Food Prices in Agricultural Markets

The World Food Crisis, Background and Implications for Exporter Policy

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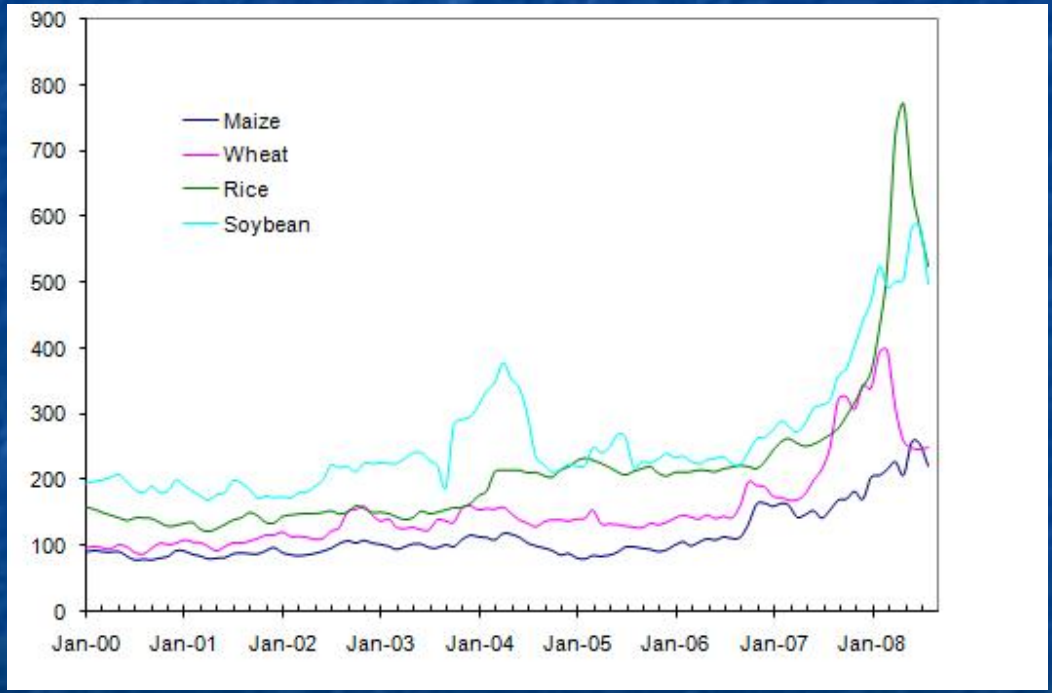
The Food Crisis in Summary

- World population continues to grow around 1.1% annually, despite slowing birth rates
- With increasing populations worldwide and rising economic prosperity in countries like India and China, demand for food will continue to increase
- Since the Green Revolution of the 20th century, agricultural production has greatly slowed down
- World food prices have seen doubling of prices in just the last two years

Rising Food Prices- Causal Factors

- From early 2006 to 2008, average world food prices of food skyrocketed:
  - Rice rose by 217%
  - Wheat by 136%
  - Maize (corn) by 125%
  - Soybeans by 107%



