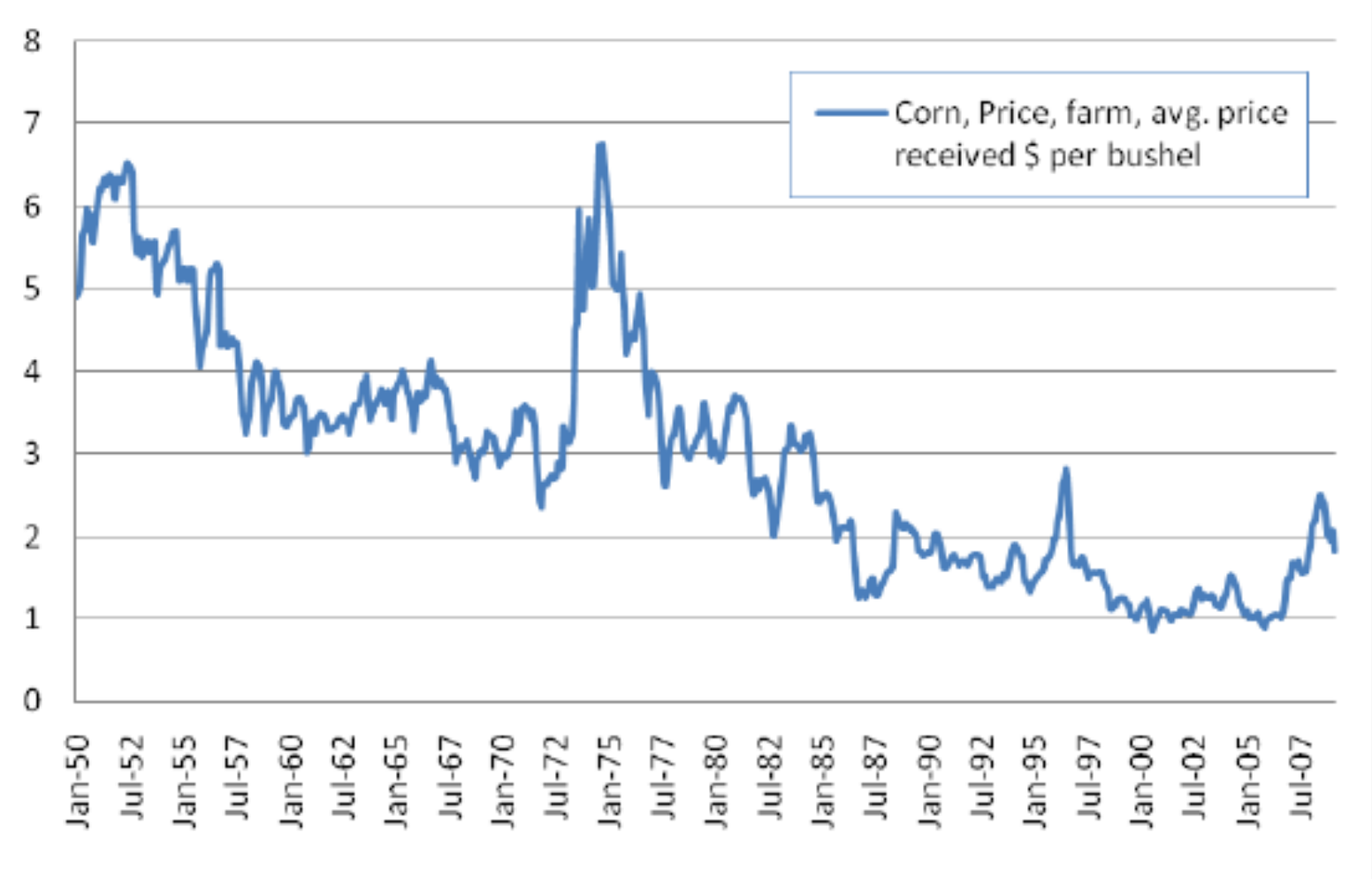
Evolution of prices



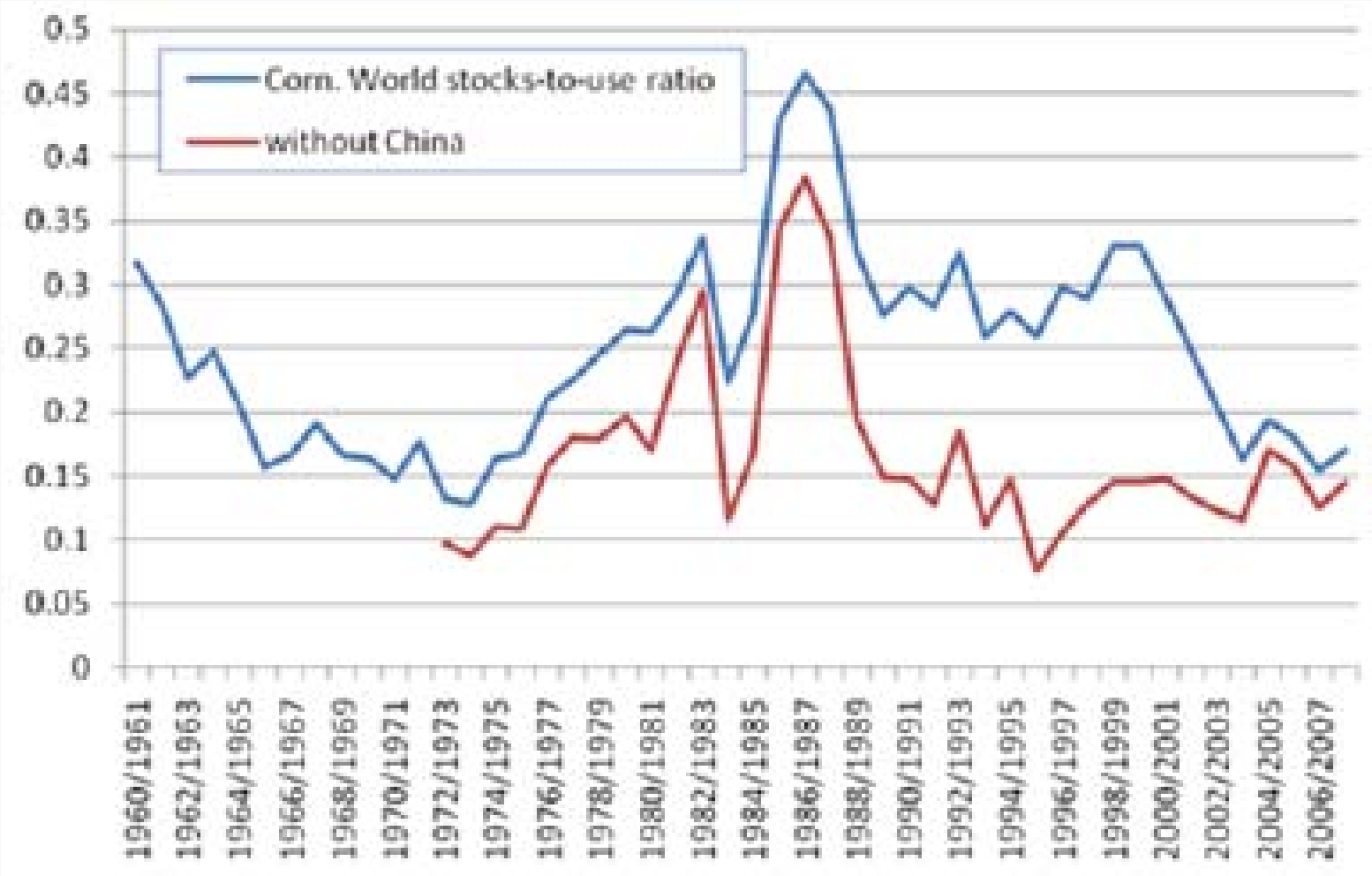


Source: FAO (Food and Agriculture Organization of the United Nations). 2011. International commodity prices database. Available at www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en. Maize = US No.2, Yellow, U.S. Gulf; Wheat = US No.2, Hard Red Winter ord. prot, US f.o.b. Gulf; Rice = White Broken, Thai A1 Super, f.o.b Bangkok; Butter = Oceania, indicative export prices, f.o.b.; and Milk = Whole Milk Powder, Oceania, indicative export prices, f.o.b.

