Biofuel and the new economics of agriculture

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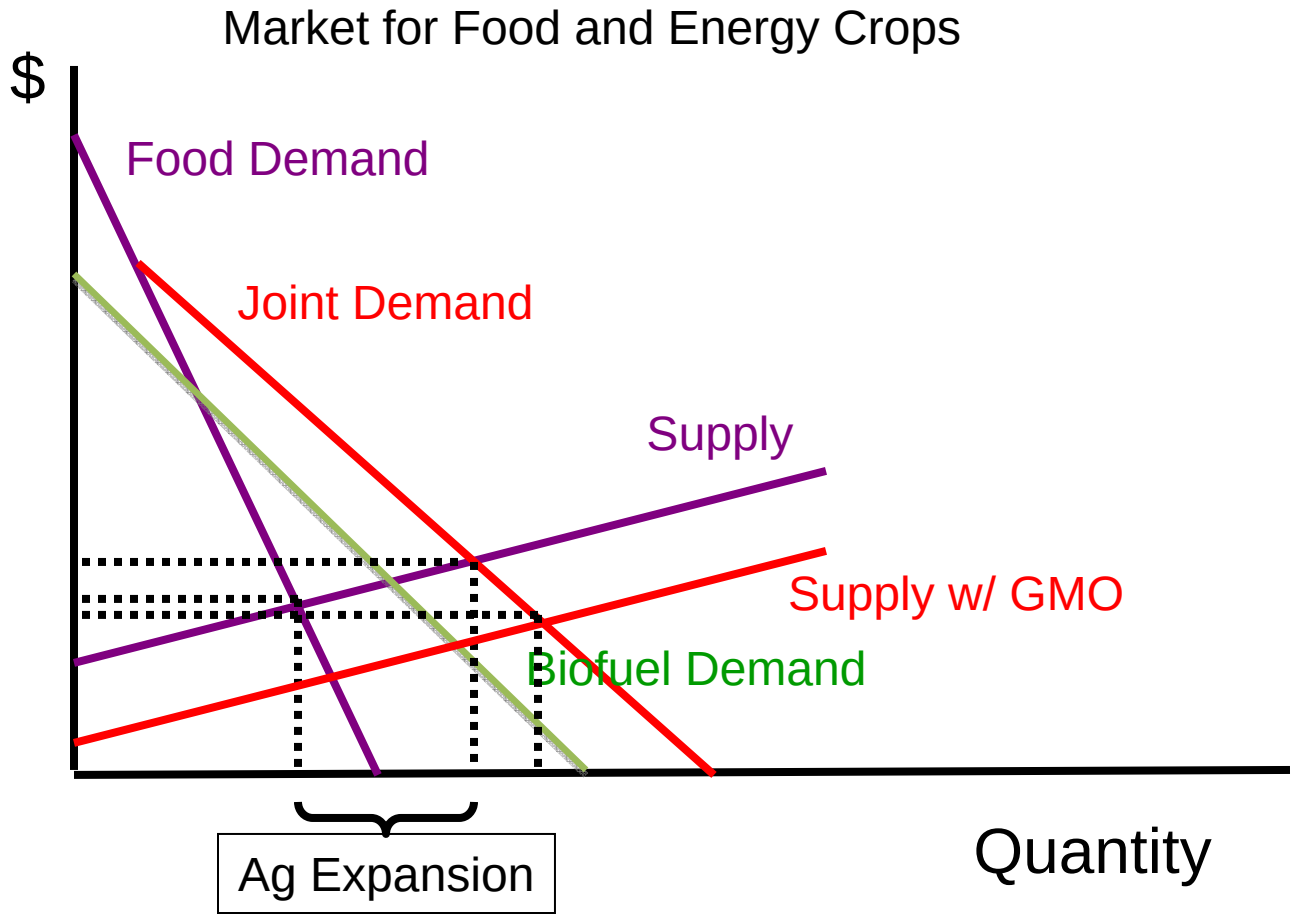
Why Biofuel ?

- Increase in demand for fuel
  - 18 cars/1000 people in China vs. 800 in US
  - Tata's Nano car
- Constrained supply of oil
  - Tar sands, CTLs have their own problem
- Concern about climate change
- Limited capacity to induce conservation (minimal support for carbon tax, CAFÉ and LCFS have limited capacity for change)
- Biofuel are not new- take advantage of human skill -farming

Biofuel And the Food Market-short term analysis



The Basic Economics of Biofuel

- Introduction of Biofuels:
  - Increased food prices; and
  - Reduces food availability
- The effects can be countered by:
  - Increased agricultural and conversion productivity
  - Second generation biofuels
  - Ag Biotech

Biofuel impacts depend on responsiveness of quantities to prices

- The less responsive fuel quantities are to fuel price changes higher will be the impact of ethanol on gasoline price
- The more responsive food quantities are to food price changes lesser will be the impact of ethanol on food price
- Therefore we estimate the impact on prices under three different scenarios of responsiveness of supply and demand

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Simulating the impacts

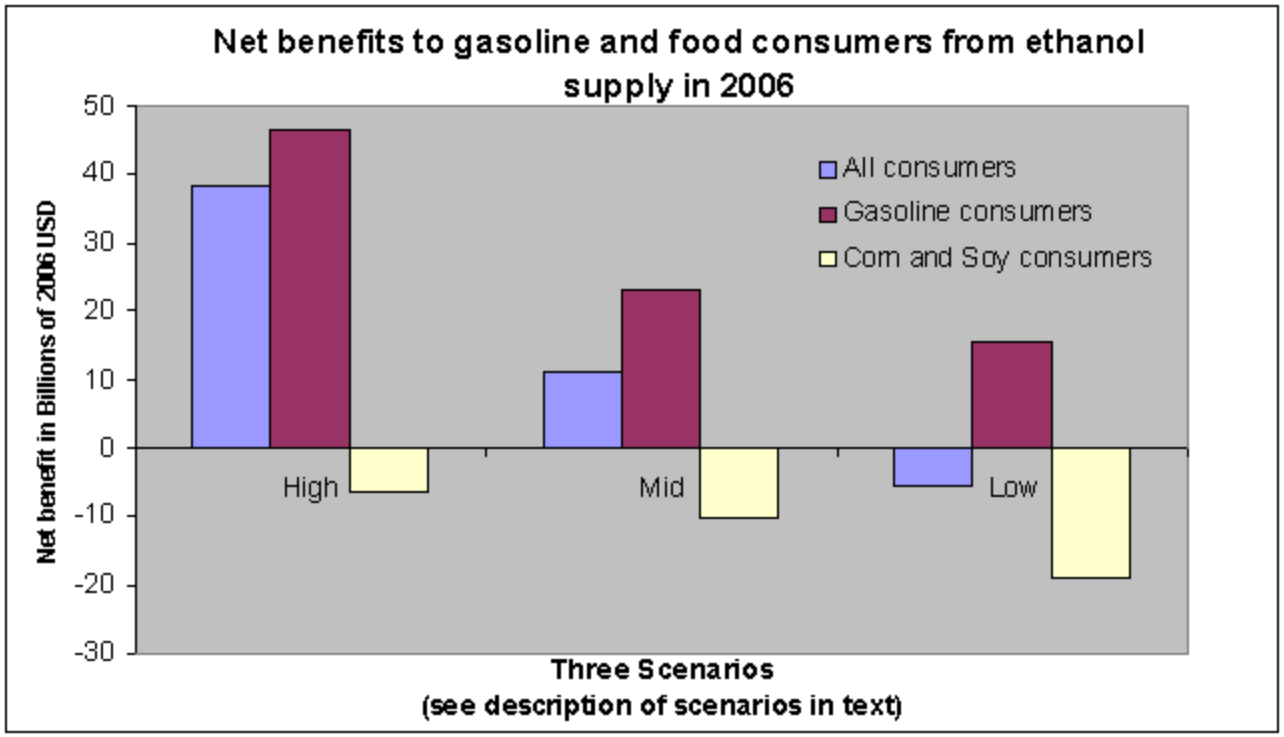
- Three Scenarios:
  - High – elastic food S (0.75) and D (-0.75), inelastic gasoline S (0.25) and D (-0.25)
  - Low – inelastic food S (0.3) and D (-0.3), elastic gasoline S (0.75) and D (0.75)
  - Mid – S (0.5) and D (-0.5)