Source: FAO International Commodity Price Database, Syngenta Foundation

Rising Food Prices - Causal Factors

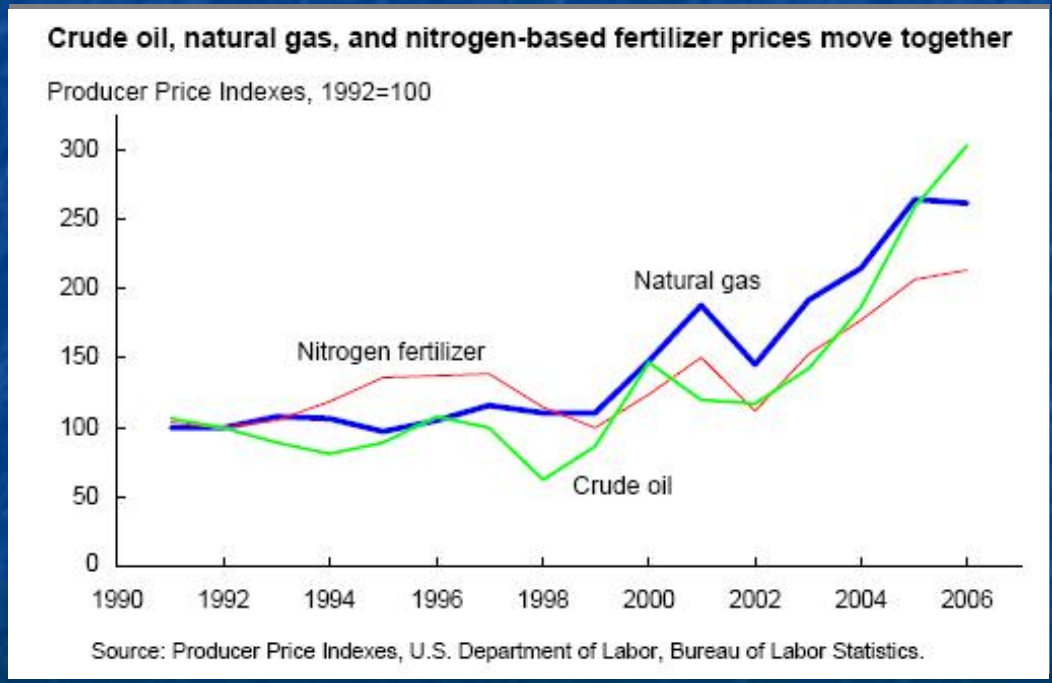
- In 2005, the world was facing a long term decline in agricultural prices
  - Concern lay with producers, who depended on higher prices for income
  - Since the pricing shift, concern has shifted to consumers in poorer countries
- What led to the change in pricing trends?

Rising Food Prices – Causal Factors

- Most economists point to a combination of supply and demand factors that pressured market conditions during this period
- On the Supply Side
  - Rapid increase of energy related factor prices, especially crude oil
  - Worldwide adaptation of Green Revolution techniques have limited new production opportunities
- On the Demand Side
  - Increase in world population
  - Increase in global income

The Supply Side
Energy Related Factor Prices

- From mid 1999 to March 2008, the indexed value of crude oil rose 547%
- Close and clear relationship between fertilizer prices and crude oil prices have been demonstrated
- Also leads to higher transportation costs of food worldwide



The Supply Side
The Green Revolution

- In the U.S., the cutting edge of agricultural productivity:
  - Average grain yields in 1960 were 45% higher than in 1950
  - Between ‘60 and ‘70, the increase was 43%
  - Between ’70 and ‘80, the increase was 20%
  - Between ‘80 and ‘90, the increase was 10%
  - Since 1990, on average, world grain harvests have increased only 0.5% a year from their previous levels
- What happened?

The Supply Side
The Green Revolution

- The Green Revolution – more accurately the ‘Chemical Revolution’
  - Pesticides, herbicides, and large amounts of fertilizer led to the gains per hectare
  - These practices have diminishing returns, and their plateaus have been reached
  - Pest populations have begun developing resistances to wide spread pesticide application
  - Current gains in food production mostly arise from bringing new land under cultivation

The Supply Side
Decrease in Per Person Production

- Overall world population growth rates have dropped to 1.5% on average, from 2% in the 1960s.
  - This masks some problems
  - The world regions with the highest growth rates are also the ones least able to grow their own food
  - Food production per person has decreased in 31 of 46 African countries in the last decade
  - Green Revolution displaced many rural populations to the cities, mostly subsistence farmers

The Demand Side
World Population Growth

- World population growth is the most obvious and most constant pressure on rising demand for food in agricultural markets
  - There is an additional 9,000,000 people being added to the demand every 12 weeks!
- Some estimates put population growth doubling the current demand for food worldwide by 2020
  - Doesn't include 101% forecasted increase in demand for grain for livestock

The Demand Side

Increase in Global Income

- Global economic growth during the period between 2000-2007, experienced a higher trend of global GDP growth, on average 3.18% annually, versus 2.55% during the 90's.
  - Led largely by China, India, and other developing nations
- Countries with incomes <15% of the U.S. exhibit significantly higher income elasticity (.72) toward food products compared to middle and high income nations (.58 and .29)
- One can infer from this that global GDP growth, led by developing nations, will lead to increased demand for agricultural products, with their higher income elasticity towards food