Historical evolution of corn prices

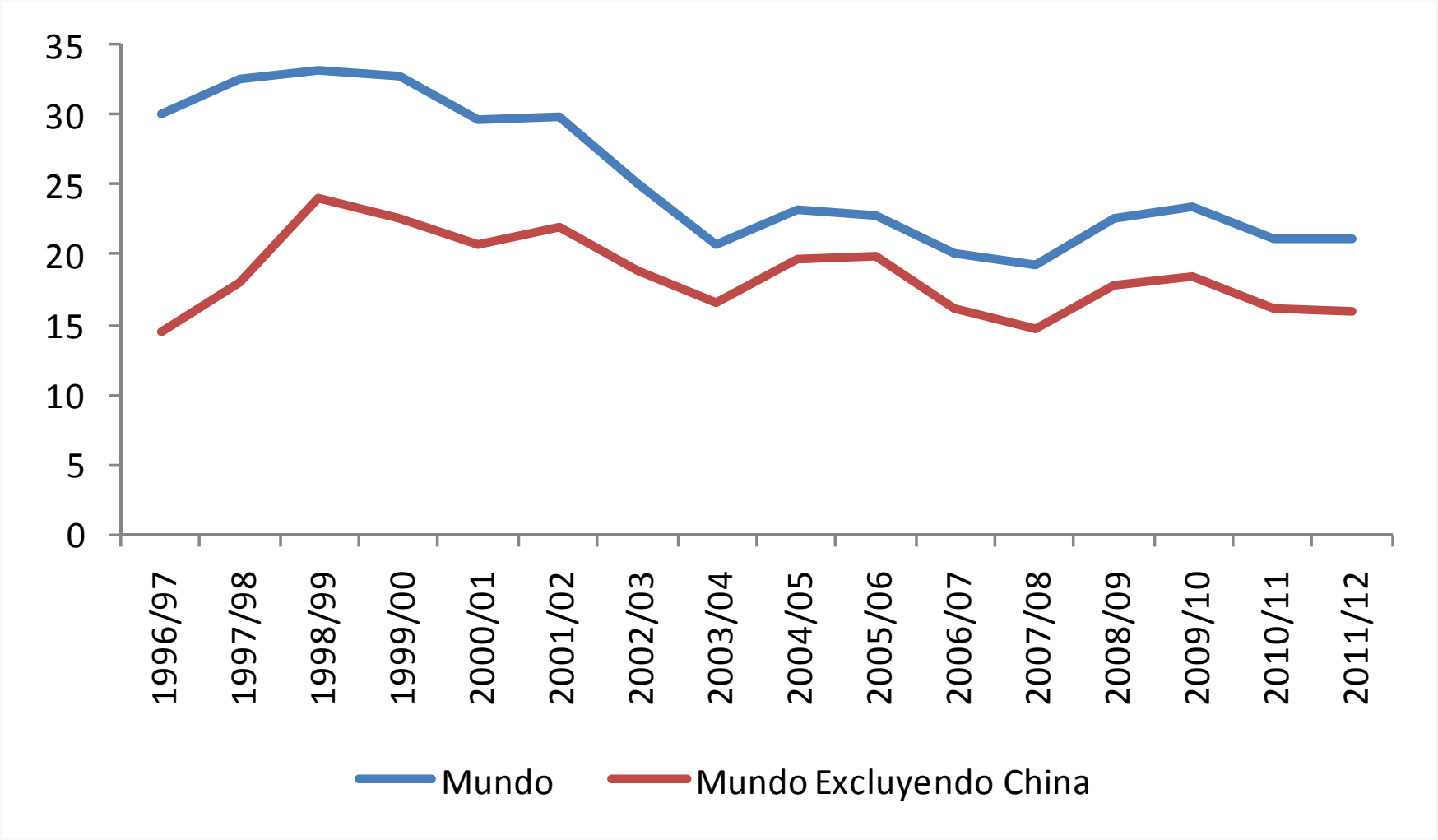


Stock to use ratio- Corn



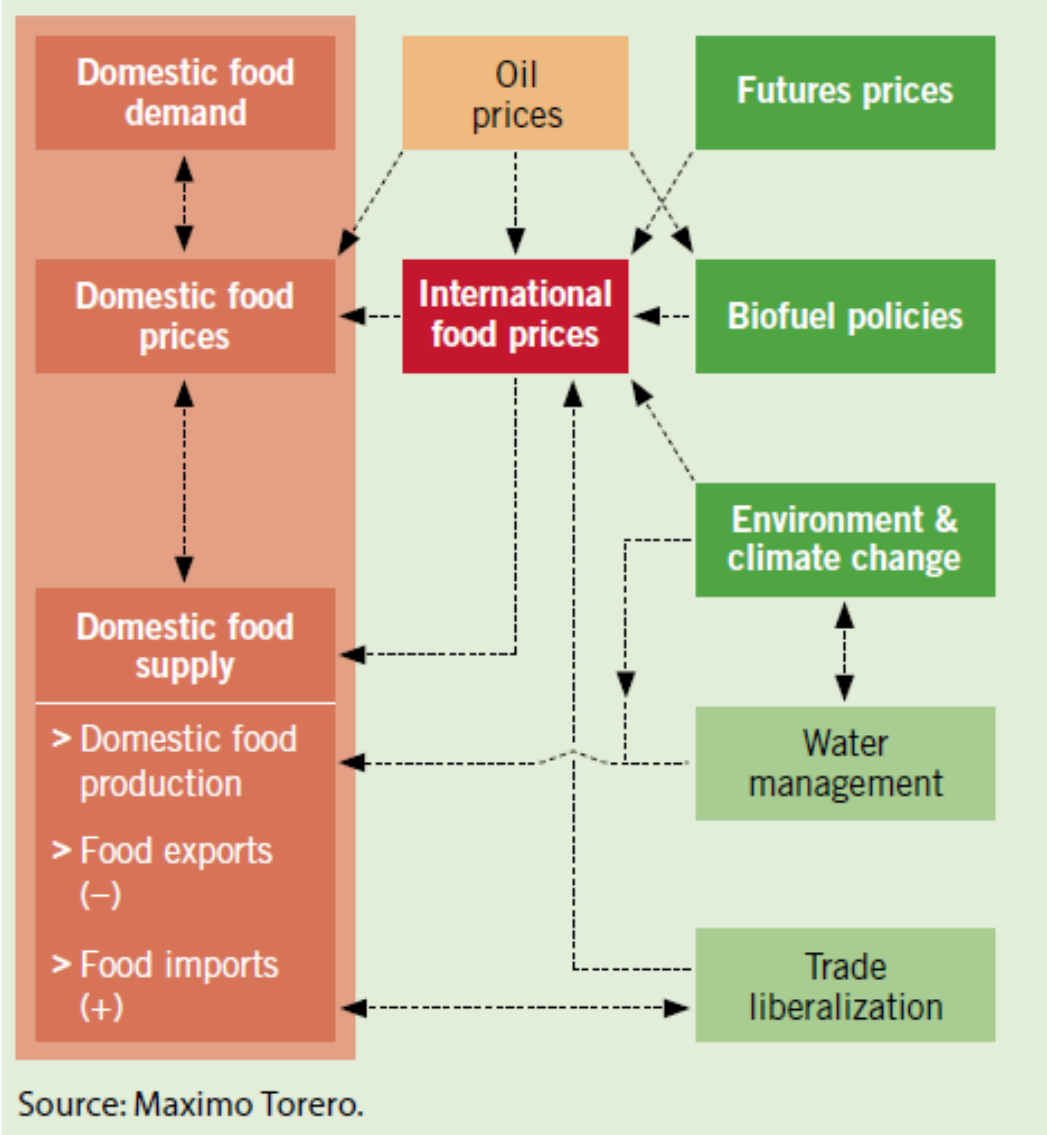
Source: FAO Food Outlook, several years.

Stock to use ratio- Cereals



Source: FAO Food Outlook, several years.

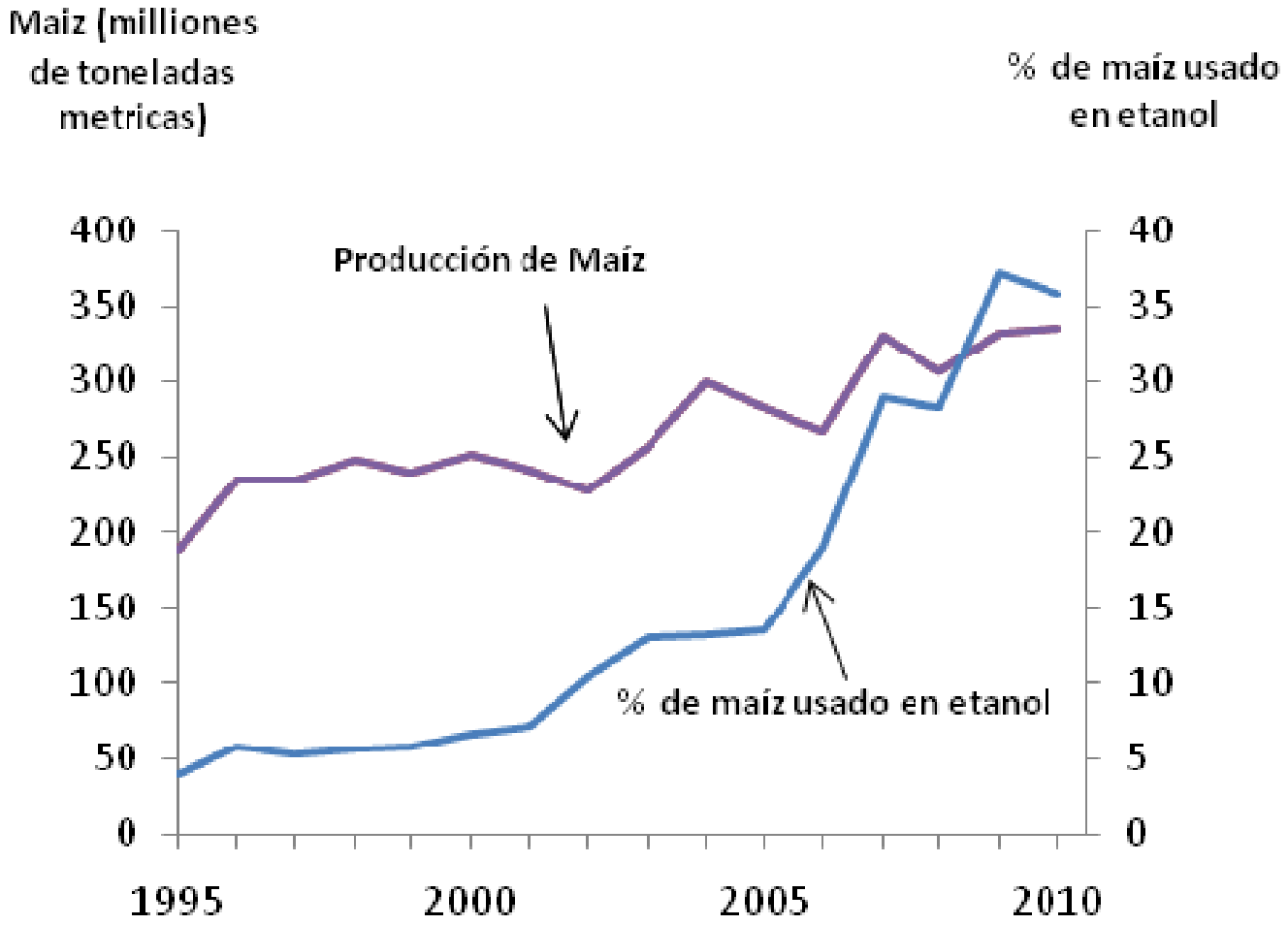
Key Factors behind the increase in agricultural commodity prices and volatility



Source: Maximo Torero.