Simulating the impacts

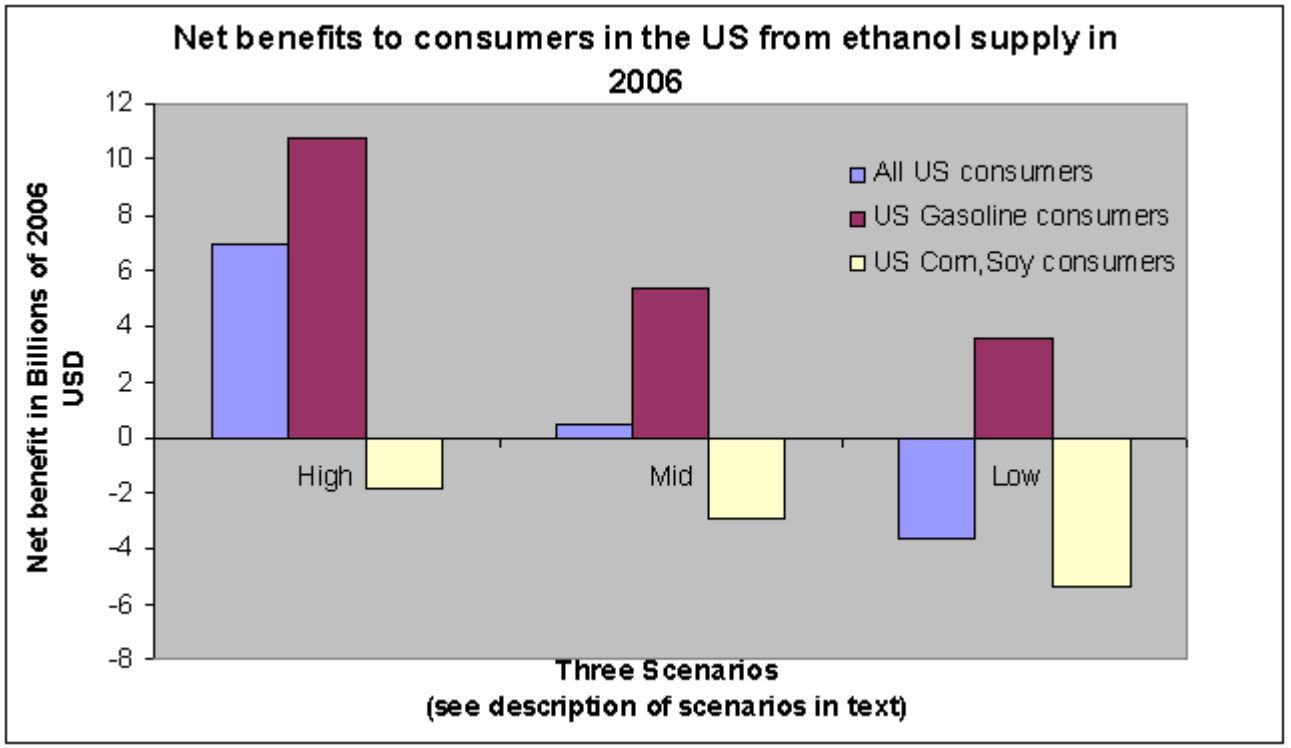
- The estimated impact of 5 billion gallons of ethanol on gasoline and crop prices under the three scenarios:

	High	Mid	Low
Change in gas price	-3%	-2%	-1%
Change in corn price	5%	7%	13%
Change in soy price	2%	3%	7%