The Demand Side

- With rising real income, consumers tend to diversify their diets, leading to higher demand for meat, dairy, fruits and vegetables.
  - Meat and dairy require their own food inputs, with 7 grams of grain producing 1 gram of meat on average
  - Fruits and vegetables are more specific in climate requirements and have higher energy and water needs

Ratio of Energy Input to Food-Energy Output

Lamb	57:1
Beef cattle	40:1
Eggs	39:1
Swine	14:1
Dairy (milk)	14:1
Turkey	10:1
Chicken	4:1
Corn	1:4

Source: Tables 2 and 4 from *Sustainability of Meat-Based and Plant-Based Diets and the Environment* by D. Pimentel and M. Pimental in J. of Amer. Clinical Nutrition, 78(suppl) p. 660S–663S.

Food Inventory Stocks

- Inventories are used as a buffer to supply and demand shocks.
  - In years of excess supply, one would expect inventories to rise, and conversely in a year of excess demand or insufficient supply, one would expect inventories to fall.

- Prior to 2006, global food prices had been observing a long term decline, making readily available stocks of grains and oilseeds less of a priority for governments.

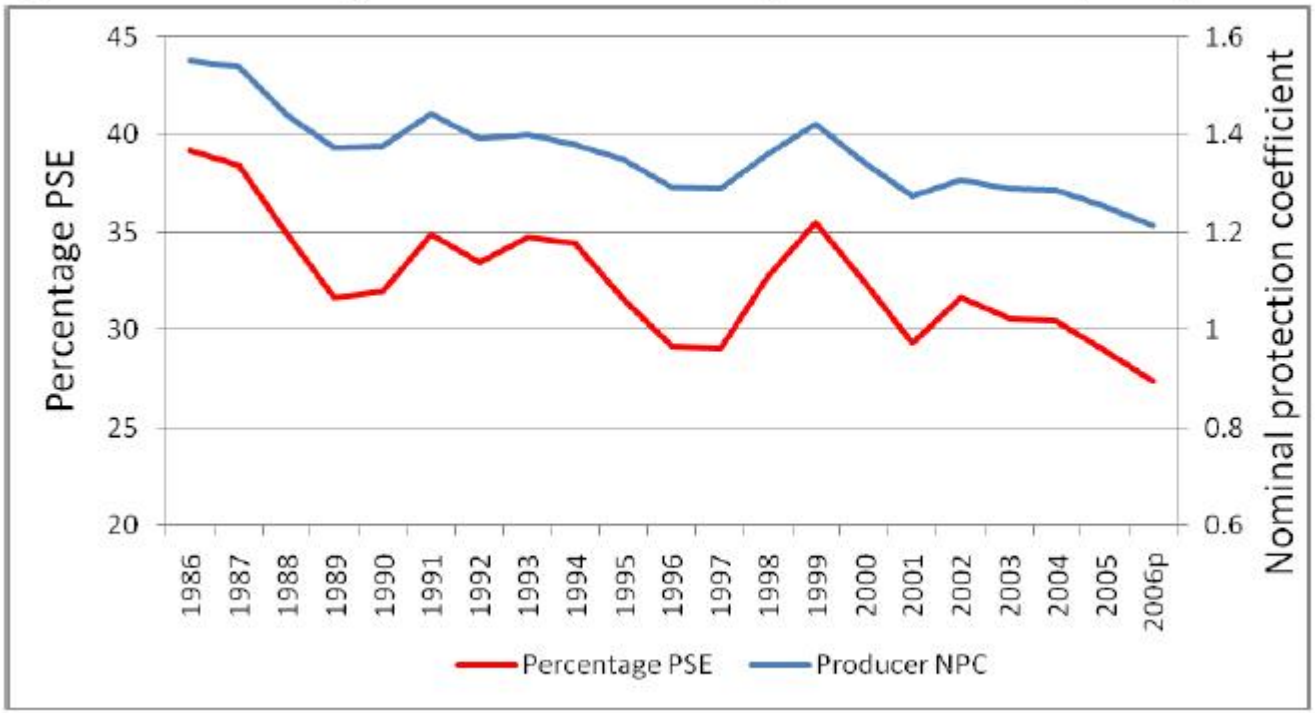
Food Inventory Stocks

Recent decades have also seen increased multilateral trade negotiations in agriculture markets