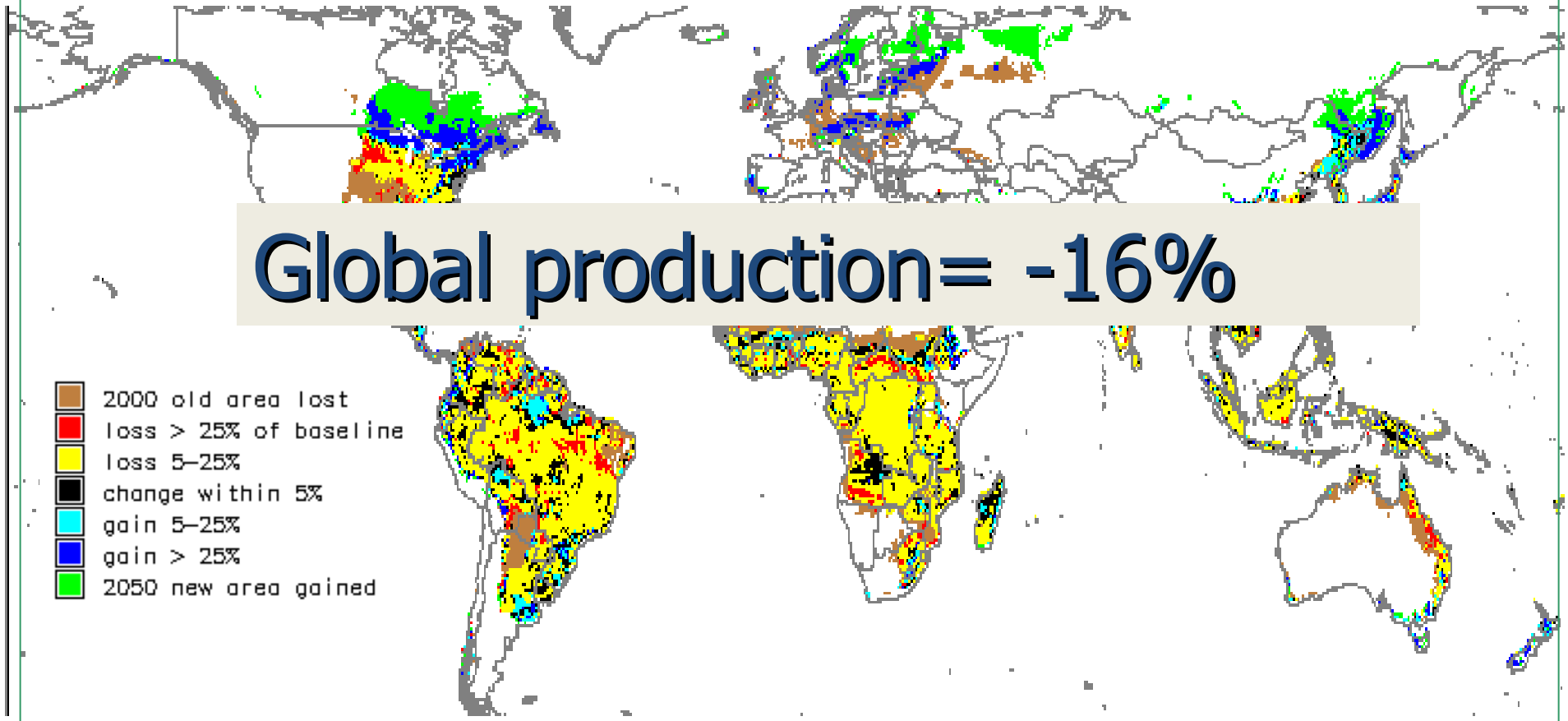
High concentration of exports

Proportion of Corn production used for Biofuels in the US, 1995–2010



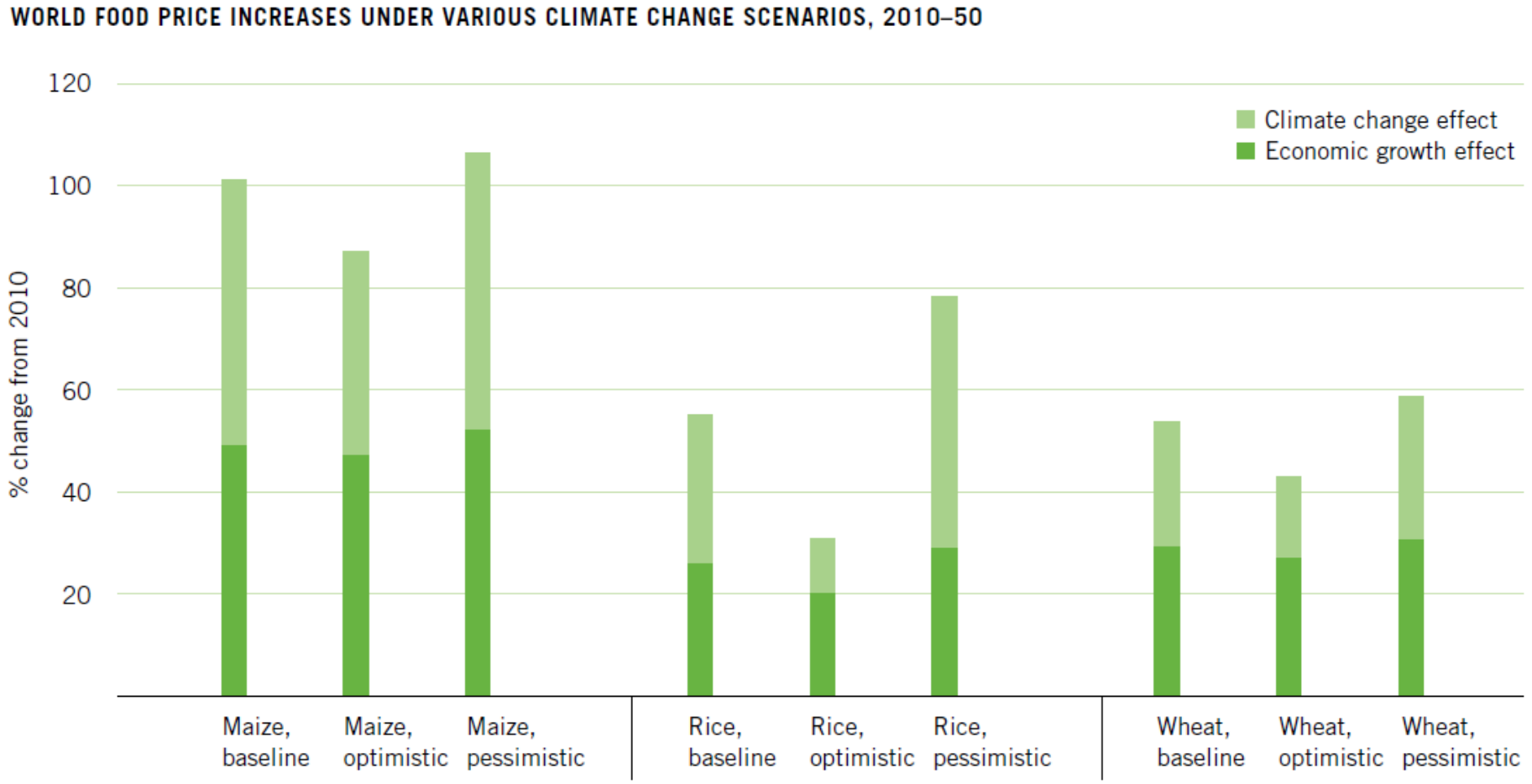
Source: Data from Earth Policy Institute (2011).

Climate Change Effects on Maize Yield



Source: Hadley GCM, SRES Scenario A2a
February 2009 results

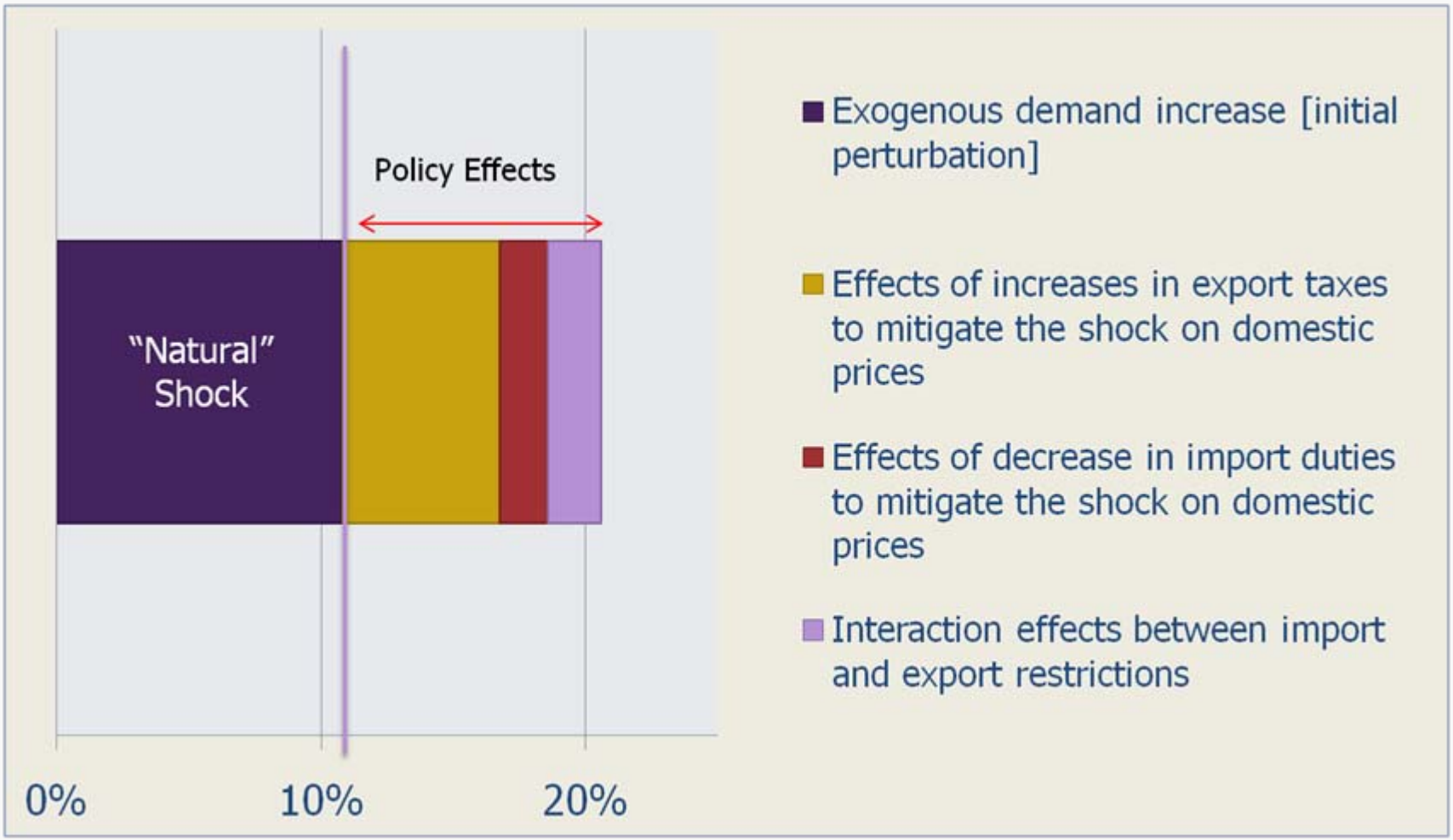
Climate Change Effects



Source: Nelson et al. (2010).