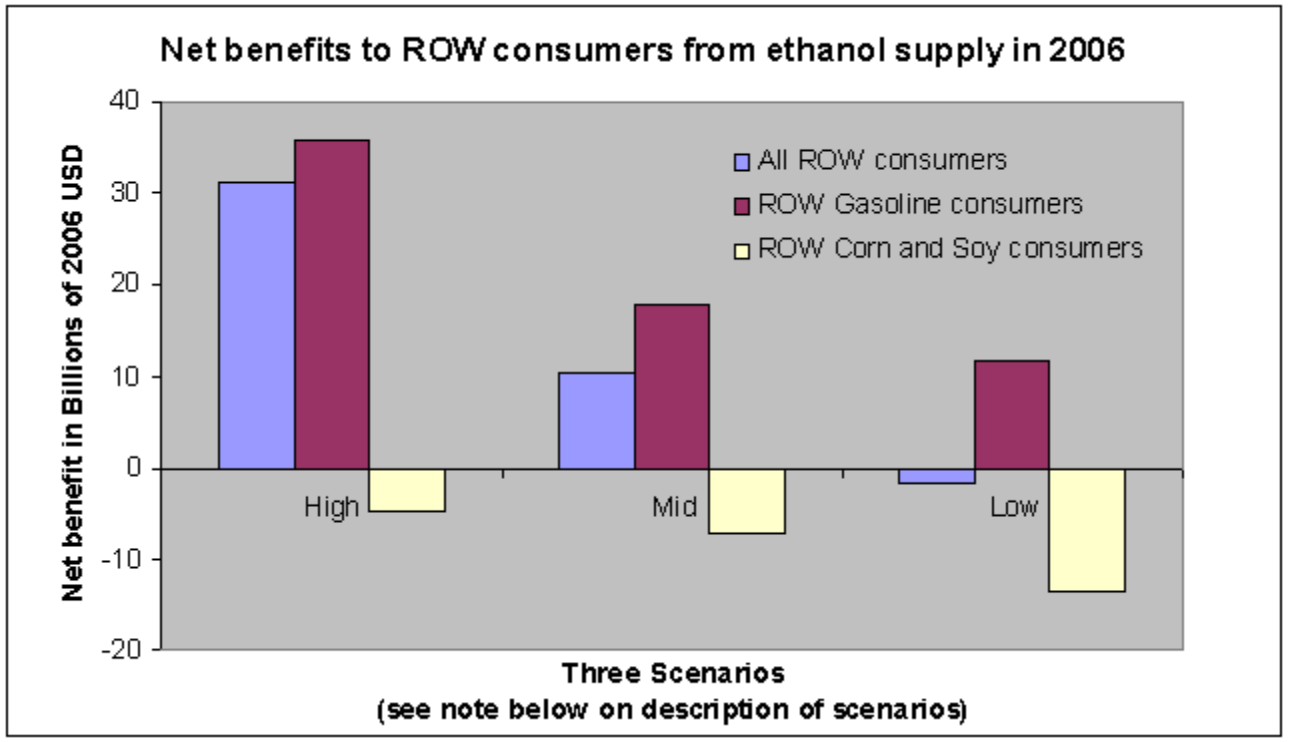
Net Benefits of 2006 Biofuel Supply



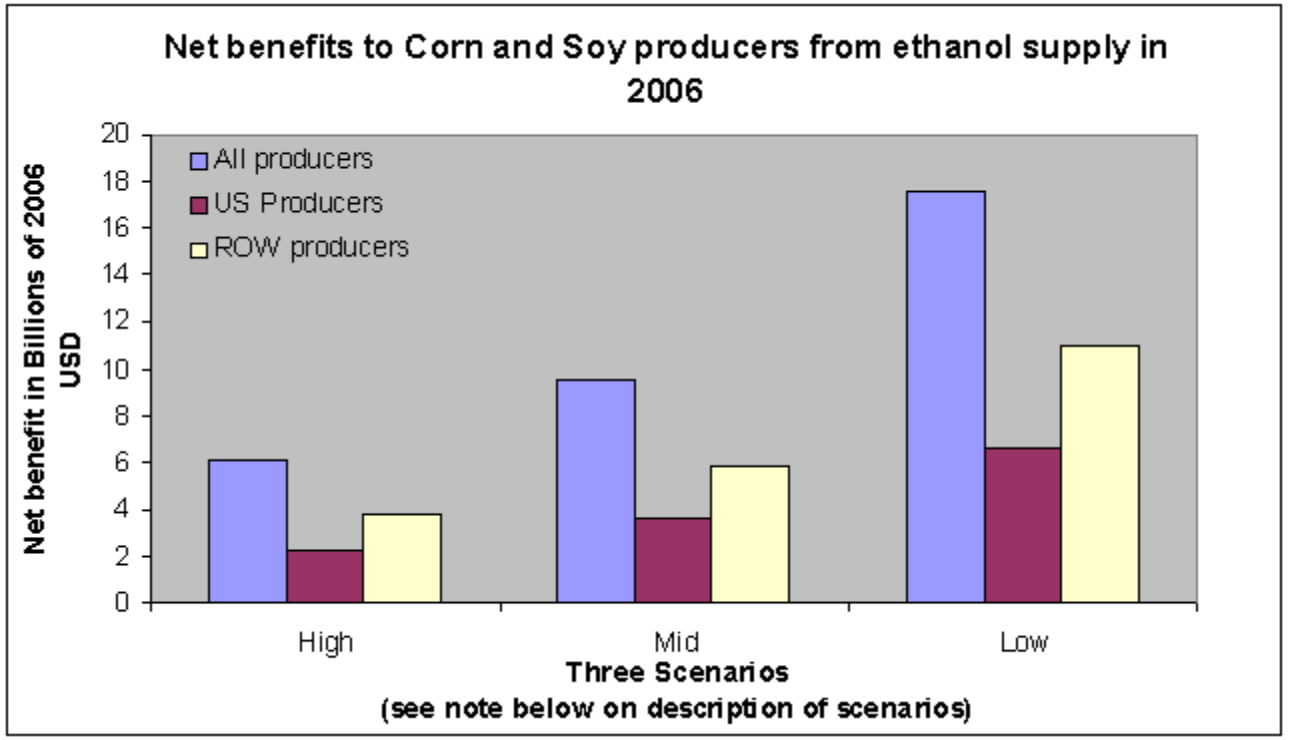
Net Benefits to US Consumers



Net Benefits to ROW Consumers



Net Benefits to Soy and Corn Producers



Impact of biofuel based on 2007-back of envelope calculations

- About 12% of the corn output was in biofuesl
- A first approximation of price effect depend on sum of price elasticities
- If it is .3 Biofuel is responsible to 40% increase in food prices
- If is .75 biofuel is responsible to16% price increase.
- But during the last few years corn storage declined

Biofuel and food-impacts of Inventory and mandates

- Price of food and fuel is affected by inventory consideration
- Future expectation will lead to demand for storage or supply from storage
- Policies like subsidies and mandate will also affect demand and supply for biofuel
- Consider the case where biofuel use is determine by a mandate- it is associated with a wide range of prices- not to high energy price
- Consider impact of inventory

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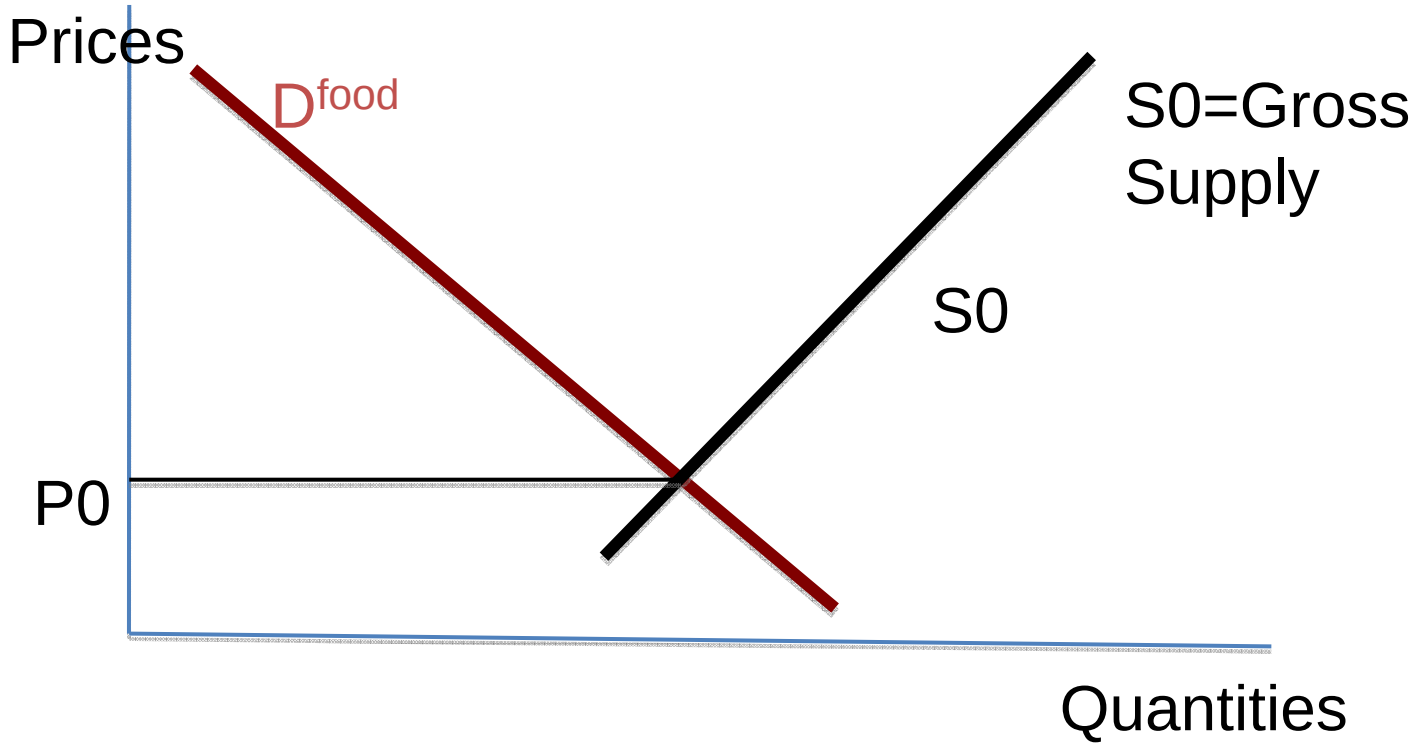
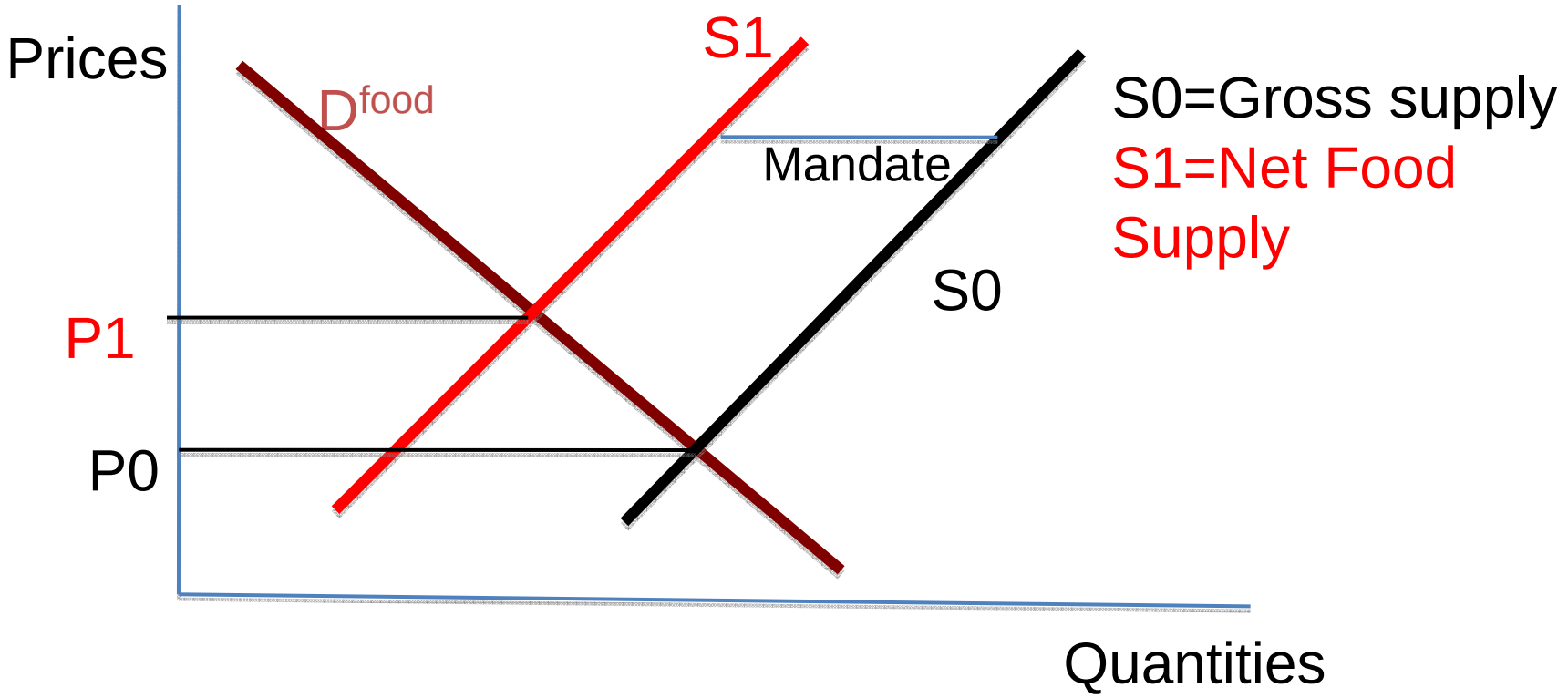
Food market-impacts of Inventory and mandates