- This has led to incorporation of developing agriculture markets into the global trading system.
- After the Uruguay Round Agreement on Agriculture (1994), organized by the OECD, many countries began to reduce:
  - Production subsidies
  - National stock policies
  - Price support stocks
- And despite slow liberalization of agriculture markets after the URAA (OECD,2001), many countries now deem trade a more attractive solution to domestic supply shortcomings than buffer stocks

Food Inventory Stocks

Figure 11. Producer Support Estimate and Nominal protection coefficient, average of OECD members



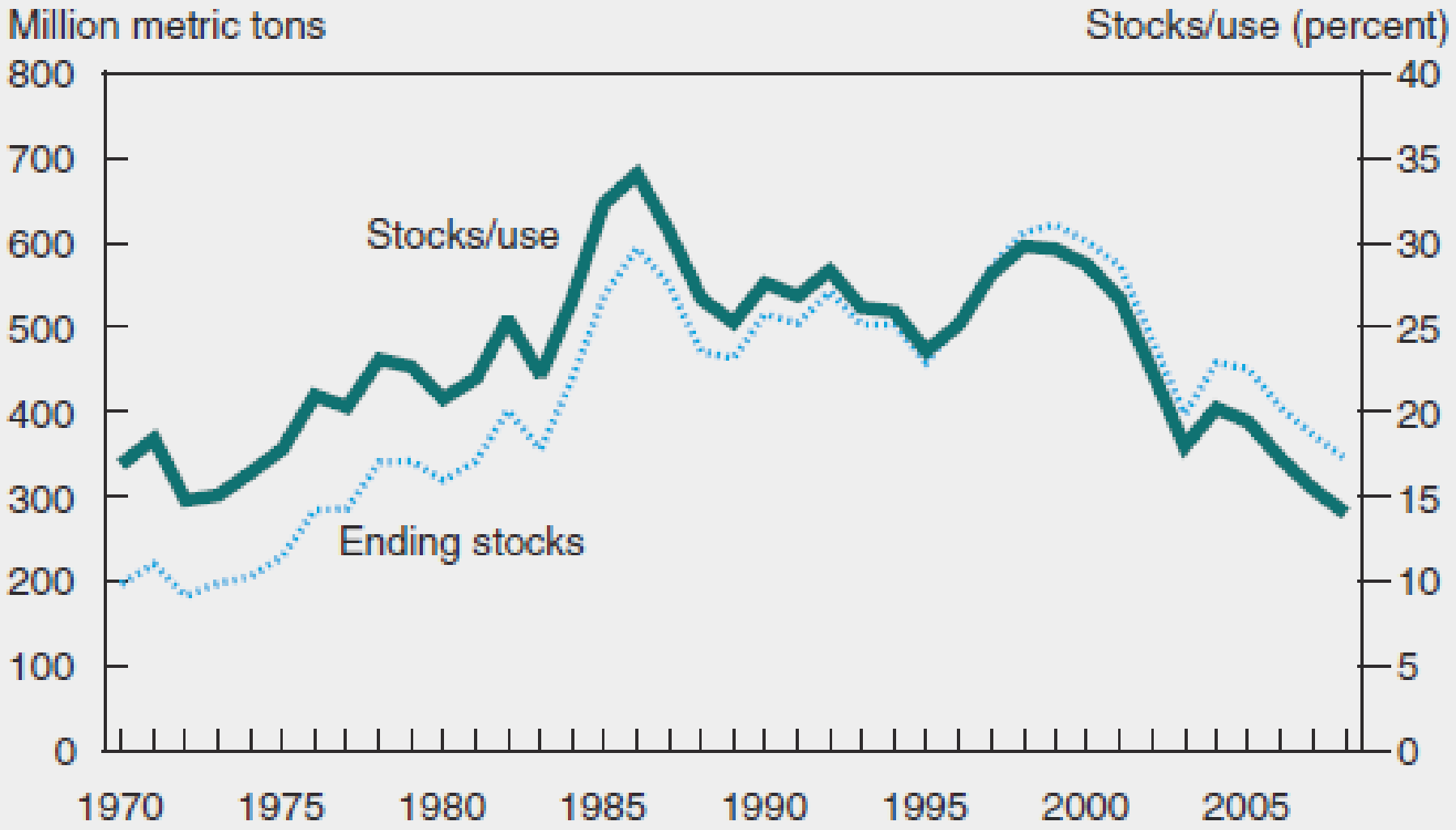
Source: OECD Statistics.