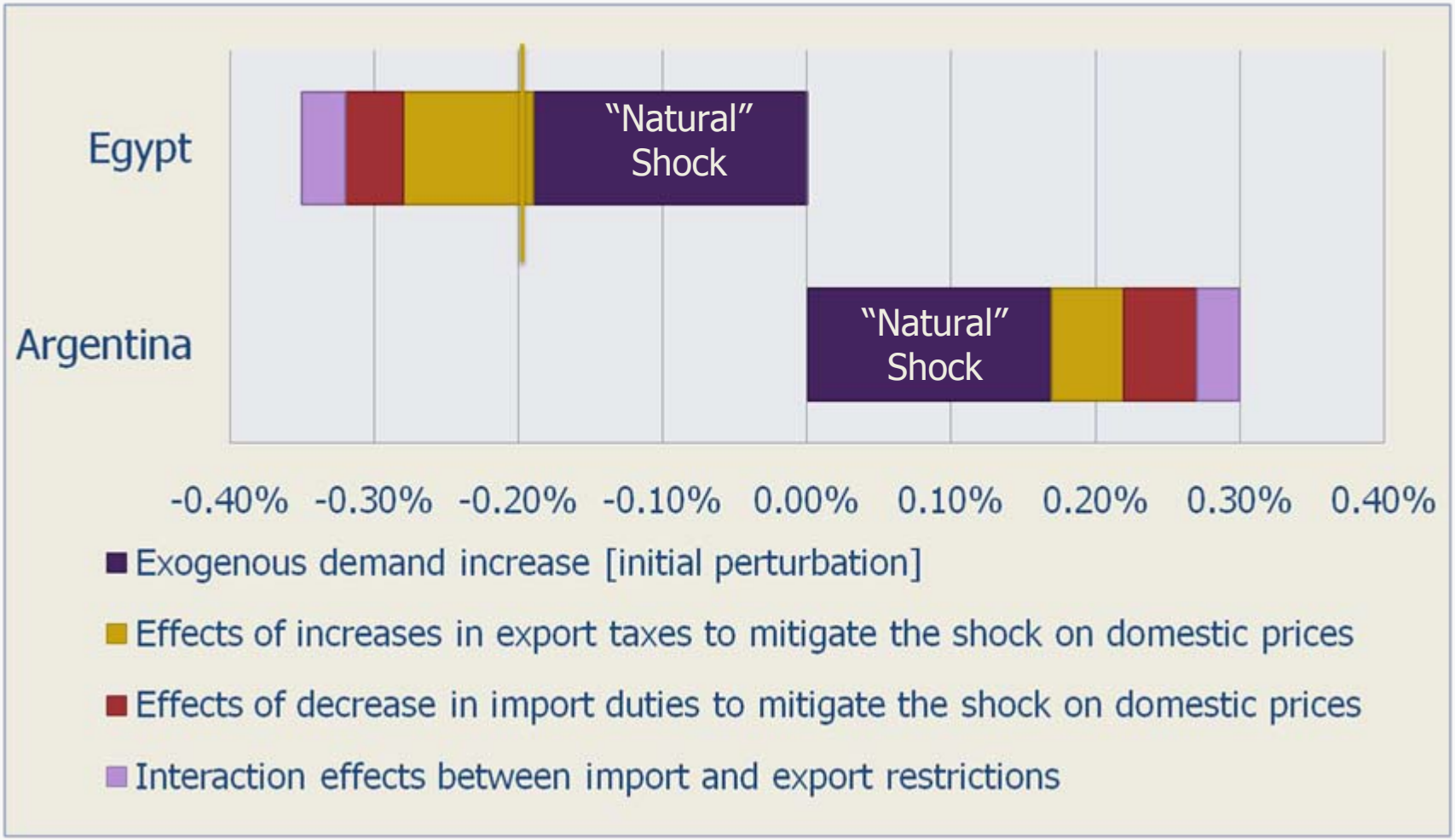
Note: The study for this graph considers three combinations of income and population growth: a baseline scenario (with moderate income and population growth), a pessimistic scenario (with low income growth and high population growth), and an optimistic scenario (with high income growth and low population growth). Each of these three income/population scenarios is then combined with four plausible climate scenarios that range from slightly to substantially wetter and hotter on average, as well as with an implausible scenario of perfect mitigation (a continuation of today's climate into the future). The climate change effect presented in the graph is the mean of the four climate change scenarios.

Secondary responses: An illustration with the wheat market: Effects on world prices of trade policy reactions for selected countries



Source: Bouet and Laborde, 2009. MIRAGE simulations

An illustration with the wheat market: Effects on real income of trade policy reactions for selected countries



Source: Bouet and Laborde, 2009. MIRAGE simulations

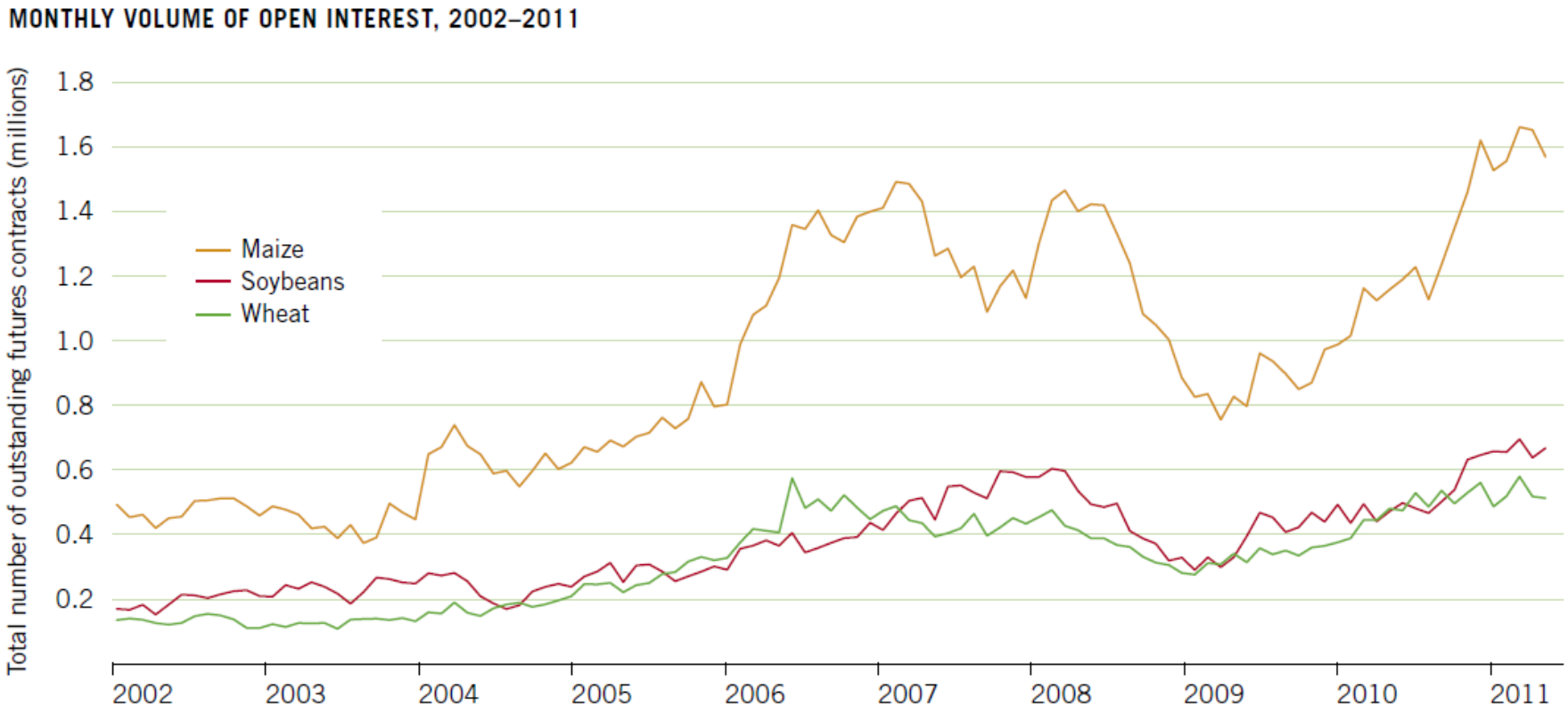
Export bans and restrictions

- Changes in trade policies contributed very substantially to the increases in world prices of the staple crops in both the 1974 and the 2008 price surges [**Martin and Anderson (2010)]**
- In 2007-8, insulating policies in the market for rice explained almost 40% in the increase in the world market for rice [**Martin and Anderson (2010)]**
- Simulations based on MIRAGE model showed that this explains around 30% of the increase of prices in basic cereals
- If you raise export taxes in a big agricultural country this will raise world prices (through a reduction in world supply) and it will be bad for small net food importing countries => A problem!
- But reduction of import duties has exactly the same effect: an increase of world prices through an expansion of demand on world markets. But you will not be criticized because it's a liberal policy!
- And when you add augmentation of export taxes in big food exporting countries and reduction of import duties in big food importing countries => real disaster for small food importing countries

Increasing financial activity in futures market

- The volume of index fund increased by a dizzying 2,300 percent between 2003 and 2008 alone.
- Today only 2 percent of commodity futures contracts result in the delivery of real goods
- For example in corn, the volume traded on exchanges (front contracts) is more than three times than the global production of corn!

Increasing financial activity in futures market

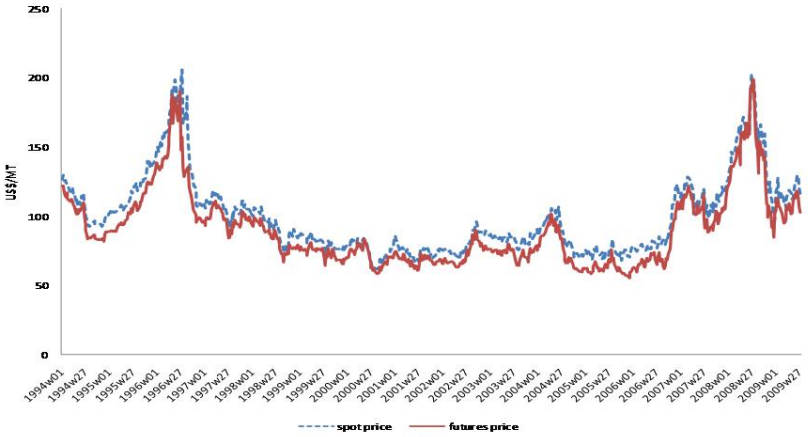


Source: CBOT (2011).
Note: Rice futures are not shown because they are traded in such low numbers.