- If inventories are low
- There are expectation to increase demand for Food
- Groing biofuel mandate over time
- Small growth in productivity and supply
- Storage will reduce supply
- Prices will go up food consumption down

Food market: no mandates

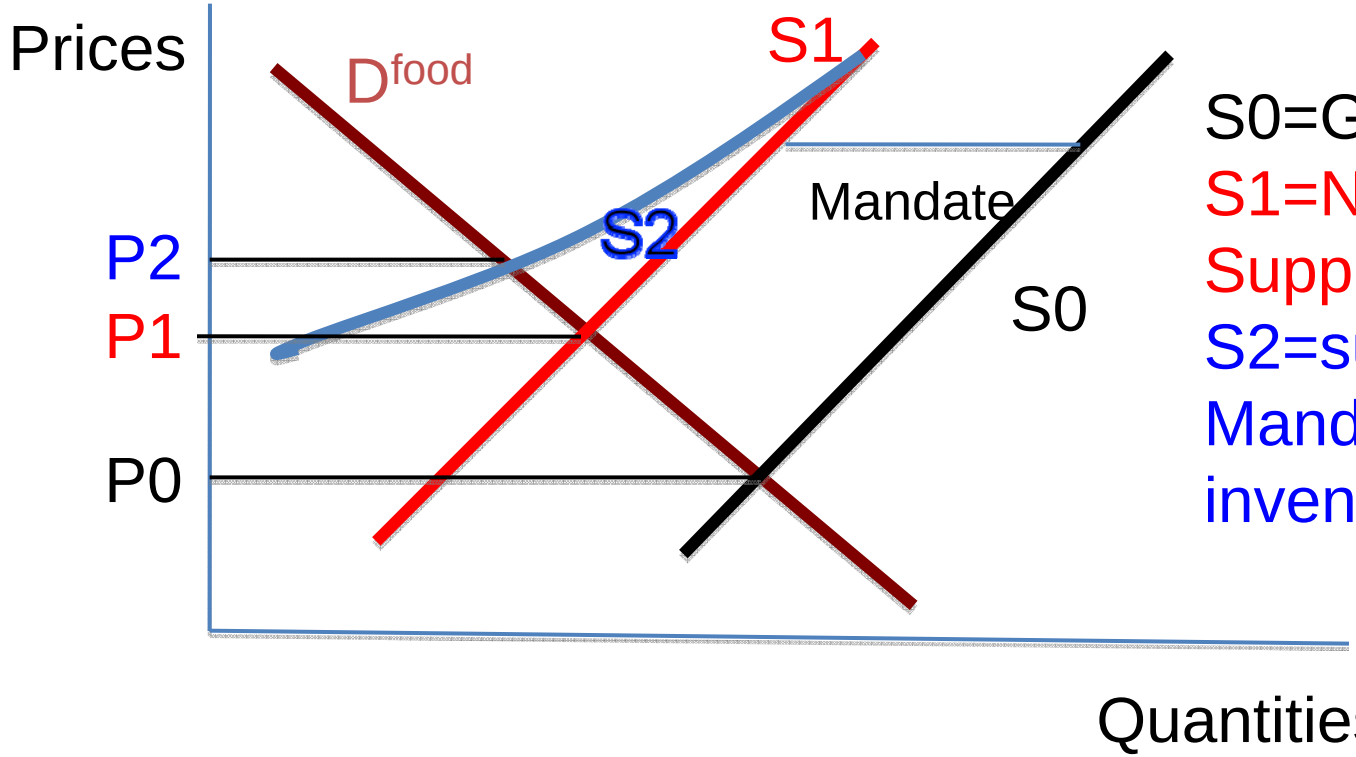


Food market: impact of mandates



Mandates increase prices reduce food Consumption

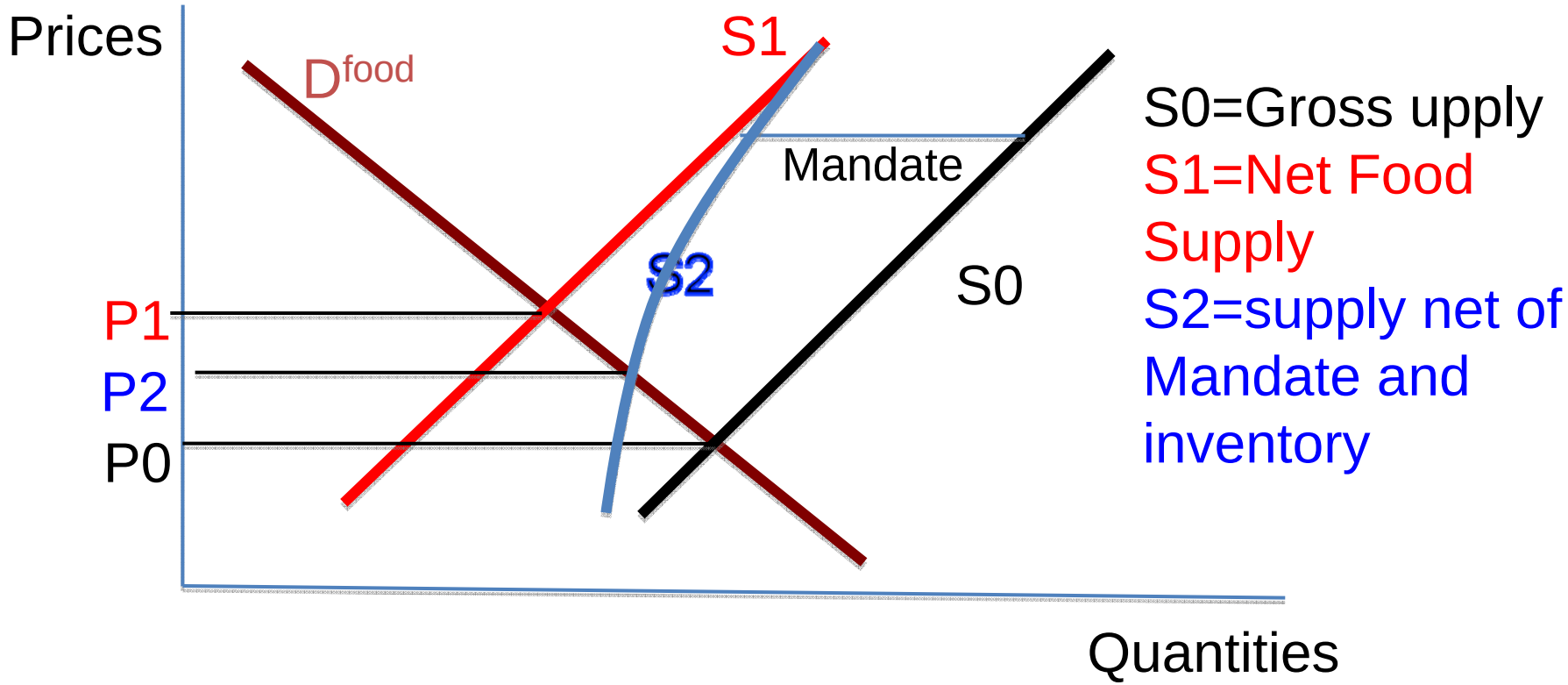
Food market: impact of mandates, low inventory, and increasing future excess demand