Food Inventory Stocks

- From 1999-2000, global food stocks as a percentage of usage began to drop from around 30 percent to under 15 percent in 2005.
  - This resulted in an all time low for the Stock/Use ratio for cereal crops.
- These levels continued to plummet to their lowest levels since the 1972 maize price surge (Schnepf, 2008).

Total world grain & oilseeds

Stocks and stocks-to-use ratio



Food Inventory Stocks

- Decreased trade barriers, liberalization of international trade, and readily available supply of staple commodities over the past decade have reduced the necessity and incentive for governments and private individuals to hold inventory stocks.
- The drop in inventories over time indicates both that demand has been slightly outpacing supply, and that the perceived risk of not holding stocks—i.e. supply shortage, price volatility—has diminished.
- These lower inventories likely amplified the resulting price increases.

Exporter Policy

- While food prices have been rising, political pressure begun to mount in many countries to protect their consumers from rising world prices.
- Starting in 2007, governments of significant food exporting nations took one of several types of policy actions in order to insulate their domestic economies from the food crisis

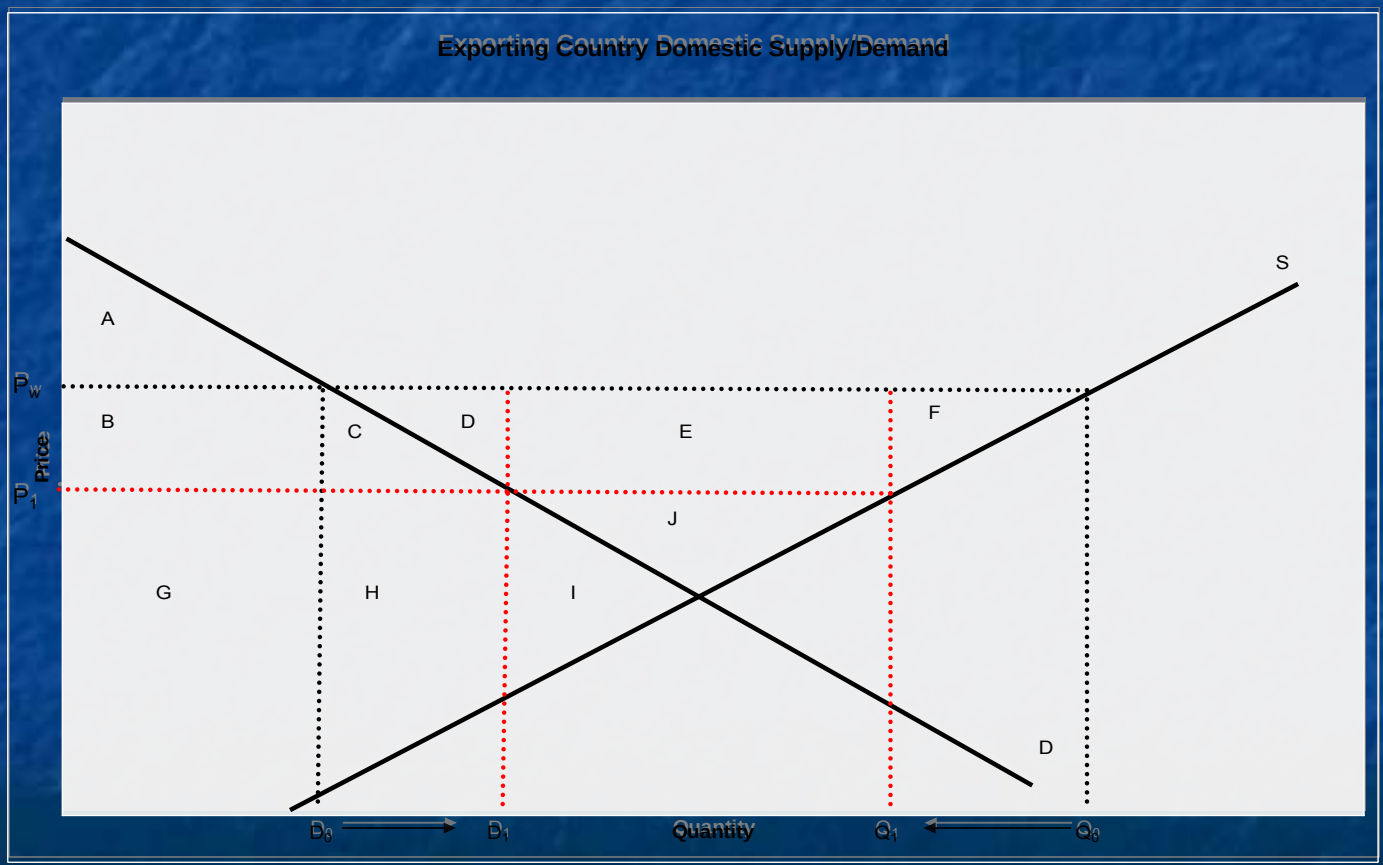
Examples of Exporter Policies

- Reduction/Elimination of Export Subsidies
  - China removed rebates on value-added taxes on grain exports and products. This action was effectively equivalent to removing an export subsidy on grains.
- Export tax increases: China, Argentina, Russia, Kazakhstan, Malaysia, Indonesia
  - China, after the removal of value-added tax rebates, imposed an export tax on grains.
  - Argentina raised export taxes on wheat, corn and soybeans
- Implementation of Export Quotas: Argentina, Ukraine, India, Vietnam, Thailand
  - India, Vietnam, and Thailand put quantitative restrictions on rice exports
- Export Bans: Ukraine, Serbia, Egypt, Cambodia, Vietnam, Indonesia, India (rice & wheat), Kazakhstan
  - India bans the export of all non-basmati rice

Trade Model

- For the exporting country, the purpose of this protection is aimed at increasing the welfare of domestic consumers.
- These policies should increase domestic consumer welfare, because consumers will be paying lower prices for food P1<Pw. For example, an increase in an export tax would lower the effective price that an producer would receive for exporting the given crop from Pw to P1, as well as reducing the number of exports. In the same regard, an export quota, with the same quantity effect as a given export tax rate will have the same effect on domestic prices.