Spots and future move together

CORN

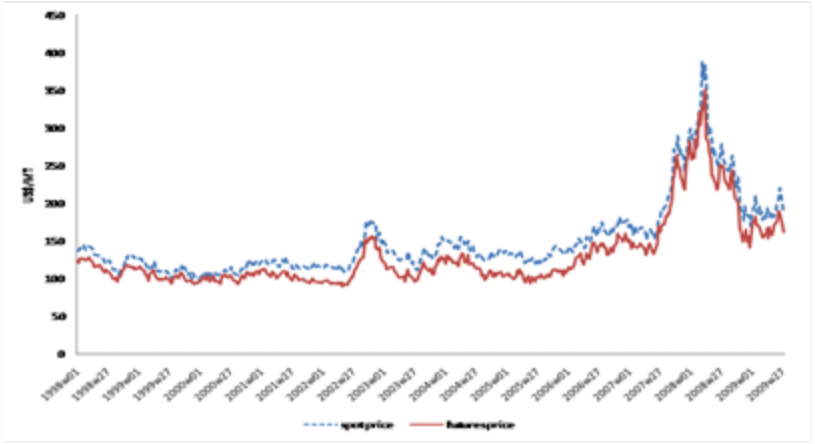
Weekly spot and futures prices, 1994 - 2009



Note: Prices deflated by US CPI, January 1994=1.

HARD WHEAT

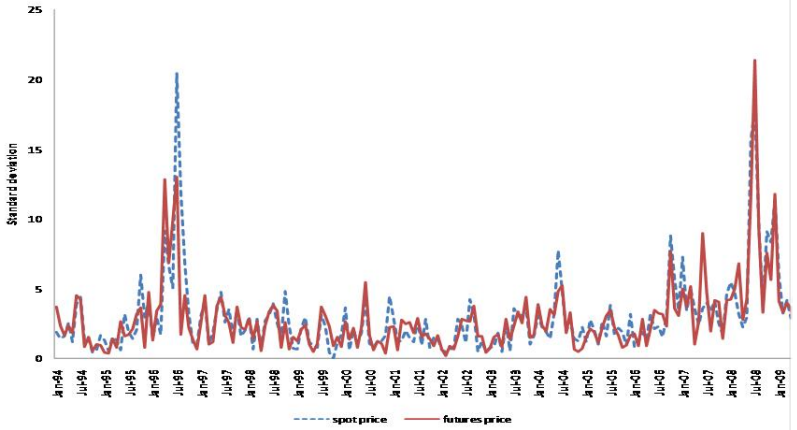
Weekly spot and futures prices, 1998 - 2009



Note: Prices deflated by US CPI, January 1998=1.

CORN

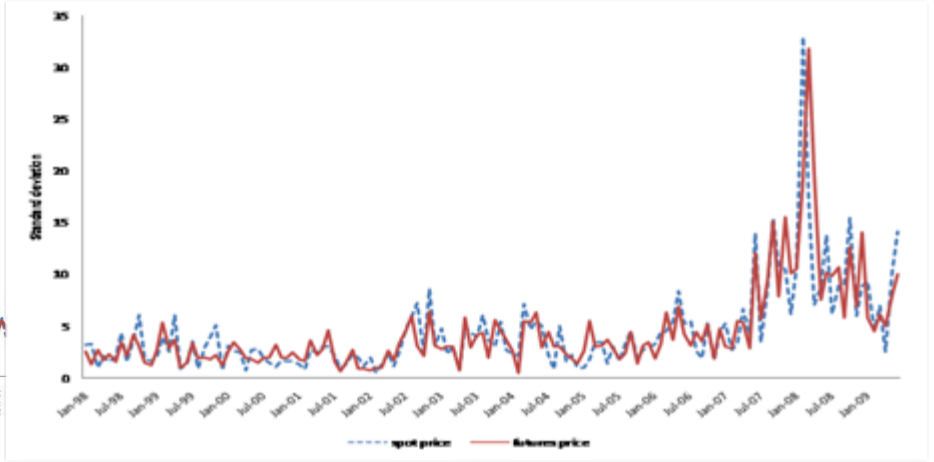
Monthly volatility in spot and futures prices, 1994 - 2009



Note: Monthly volatility based on weekly spot and futures prices.

HARD WHEAT

Monthly volatility in spot and futures prices, 1998 - 2009



Note: Monthly volatility based on weekly spot and futures prices.

Source: Hernandez & Torero (2009)

Granger causality tests

- Granger causality tests were performed to formally examine the dynamic relation between spot and futures markets.
- The following regression model is estimated to test if the return in the spot market (*RS*) at time *t* is related to past returns in the futures market (*RF*), conditional on past spot returns,

$$RS_t = a_0 + \sum_{k=1}^{p} a_{1k} RS_{t-k} + \sum_{k=1}^{p} a_{2k} RF_{t-k} + e_t$$

where H_0: $a_{2k} = 0 \ \forall \ k = 1, \ldots, p$ (i.e. *RF* does not Granger-cause *RS*).

- Conversely, RF_t is the dependent variable to evaluate the null hypothesis that spot returns (*RS*) does not Granger-cause futures returns (*RF*).
- Similar tests are performed to examine causal links in the volatility of spot and futures returns.

Source: Hernandez & Torero (2009)

Linear causality test on returns

Granger causality test of weekly returns in spot and futures markets, 1994 - 2009

# lags	H_0: Futures returns does not Granger-cause spot returns				H_0: Spot returns does not Granger-cause futures returns			
	Corn	Hard Wheat	Soft Wheat	Soybeans	Corn	Hard Wheat	Soft Wheat	Soybeans
1	167.47***	263.03***	169.85***	15.44***	6.10***	2.20	0.40	0.55
2	116.20***	186.92***	106.61***	21.24***	2.09	0.02	0.01	0.47
3	77.58***	135.27***	75.33***	20.74***	2.24*	0.11	0.27	1.75
4	58.56***	100.84***	57.92***	16.93***	2.08*	0.97	1.50	1.41
5	48.65***	79.91***	46.38***	14.57***	1.66	1.32	1.59	1.28
6	40.63***	65.92***	38.36***	12.41***	1.59	1.21	1.64	1.06
7	34.76***	56.21***	32.90***	11.51***	2.12**	1.45	1.76*	0.96
8	30.95***	49.91***	29.37***	10.35***	1.97**	1.21	1.46	1.06
9	27.62***	44.64***	26.09***	9.38***	1.58	1.10	1.25	1.04
10	24.80***	40.89***	23.44***	9.05***	1.45	1.21	1.21	1.03

*10%, **5%, ***1% significance. F statistic reported.

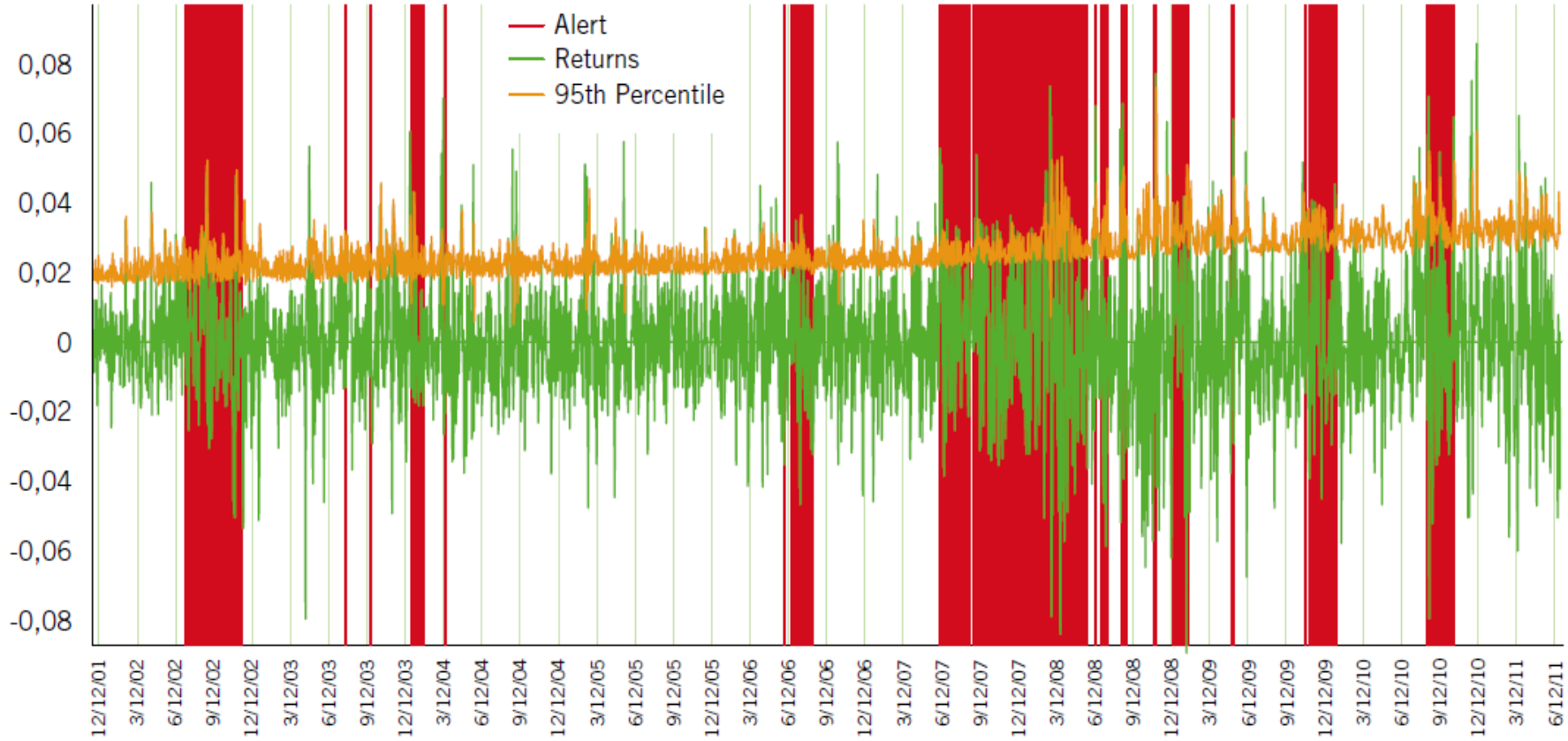
Note: The Schwartz Bayesian Criterion (SBC) suggests lag structures of 2, 3, 2 and 3 for corn, hard wheat, soft wheat and soybeans, respectively. The Akaike Information Criterion (AIC) suggests lag structures of 8, 3, 4 and 5, respectively.

Period of analysis January 1994 - July 2009 for corn and soybeans, and January 1998 - July 2009 for hard and soft wheat.

It appears that futures prices Granger-cause spot prices.