S0=Gross upply
S1=Net Food Supply
S2=supply net of Mandate and inventory

Future worries increases current prices and reduce consumption

Food market: impact of mandates, high inventory, and future with excess supply



Future hopes reduce current prices
And increase consumption

Productivity, inventories technologies, and prices

- Increased productivity reduces prices as long as it is above demand
- Forces that lead to increased demand for fuel will lead to increased food demand
- Declining inventories – indicators of deteriorating food situations
- Low inventories and expectations of high biofuel mandates contribute to the high prices
- Expectation for innovation and technological change tends to reduce price pressure

Yearly change in consumption of coarse grains from 04/05 to 07/08

	2004/2005	2005/2006	2006/2007	2007/2008
US	6.3%	2.0%	-0.9%	15.5%
China	1.8%	4.5%	3.2%	3.5%
India	-6.8%	1.8%	-5.2%	8.9%
EU-27	5.1%	-3.3%	-0.7%	4.1%
Brazil	6.8%	1.6%	2.9%	4.4%
Russia	-11.6%	-5.8%	3.2%	1.6%
Canada	-1.5%	-0.3%	6.7%	0.8%
Argentina	22.3%	3.5%	6.9%	2.5%
World	**3.7%**	**1.1%**	**1.7%**	**5.5%**

Biofuel contributed to increased US Coarse grain demand

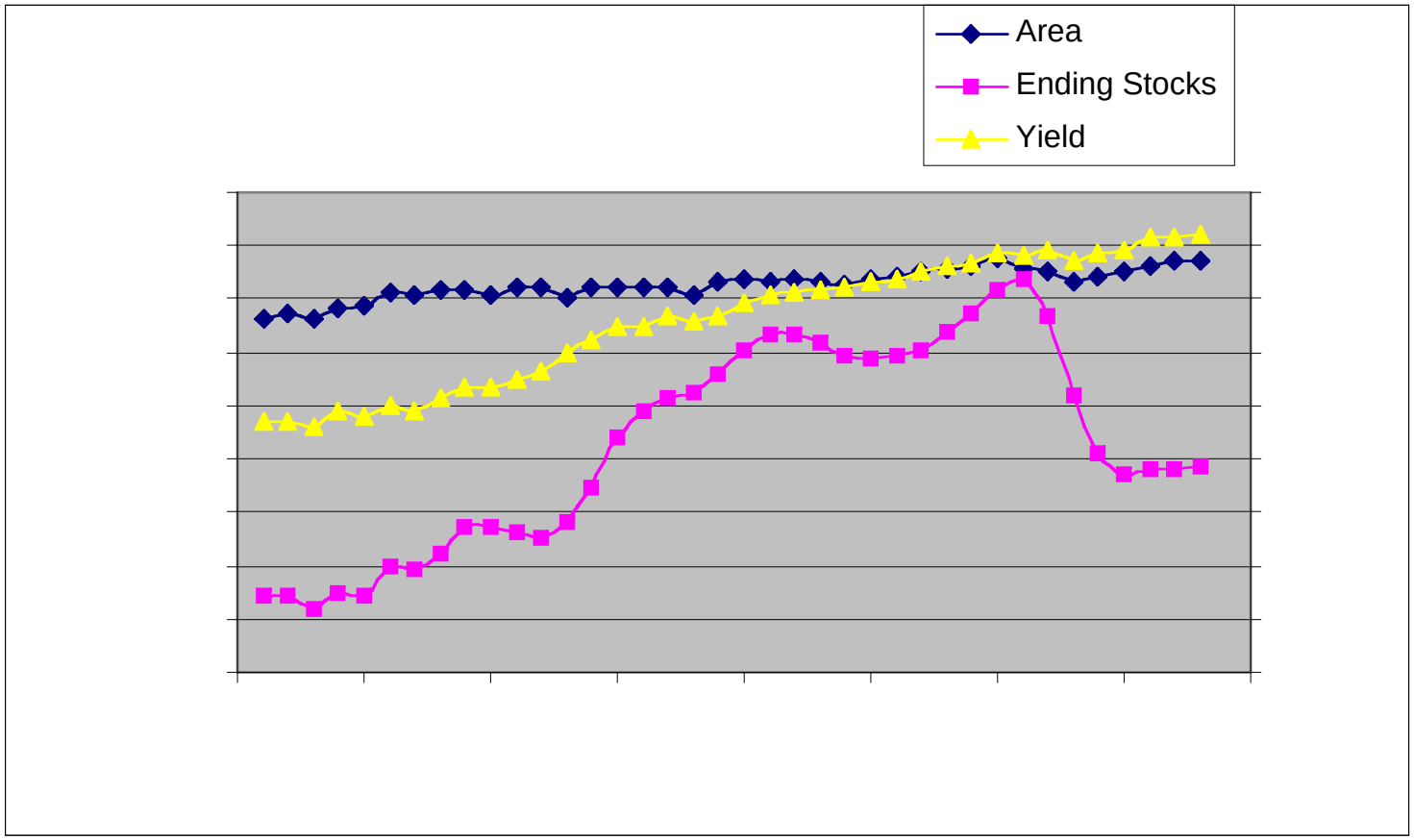
Yearly change in consumption of Wheat from 04/05 to 07/08

	2004/2005	2005/2006	2006/2007	2007/2008
US	-2%	-1%	-1%	0%
China	-2%	-1%	0%	0%
India	7%	-4%	5%	3%
EU-27	7%	3%	-2%	-4%
Brazil	4%	6%	-3%	0%
Russia	5%	3%	-5%	5%
Canada	15%	1%	5%	4%
World	**4%**	**2%**	**0%**	**0%**