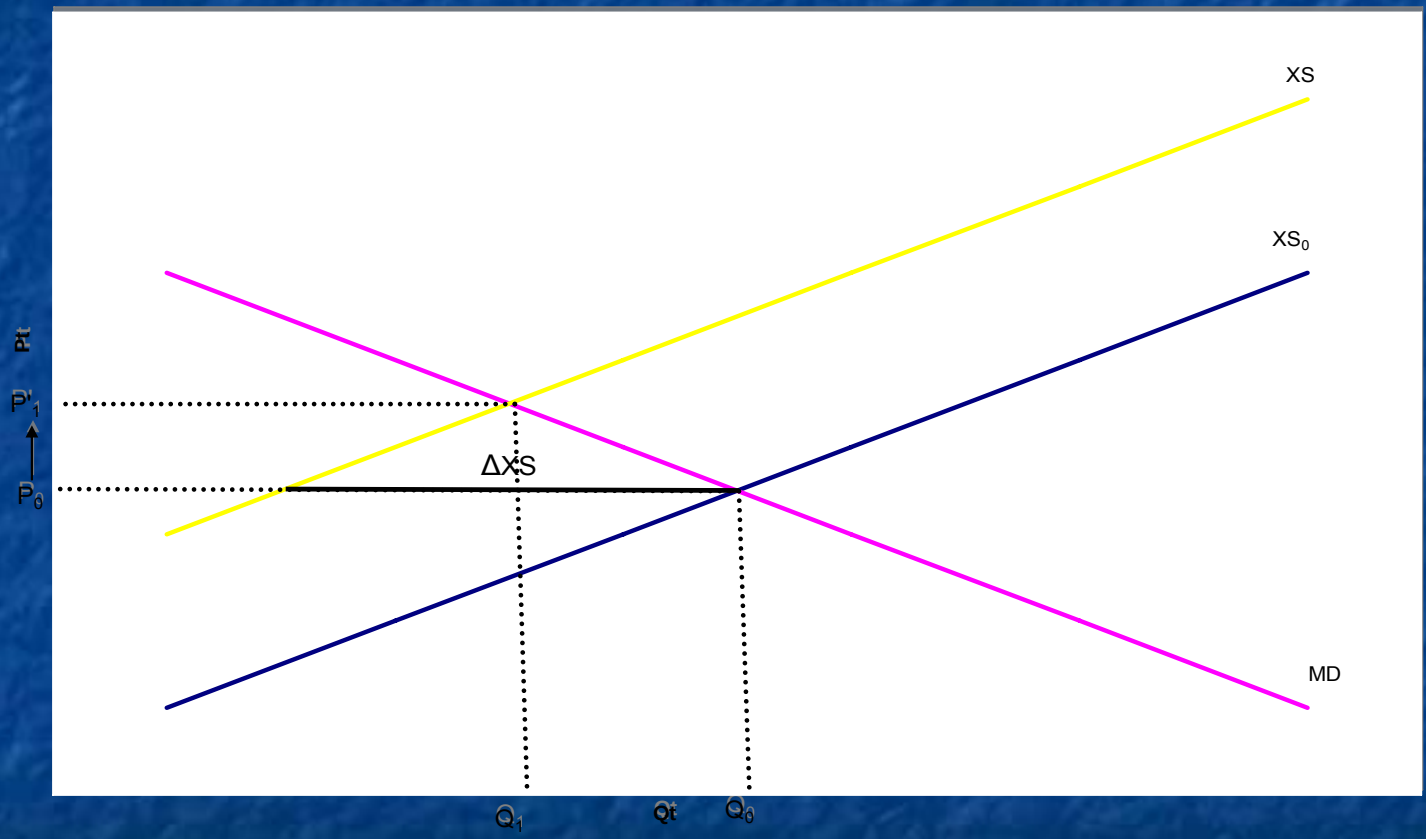
Trade Model


Exporting Country Domestic Supply/Demand
S
A
P_w
B
C
D
E
F
Price
P_1
J
G
H
I
D
D_0
D_1
Quantity
Q_1
Q_0

Trade Model

- As protectionist policies result in decreased exports, the global supply of exports in a particular commodity is predicted to decrease for a given price level.
- An exogenous shift of global export supply, as caused by these policies is represented by a shift in the export supply curve, XS, from XS0 to XS1.
- As such, all else constant, the global price of the commodity is expected to increase from Pw to P1. As well, the quantity of exports being traded on the global market is expected to decrease from Q0 to Q1. For major importers, the change from P0 to P1 will dictate the resulting loss in consumer welfare resulting from the policy.