Source: Hernandez & Torero (2009)

Periods of Excessive Food Price Variability for Hard Wheat



Source: Martins-Filho, Torero, and Yao 2010. See details at http://www.foodsecurityportal.org/soft-wheat-price-volatility-alert-mechanism. Note: The green line is a logarithm of the observed daily return (rate of increase of prices from one day to the next) on investment. The orange line represents a level below which returns have a 95 percent probability of occurring. When the blue line (return) exceeds the red line (95th percentile), it is characterized as an excessively large return. One or two such returns do not necessarily indicate a period of excessive volatility. Periods of excessive volatility are identified based on a statistical test applied to the number of times the extreme value occurs in a window of consecutive 60 days (for details on the definition see Appendix D).

Measuring excessive food price variability

- NEXQ (Nonparametric Extreme Quantile Model) is used to identify periods of excessive volatility
- NEXQ is a tool developed by IFPRI to analyze the dynamic evolution of the returns over time in combination with extreme value theory to identify extreme values of returns and then estimate periods of excessive volatility.
- Details of the model can be found at www.foodsecurityportal.org/excessive-food-price-variability-early-warning-system-launched and in Martins-Filho, Torero, and Yao 2010).

Why Excessive Volatility is a Concern?

- Producers of agricultural commodities do not have market power. As a result, output decisions are made taking market price as given.
- Let $c(y; w)$ be the producer cost function, where y denotes output and w denote input prices and let marginal cost be denoted by $c'(y; w)$.
- P is a *random* variable that denotes market price.
- P has distribution given by F_P with expected value $\mu_P = \int p \, dF_P(p)$ and variance $\sigma_P^2 = \int (p - \mu_P)^2 \, dF_P(p)$.
- Profit maximization requires $\mu_P = c'(y^*; w)$.

Source: Martins-Filho, & Torero ,(2010)

Why Excessive Volatility is a Concern?

- Producer output cannot be adjusted with the speed at which prices change, producers attain suboptimal profits (L) whenever $P \neq \mu_P$.
- Now, assume without loss of generality that the optimal level of output for price P is $y > y^*$. Then lack of output adjustment produces a loss in profit given by

$$L = -Pdy + \int_{y^*}^{y} c'(\alpha; w) d\alpha \text{ where } dy = y - y^*. \quad (1)$$

Source: Martins-Filho, & Torero ,(2010)

Why Excessive Volatility is a Concern?

- If $c'(y;w) = b(w) + 2c(w)y$ where $b(w)$ and $c(w)$ are constants, then

$$L = -\frac{1}{4c(w)}(P - \mu_P)^2.$$

- Expected loss in profits is

$$E(L) = \frac{1}{4c(w)}E(P - \mu_P)^2 = \frac{1}{4c(w)}\sigma_P^2. \qquad (2)$$

- There is, consequently, a monotonically increasing relationship between volatility (σ_P) and expected losses.

Source: Martins-Filho, & Torero ,(2010)

Why Excessive Volatility is a Concern?

1. Smaller price volatility reduces losses. In fact, if it were possible to attain $\sigma_P^2 = 0$ there would be no loss in profits.
2. Since choosing output to maximize profit equates marginal cost to price, there is optimal allocation of inputs into the agricultural sector. Hence, misallocation is reduced by reducing price volatility. Large values of σ_P^2 produce increased misallocation of resources.
3. Increased price volatility through time generates the possibility of larger net returns $R_t = P_t/P_{t-1} - 1$, where t indexes time. Potential larger returns create the possibility of constructing investment portfolios that previously did not contain agricultural commodities. As such increased price volatility may lead to increased (potentially speculative) trading.

Source: Martins-Filho, & Torero ,(2010)

What are the proposed options

(1) ER = Emergency Reserve, Von Braun & Torero (2009 a,b)
(2) ICGR= Internationally coordinated grain reserves, Linn (2008)
(3) RR = Regional Reserves as the one of ASEAN
(4) CR = Country level reserves, this could imply significant relative costs at the country level, significant distortions and little effect on volatility given low effect over international markets.
(5) VR= Virtual Reserves, Von Braun & Torero (2009)
(6) DFIF=Diversion from industrial and animal feed uses, Wright 2009
(7) IS+IFA= Better information on Storage and International Food Agency (Wright 2009)
(8) IGCA= International Grain Clearance Arrangement, Sarris (2009)
(9) FIFF= Food Import Financing Facility, Sarris (2009).
(10) EWM=Early Warining mechanism
(11) TF= Trade Facilitation - Wright (2009) and Lin (2008)

Option 1: Challenges of Physical reserves

- **Determination of optimum stock, which is politically loaded**,
  - Predicting supply and demand and where the potential shortfalls in the market may be can be extremely difficult
  - Reserves are dependent on transparent and accountable governance

- **Level of costs / losses**
  - Reserves cost money and stocks must be rotated regularly
  - The countries that most need reserves are generally those least able to afford the costs and oversight necessary for maintaining them
  - The private sector is better financed, better informed, and politically powerful, putting them in a much better position to compete

- **Uncertainties that strategic reserves can bring about in the market place**.
  - Reserves distort markets and mismanagement and corruption can exacerbate hunger rather than resolving problems

Option 2: Regulation of Future exchanges

Should we reform commodity exchanges by:

- limiting the volume of speculation relative to hedging through regulation;
- making delivery on contracts or portions of contracts compulsory; and/or
- imposing additional capital deposit requirements on futures transactions.

Answer: Requires several conditions to be effective

Problem 1: not binding regulation - we have seen triggers were not activated and also not clear incentives

Problem 2: Inter-linkages between exchanges

Option 2: Regulation of Future exchanges

Methodology: We use three MGARCH models: the interrelations between markets are captured through a conditional variance matrix *H*, whose specification may result in a tradeoff between flexibility and parsimony. We use three different specifications for robustness checks:

- Full T-BEKK models (BEKK stands for Baba, Engle, Kraft and Kroner), are flexible but require many parameters for more than four series.
- Diagonal T-BEKK models are much more parsimonious but very restrictive for the cross-dynamics.
- Constant Conditional Correlation Model (CCC) models allow, in turn, to separately specify variances and correlations but imposing a time-invariant correlation matrix across markets.

Data:

- In the case of corn, we examine market interdependence and volatility transmission between USA (CBOT), Europe/France (MATIF) and China (Dalian-DCE);
- for wheat, between USA, Europe/London (LIFFE) and China (Zhengzhou-ZCE); and for soybeans, between USA, China (DCE) and Japan (Tokyo-TGE).
- We focus on the nearby futures contract in each market and account for the potential impact of exchange rates on the futures returns and for the difference in trading hours across markets.

Source: Hernandez, Ibarra and Trupkin (2011)

Option 2: Regulation of Future exchanges

- The results show that the correlations between exchanges are positive and clearly significant for the three agricultural commodities, which implies that there is volatility transmission across markets.
- In general, we observe that the interaction between USA (CBOT) and the rest of the markets considered (Europe and Asia) is higher compared with the interaction within the latter.
- In particular, the results show that the interaction between CBOT and the European markets is the highest among the exchanges considered for corn and wheat. Similarly, the results indicate that China's wheat market is barely connected with the other markets.
- However, in the case of soybeans, China has a relatively high association with the other markets, particularly with CBOT.

Source: Hernandez, Ibarra and Trupkin (2011)

Option 3: AMIS

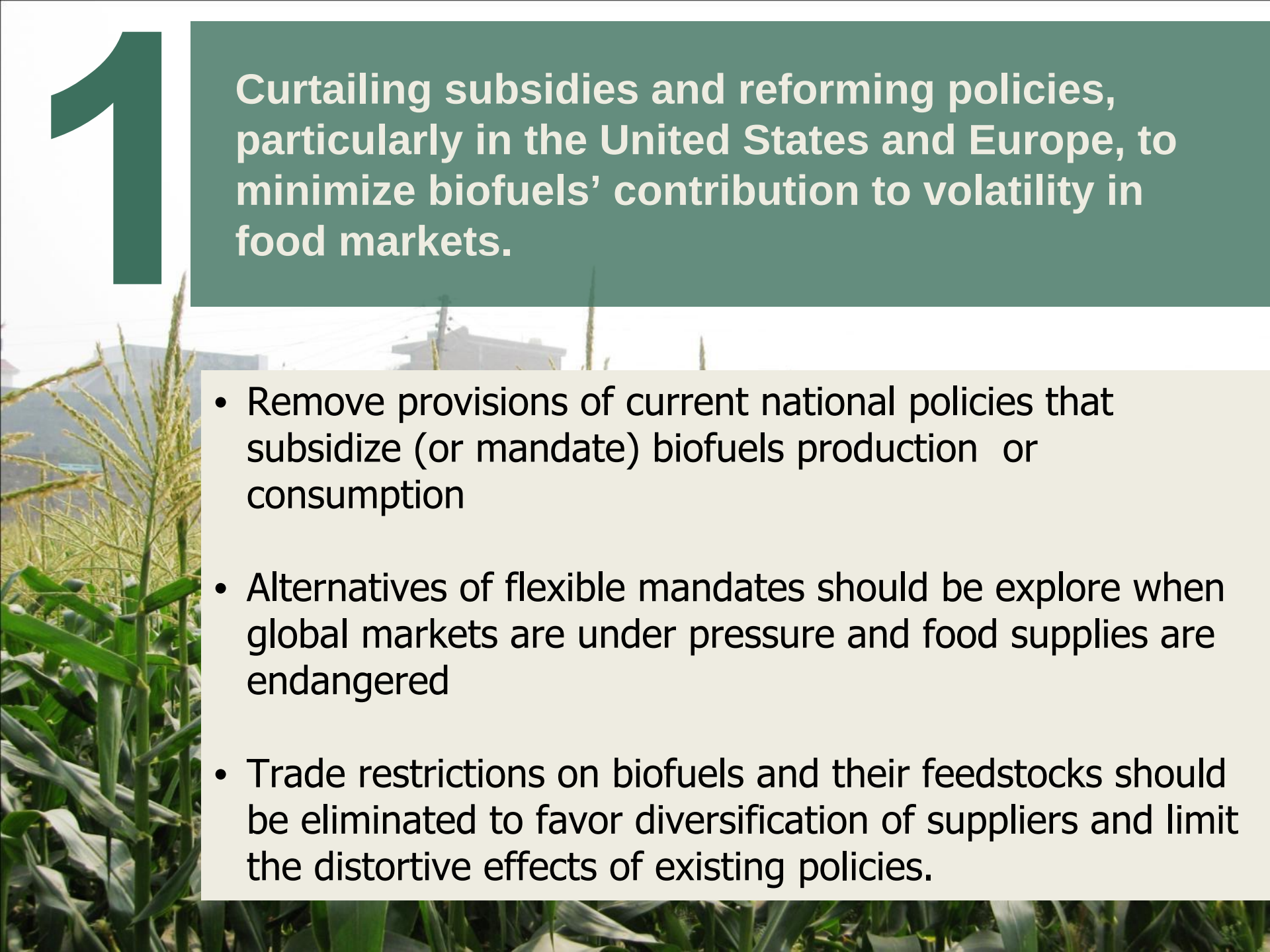
- Better information of reserves for key staples
- Early warning system of prices
- Modeling and better forecasting prices and volatility
- Understanding price transmission to consumers and producers

7 STEPS to

Prevent Recurring Food Crises

1

Curtailing subsidies and reforming policies, particularly in the United States and Europe, to minimize biofuels' contribution to volatility in food markets.