Short term vs long term price effects of biofuels

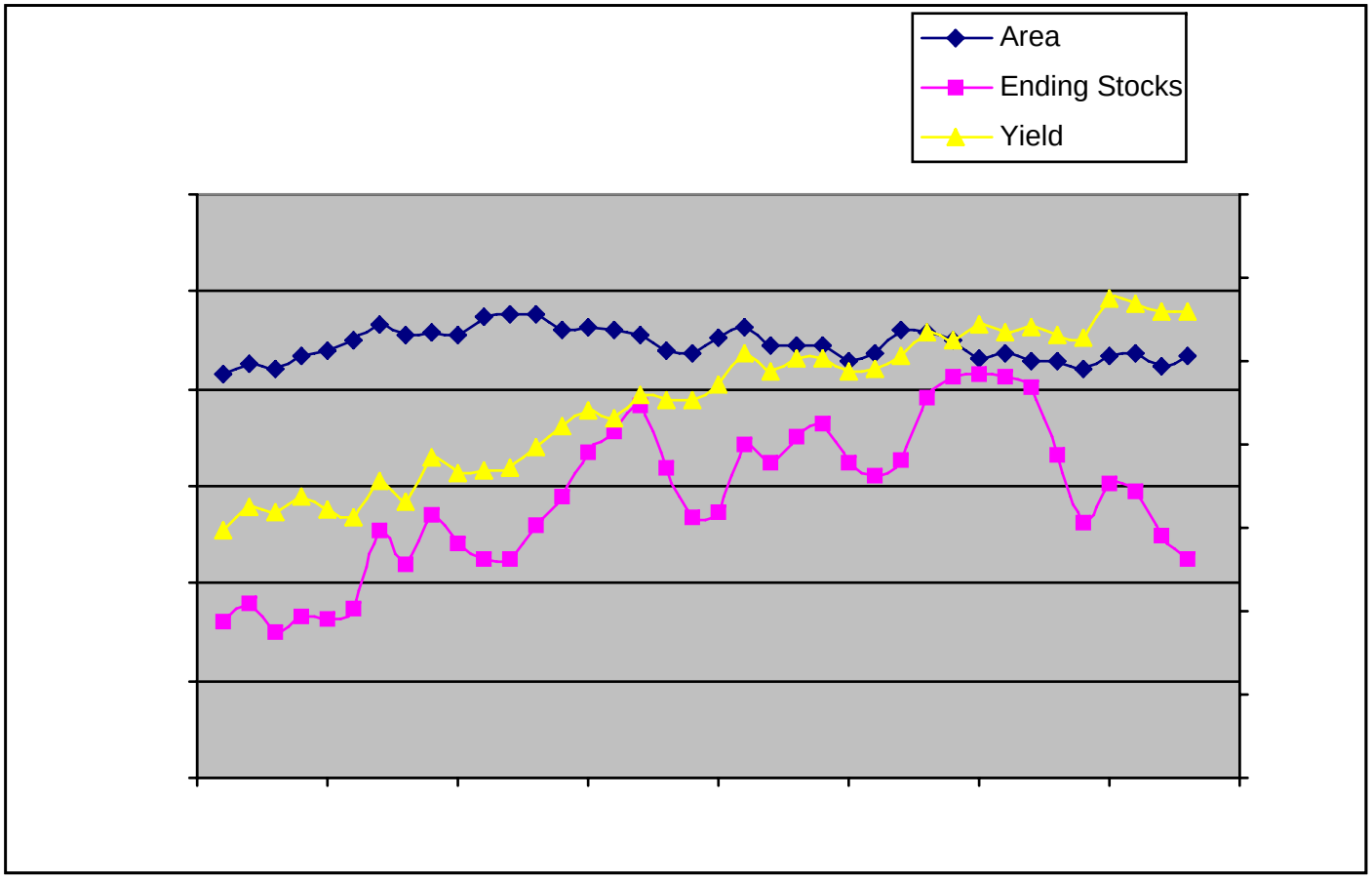
- The impacts of biofuel on food prices has been accumulating
- The 16-40 % increases we attribute to biofuel based on short tem elasticities are lower bounds
- Continuing shortages, negative supply shocks (Australia) and expectation for higher price may push for 50-70% price effects as suggested by the world bank
- But small changes in supply relieving the pressure could have done wonders

Rice yields increase in 70s because of Green Revolution; they have stagnated in recent years