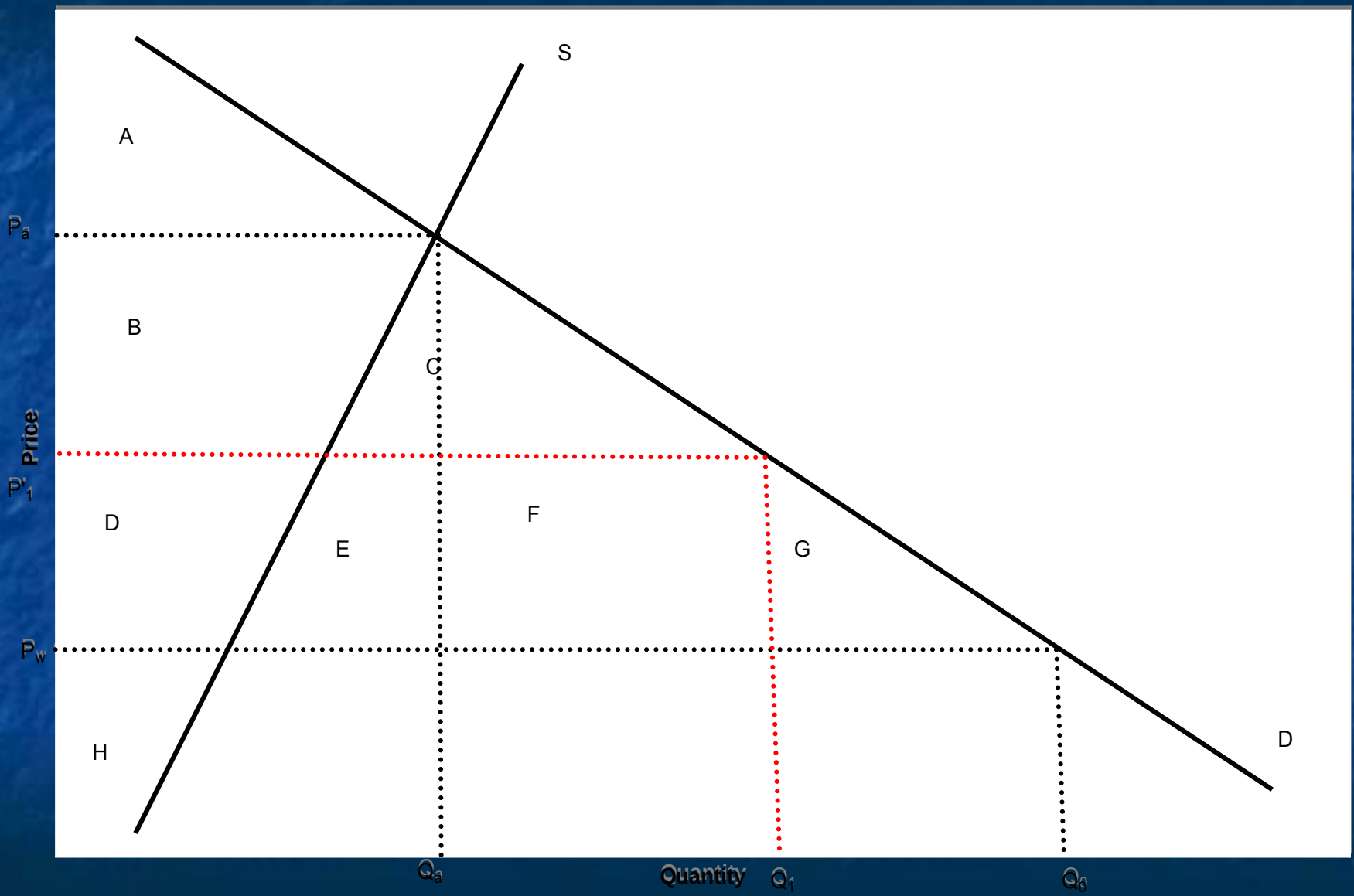
Global Export Supply/Demand



Trade Model

- With global prices increasing from P0 to P'1, there are clear welfare implications for importing nations.
- As global prices are expected to rise, given a shortfall in XS, consumers in importing countries will be adversely affected, losing areas surplus, as they are now paying more for food goods.
- As well, the model suggests that the importing country will import less, as the differential between demand and supply has narrowed, (D0-S0)>(D1-S1). Lower income countries with poor agricultural endowments are the ones most likely to suffer from the enactment of such policy (i.e. Haiti, Bangladesh).

Importing Country Domestic Supply/Demand



Econometric Model

- In this model, the natural logarithm of exports serves as the dependent variable. In the supply equation, the dependent variable, $\ln(Q_t)$, is regressed against the lagged value of prices $\ln(P_{t-1})$. This model assumes that the production decision is made in the previous time period, as a crop being planned would likely be.