- Remove provisions of current national policies that subsidize (or mandate) biofuels production or consumption
- Alternatives of flexible mandates should be explore when global markets are under pressure and food supplies are endangered
- Trade restrictions on biofuels and their feedstocks should be eliminated to favor diversification of suppliers and limit the distortive effects of existing policies.

- Social protection programs are also desirable
- National governments should immediately expand safety net programs already in place.
- South – South learning is essential
- Combined social protection and agricultural support interventions can lead to greater impacts on food security than either intervention alone

2

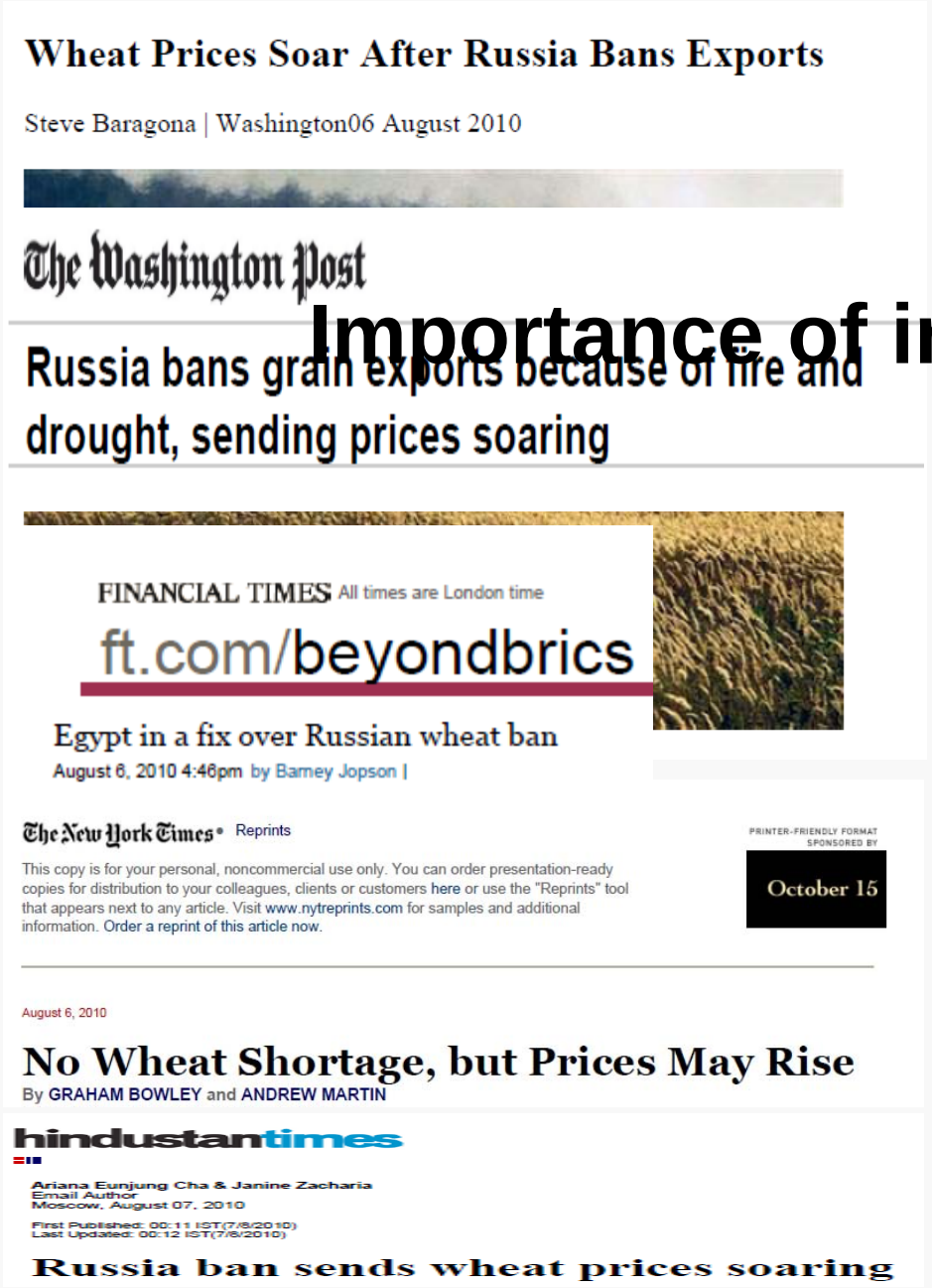
Creating or strengthening social protection for women, young children, and other especially vulnerable groups—something few countries have done during or since the 2007-08 crisis.

Improving the transparency, fairness, and openness of international trade to enhance the efficiency of global agricultural markets.

3

- National governments should eliminate existing export restrictions, such as export bans, and refrain from imposing new ones.
- Governments should also eliminate harmful import tariffs and nontariff trade barriers.
- A quick and favorable completion of the World Trade Organization (WTO) Doha Round would reduce maximum tariff levels and thereby also reduce the risk of governments implementing policies that would further destabilize world food markets.

Importance of information



Wheat Prices Soar After Russia Bans Exports

Steve Baragona | Washington06 August 2010

The Washington Post

Russia bans grain exports because of fire and drought, sending prices soaring

FINANCIAL TIMES All times are London time

ft.com/beyondbrics

Egypt in a fix over Russian wheat ban

August 6, 2010 4:46pm by Barney Jopson |

The New York Times Reprints

This copy is for your personal, noncommercial use only. You can order presentation-ready copies for distribution to your colleagues, clients or customers here or use the "Reprints" tool that appears next to any article. Visit www.nytreprints.com for samples and additional information. Order a reprint of this article now.

PRINTER-FRIENDLY FORMAT SPONSORED BY

October 15

August 6, 2010

No Wheat Shortage, but Prices May Rise

By GRAHAM BOWLEY and ANDREW MARTIN

hindustantimes

Ariana Eunjung Cha & Janine Zacharia
Email Author
Moscow, August 07, 2010

First Published: 00:11 IST(7/8/2010)
Last Updated: 00:12 IST(7/8/2010)

Russia ban sends wheat prices soaring

New York Times
"No Wheat Shortage, but Prices May Rise"

Financial Times
Russia grain export ban sparks price fears
Published: August 5 2010 10:50

Voice of America
"Wheat Prices Soar after Russia Bans Exports"

WSJ
Wheat Prices Hit 2-Year Highs Following Russian Ban
Aug 5, 2010

Economic Times (India)
"Russian Crisis Won't Impact Global Wheat Supplies, Prices"

The Diane Rehm Show (USA)
"World Wheat Supplies"

Radio France Internationale, English to Africa service
"Russia Wheat Ban Raises Food Security Fears"

Radio France Internationale, Latin America Service

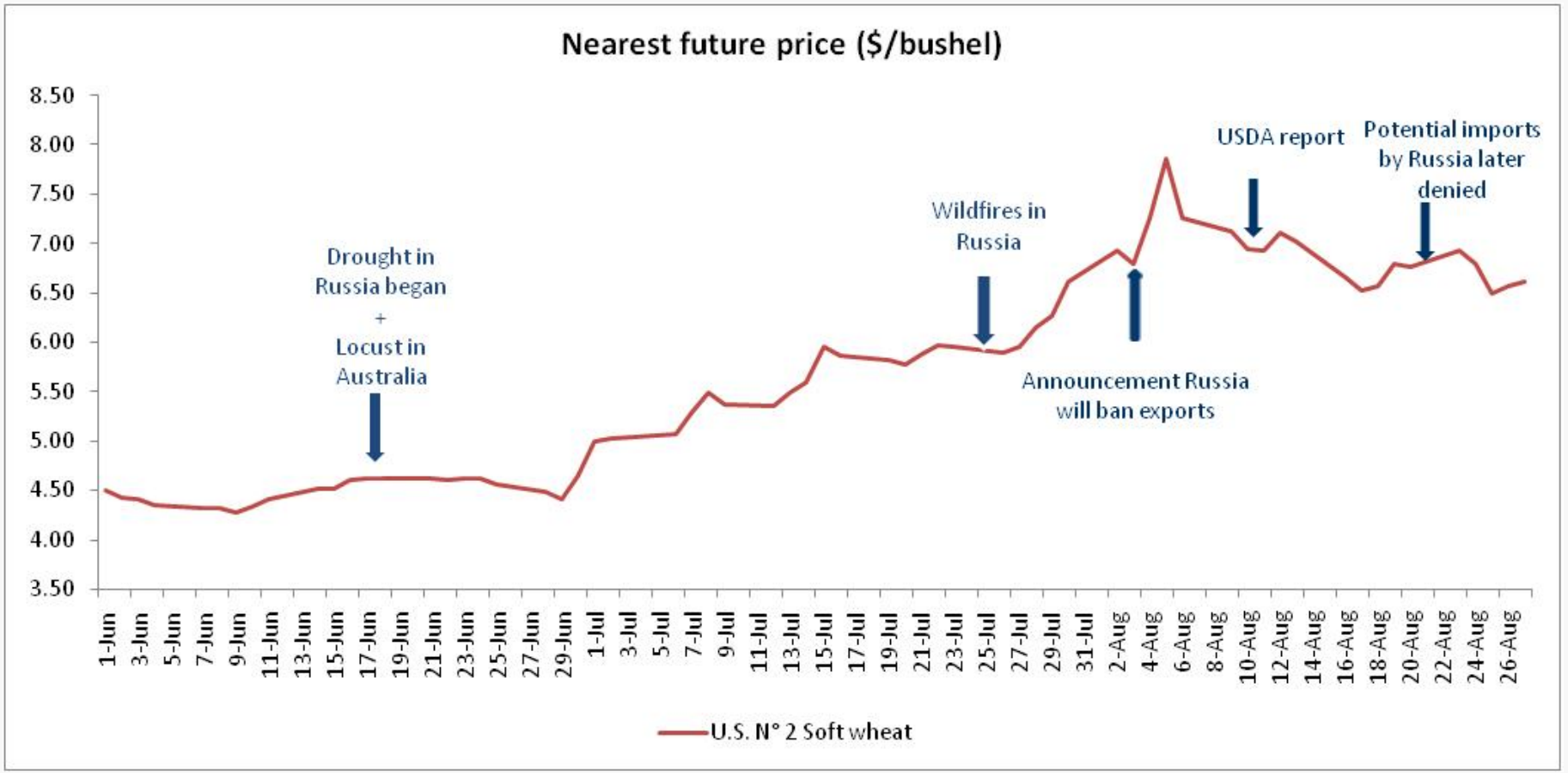
Asia Sentinel
"Is Another Food Crisis Coming?"