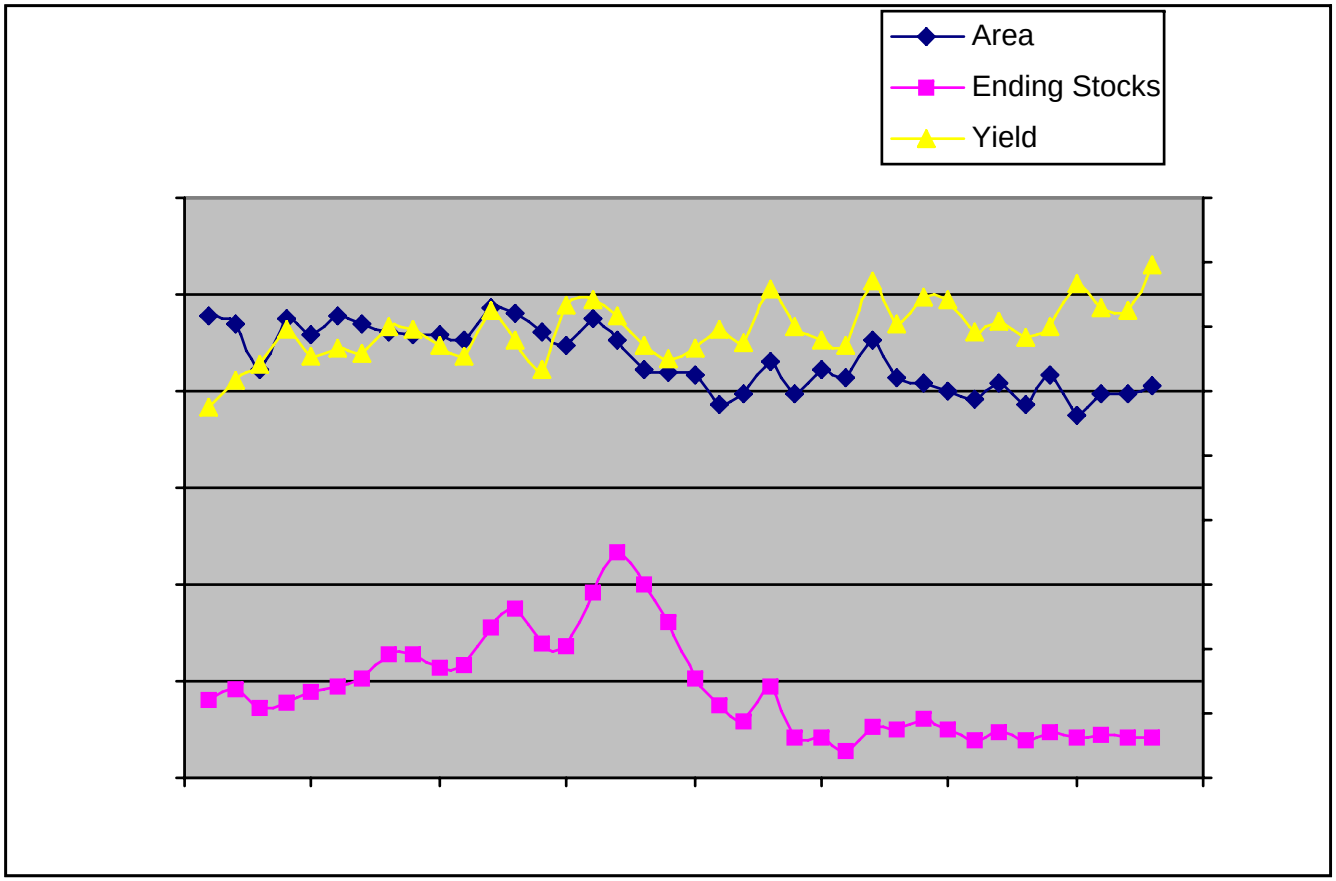


Look at inventories-they declined leading to price pressure

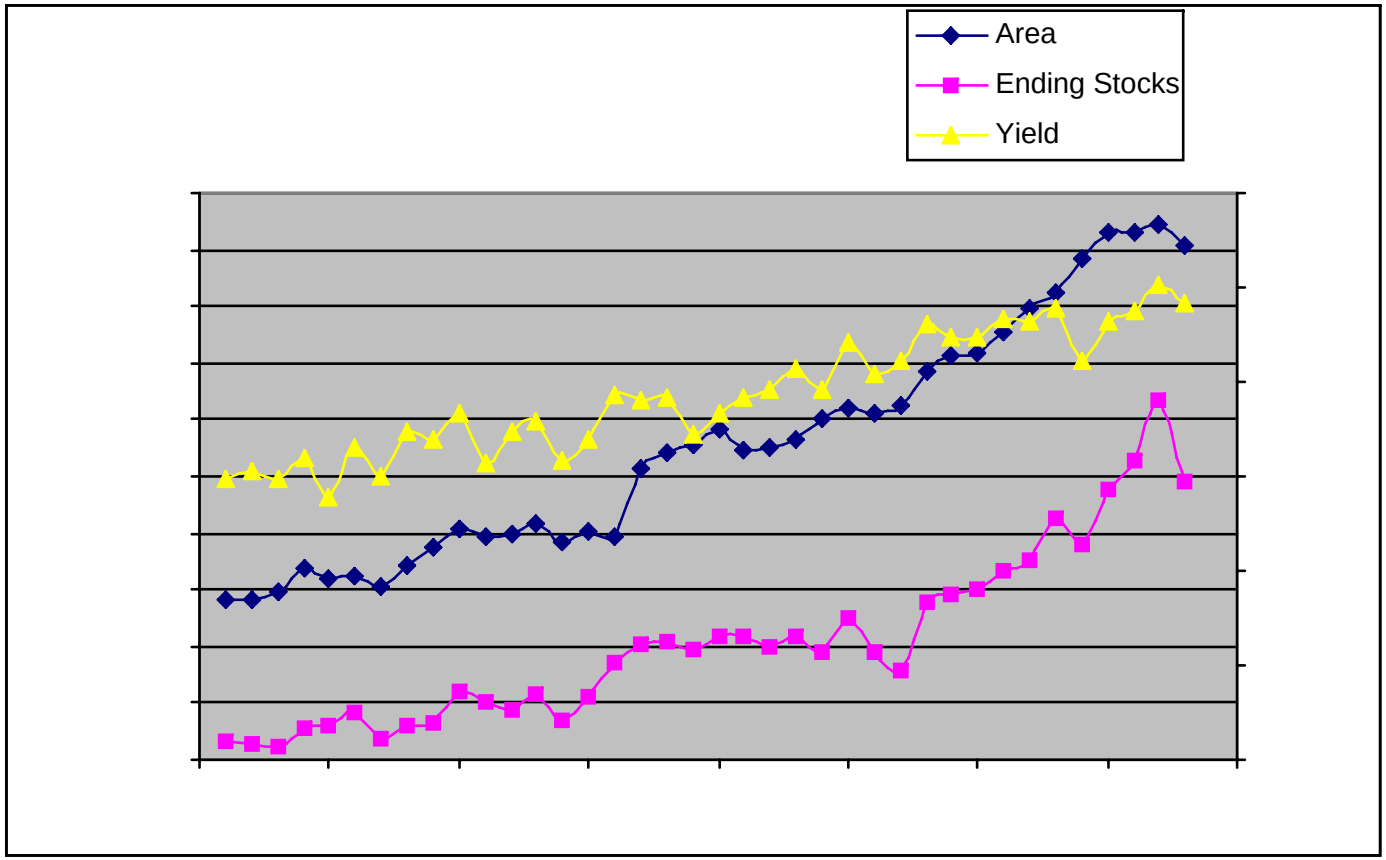
Wheat also benefited from Green Revolution and has seen little productivity growth of late.



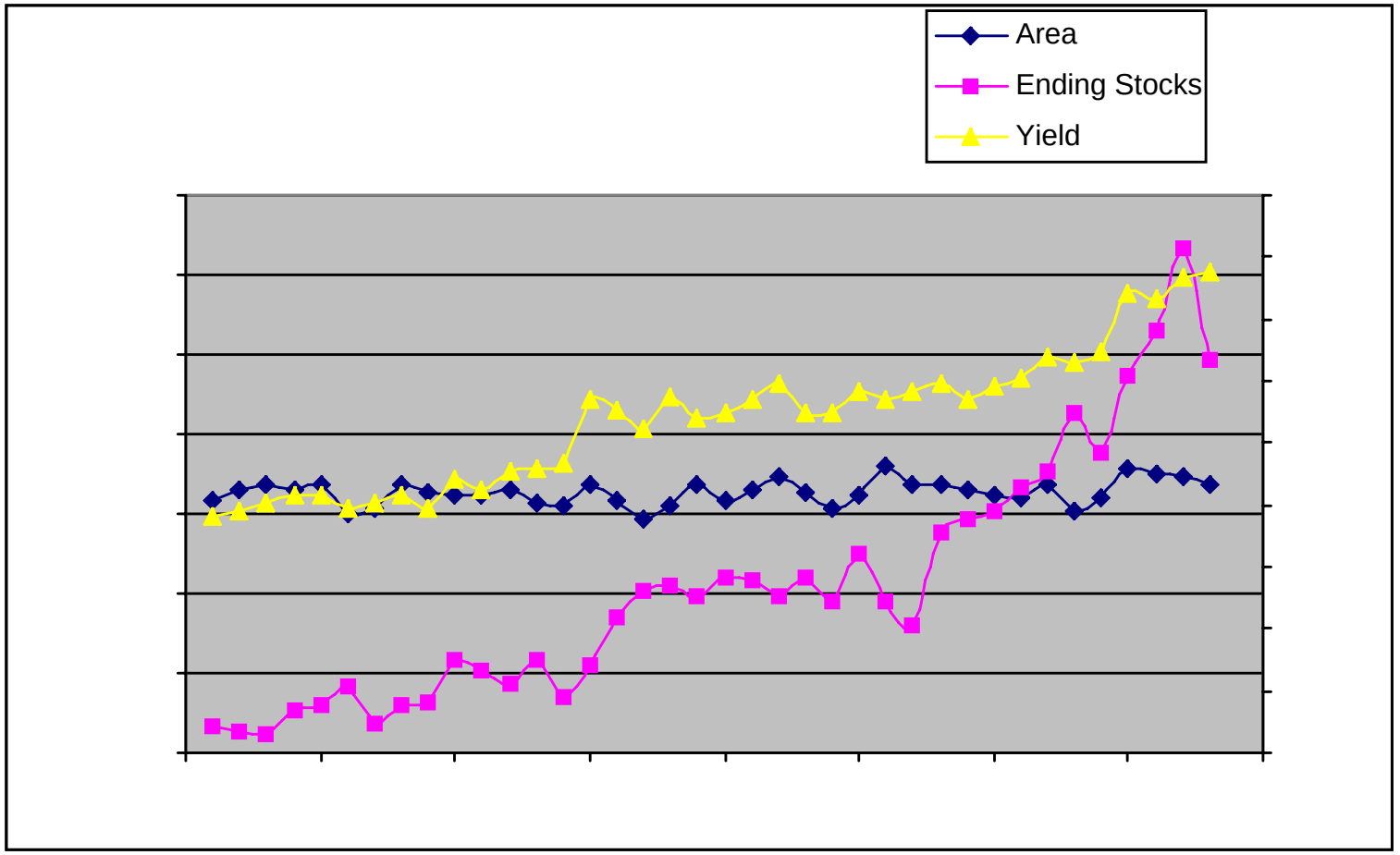
Sorghum is the food of the poor. It has experienced little increase in yields and a decline in inventories



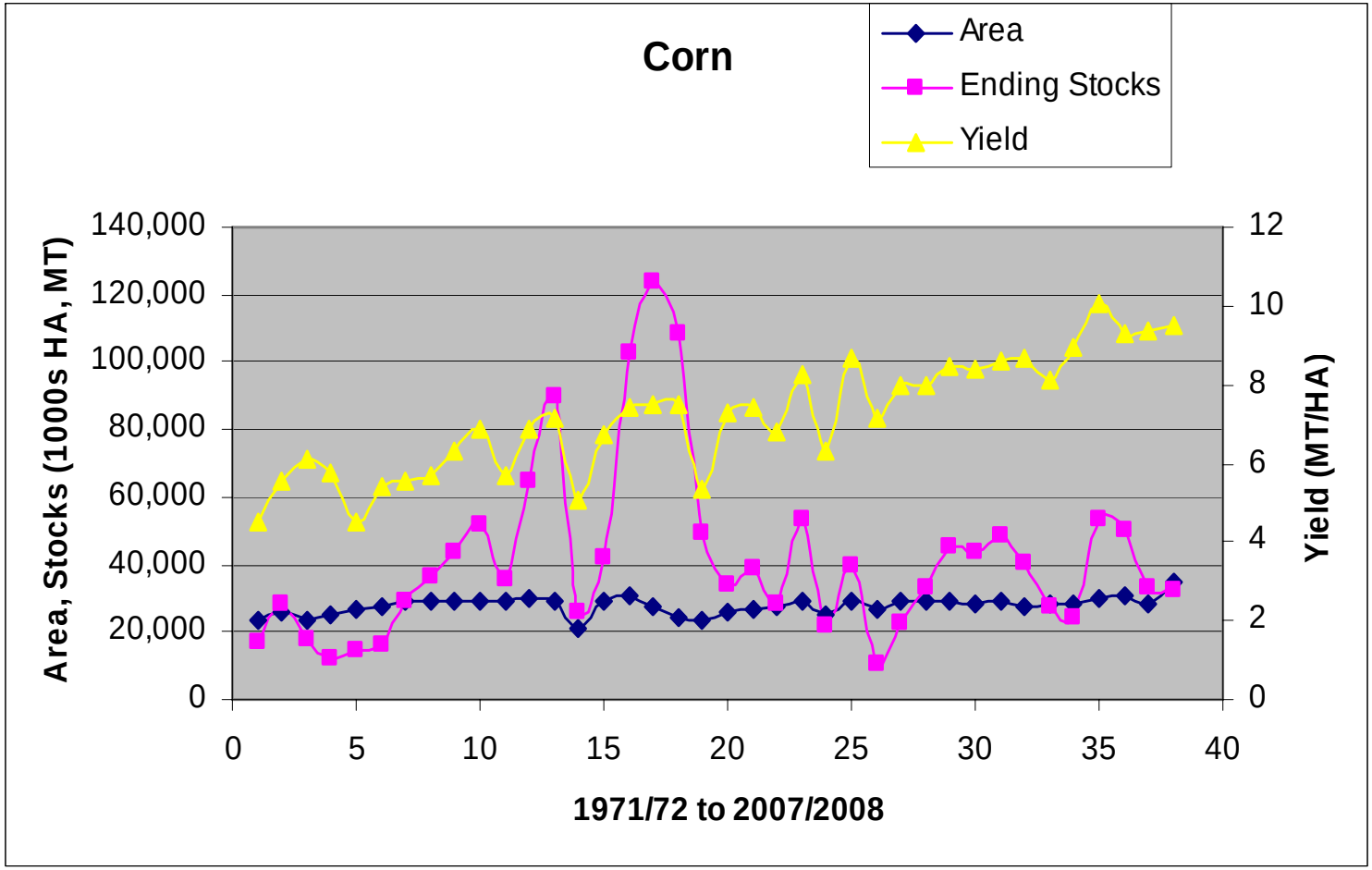
Soybean has benefited from GMO



Cotton sees sharp increase in productivity growth around 2000 due to GMO



Corn US:yield increased recently. GMO?



Cheap and clean oil and food Require more R&D Ag investment

- Ag research has been deemphasized in recent year
- Biotech -over-regulated and underdeveloped
- Cotton and corn yields have yield much more relative to rice and
- Food productivity- except of some biofuel crop stagnating
- Much More food and fuel from the land will not be feasible without massive land expansion and increased productivity

Biofuel and Climate Change

- Biofuel is not fully renewable because energy is needed to produce inputs and refine fuels
- Some biofuel emits 18% less GHG than others.. Sugarcane ethanol emits 60% less than oil much less than corn .
- But impact of Biofuels on primate change is difficult to figure out leading to methodological studies with policy implication
- Key tool life cycle analysis
-

The current high food prices will lead to supply expansion

- Eastern Europe where yields are half than the west
- Africa and Latin America has regions of unutilized ag production potential
- May lead to introduction of second generation biotechnology and enhanced development of second generation biofuel

First and Second Generation biofuels

- If processors have to meet higher environmental standards it will reduce the amount paid for biofuel.
- Payment for environmental contributions at the farm level (carbon sequestration, residue reduction) is likely to affect crop and technology choices—and the geographic distribution of biofuel crops
- But whatever we do, productivity matters.
  - Except of sugar cane, sweet sorghum, and some oil crops, the first generation of biofuels have limited capacity to address climate change concerns. We need to be able to process celluloids.

Productivity Matters

CROP	Harvest-able Biomass (tons/ acre)	Ethanol (gal/acre)	Million acres needed for 35 billion gallons of ethanol	% 2006 harvested US cropland[5]
Corn grain[1]	4	500	70	25.3
Corn stover[2]	3	300	105	38.5
Corn Total	**7**	**800**	**40**	**15.3**
Prairie	**2**	**200**	**210**	**75.1**
Switch-grass	**6**	**600**	**60**	**20.7**
Miscanthus	**17**	**1700**	**18**	**5.8**
Source:Steve Long				

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Addressing environmental concern (Discussed among wonks)

- Banning export from sensitive areas
- Certification program for each shipment
- Signing agreement in major countries to limit or control deforestation
- BUT FOOD SHORTAGES ARE MORE SEVERE PROBLEMS
- May lead to
  - Banning of biofuels
  - Smaller mandates
  - Upper bound of acreage diverted
  - Food aid fund

The Future of Biofuel is Dependent Upon Innovation

- Need better feedstock
  - Cleaner processing
  - Higher productivity agriculture
  - Dissemination and access to technology
- Lessons of electronics and biotech: Emergence of educational industrial complex
  - Public/private partnership in R&D and infrastructure
  - Technology transfer, start-ups
- Evolution of industry affected by IPR and regulation
  - IPR: access, sharing arrangement and enforcement
  - Regulations: land use, carbon content

Way to deal with side effect of biofuel

- Green house gas issues addressed
  - Carbon tax (if feasible)
  - Certification of GHG emission through lifecycle analysis
- Food fund to address food shortages
- Adapting mandates to adjust to food availablility conditions
- Increased productivity of food and biofuel
-

Cheap and clean fuel and food Require more R&D investment and sound regulations

- Ag research has been deemphasized and over regulated in recent year
- Food productivity- except of some crop stagnating
- Expansion of food and fuel with small or no expansion of land base land will be feasible with
  - Increased productivity of underperforming regions
  - Introduction and Adoption of new technologies

The bottom line

- Biofuel already contributes to reduced fuel prices (<5% in 2006 more in 2007), but raises food prices (>10%, maybe up to 50%)
- Largest price increases are in rice and wheat, perhaps due to under-use of new technologies
- Recent growth in agriculture has not been linear in land.
  - Incentives and technologies led to increased food supply with much less than proportional land expansion
  - There is ample under-performing or abandoned farmland and degraded or under-utilitized land that would allow expansion w/o significant GHG and resource consequences.
  - It all depends on policy, which reflects our commitment to meeting food, fuel and environmental objectives.
  - We must consider alternatives: what will happen if we abandon biofuel opportunities

Integration of Agricultural, Energy and Environmental Policies

- Traditional commodity support program becomes redundant
- Biofuel mandates and support:
  - Should be linked to environmental performance and food situation (differentiate based on emissions)
  - May provide insurance
  - Government may help establish biofuel industry, then it must compete .
- Food security funds
- Certification of biofuel sources- at both micro and macro levels
- Emphasis on innovation

Methodological implications

- Static analysis is a partial approximation-
- Inventories matters the present is a result of the past
- There is light at the end of the tunnel –the back up technology (and the back up of the back up)-but it may be killed by regulations
- Regulatory tools are too important to leave to
  - Engineers (outcomes are not numbers- they are functions- of markets and policies)
  - Economists-need to understand political landscape
  - Politicians- need to understand what's going on

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