BBC World News America
"From Farmers to Bakers: What the Wheat Shortfall Means"

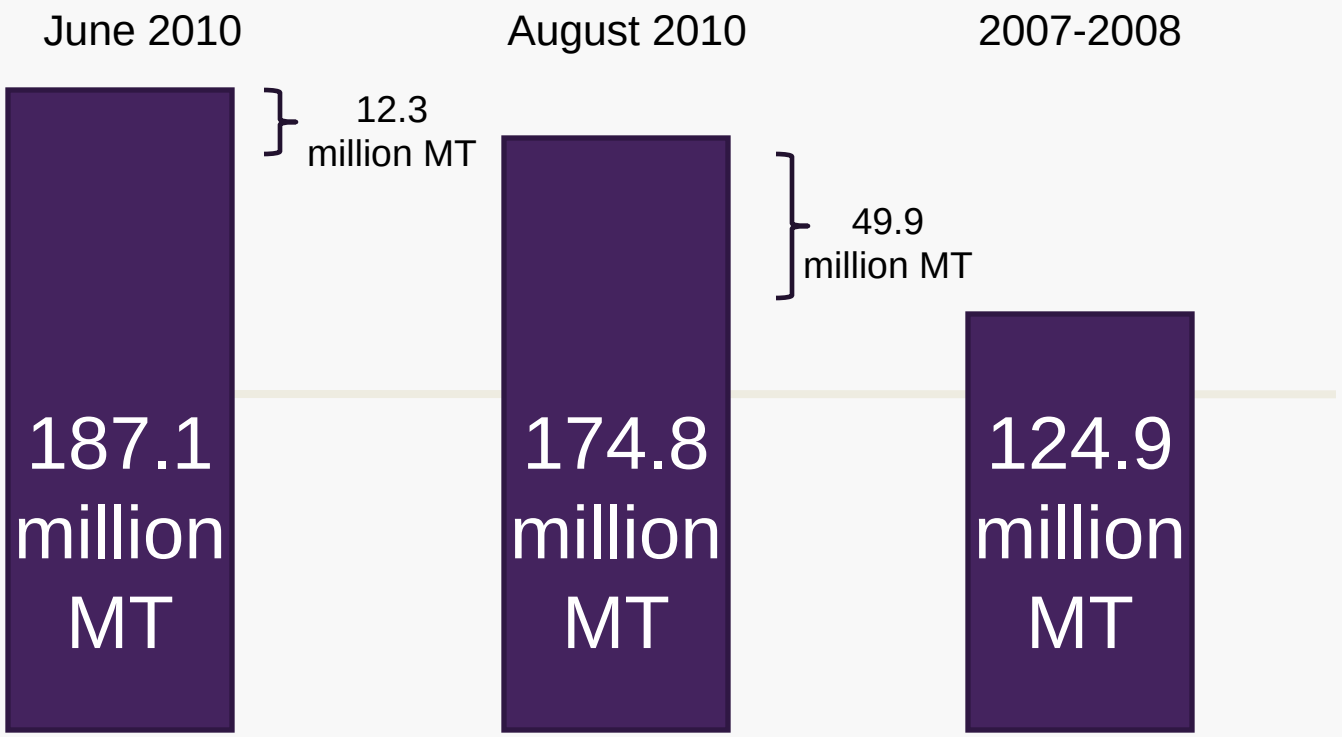
Financial Times
Prospect of Russian grain imports lifts wheat
Published: August 19 20

Bloomberg
Wheat Prices Jump Most in Week as Argentina, Russia Crops Hurt by Drought

CBOT wheat prices

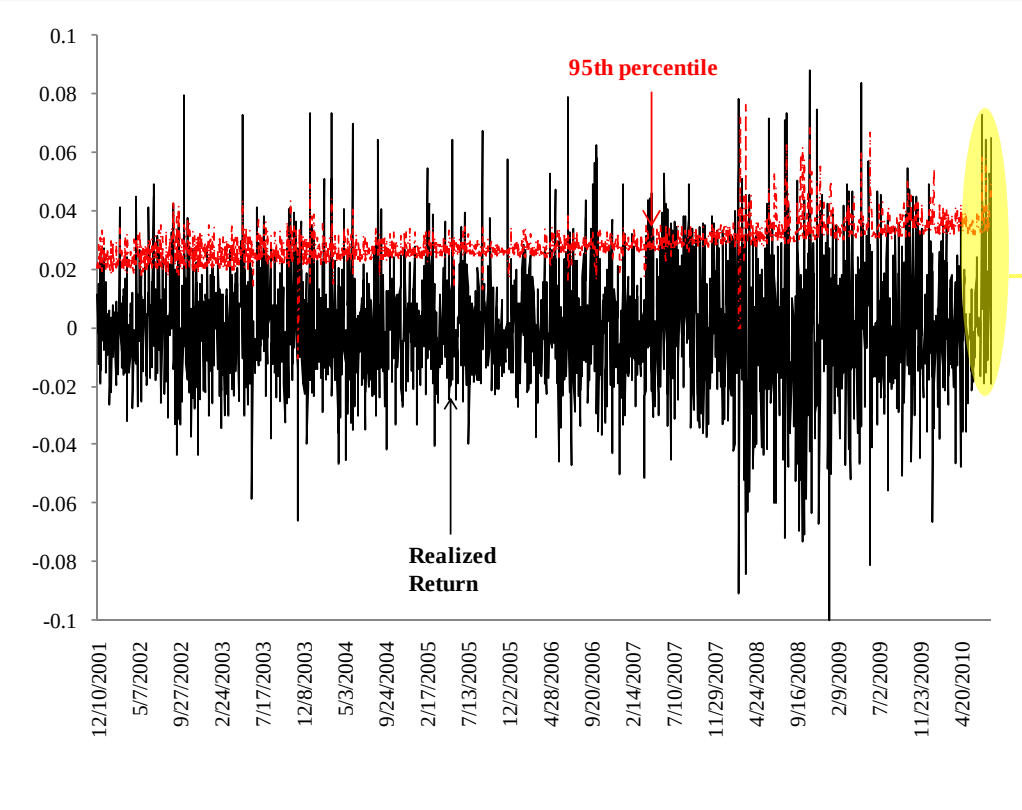


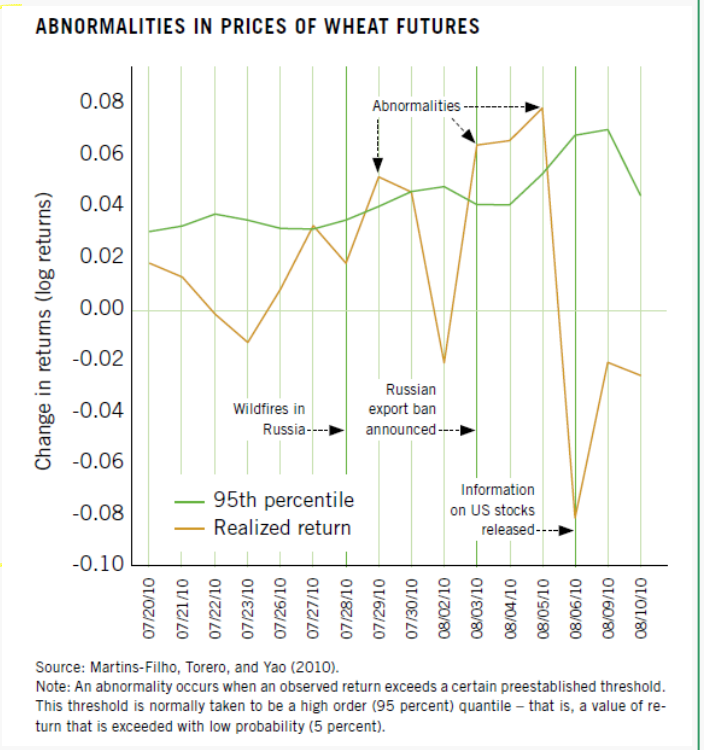
Global stocks of wheat



Source: World Agricultural Outlook Board (August 12, 2010).

CBOT wheat prices – IFPRI model to detect abnormal spikes





Source, Martins-Filho, Torero, Yao (2010)

4 Setting up a global emergency grain reserve to handle food price crises.

- This "emergency reserve”:
  - Is not a buffer stock,
  - It is not to stabilize prices
  - It is directly linked to **access of food** in extreme price abnormalities where markets don't work properly in the short term and countries in emergency situation can't have access to commodities.
- The concept requires:
  - A clear trigger mechanism
  - Cost effectiveness (supply should be re-paid at market price)
  - Targeting by linking to safety net programs

- Improve enabling environment for farmers and other private sector actors
- Improve food an agriculture innovation systems
- Strengthen the CGIAR system
- Input markets (fertilizer and extreme climate resistant seeds)
- Bottlenecks in the value chain that could reduce time for response from producers
- Reducing waste and increasing nutritious content across the value chain
- Moving from emergency response to social protection and insurance

5

Pursuing policies and investments to promote agricultural growth, in particular smallholder productivity, in the face of climate change.

Investment by national governments in climate change adaptation and mitigation using the full potential that agriculture offers.

6

7 Establishing an international working group to monitor the world food situation and trigger action to prevent excessive price volatility.

- **A web-based information and knowledge clearinghouse**
  - A model to **forecast extreme value of price spikes**
  - Understanding **price transmission** and a **policy tool for measuring price transmission** from global to local prices
  - Understanding the effects of price changes

- **Policy Analysis-support tools**
  - Built capacities at the country level
  - Tracking food policies

- **Identifying best and bad practices for food security**

7 STEPS to Prevent Recurring Food Crises

1. Effective policies and technology investments to minimize food–fuel competition.
2. Social protection, especially social safety nets, for the most vulnerable groups.
3. Transparent, fair, and open global trade.
4. A global emergency physical grain reserve.
5. Policies and investments to promote agricultural growth, in particular smallholder productivity, in the face of climate change.
6. Investments by national governments in climate change adaptation and mitigation using the full potential that agriculture offers.
7. An international working group to regularly monitor the world food situation and trigger action to prevent excessive price volatility.

www.foodsecurityportal.org

Thank you