- In the demand equation, $\ln(Q_t)$ is regressed against the current prices, as the model assumes that the demand decision occurs within the same time period—in this case, year t. Annualized data were gathered from 1970-2006, and global export supply and demand equations were estimated over this time period.

Econometric Model

- The purpose of this model is twofold:
  - To estimate, through TSLS, export supply and import demand equations for maize and rice commodity markets
  - Based on these supply and demand curves, to isolate how an exogenous shift in the XS curve would affect prices in both the short and long term.

Maize

- Supply Function

$$Ln(Q_t) = \alpha_0 + \alpha_1 Ln(M_{t-1}) + \alpha_2 Ln(Q_{t-1}) + \alpha_3 Ln(W_{t-1}) + \alpha_4 C_t + \alpha_5 C_{t-1} + \beta_6 Ln(Tonnes) + \beta_7 TIME + U_t$$

- Demand Function

$$Ln(Q_t) = \beta_1 Ln(M_t) + \beta_2 Ln(GDP_t) + \beta_3 Ln(Currex_t) + \beta_4 Ln(Pop_t) + V_t$$

Rice

- Supply Equation

$$Ln(Q_t) = \alpha_0 + \alpha_1 Ln(R_{t-1}) + \alpha_2 Ln(Q_{t-1}) + \alpha_3 Ln(Tonnes) + \alpha_4 Ln(C_t) + U_t$$

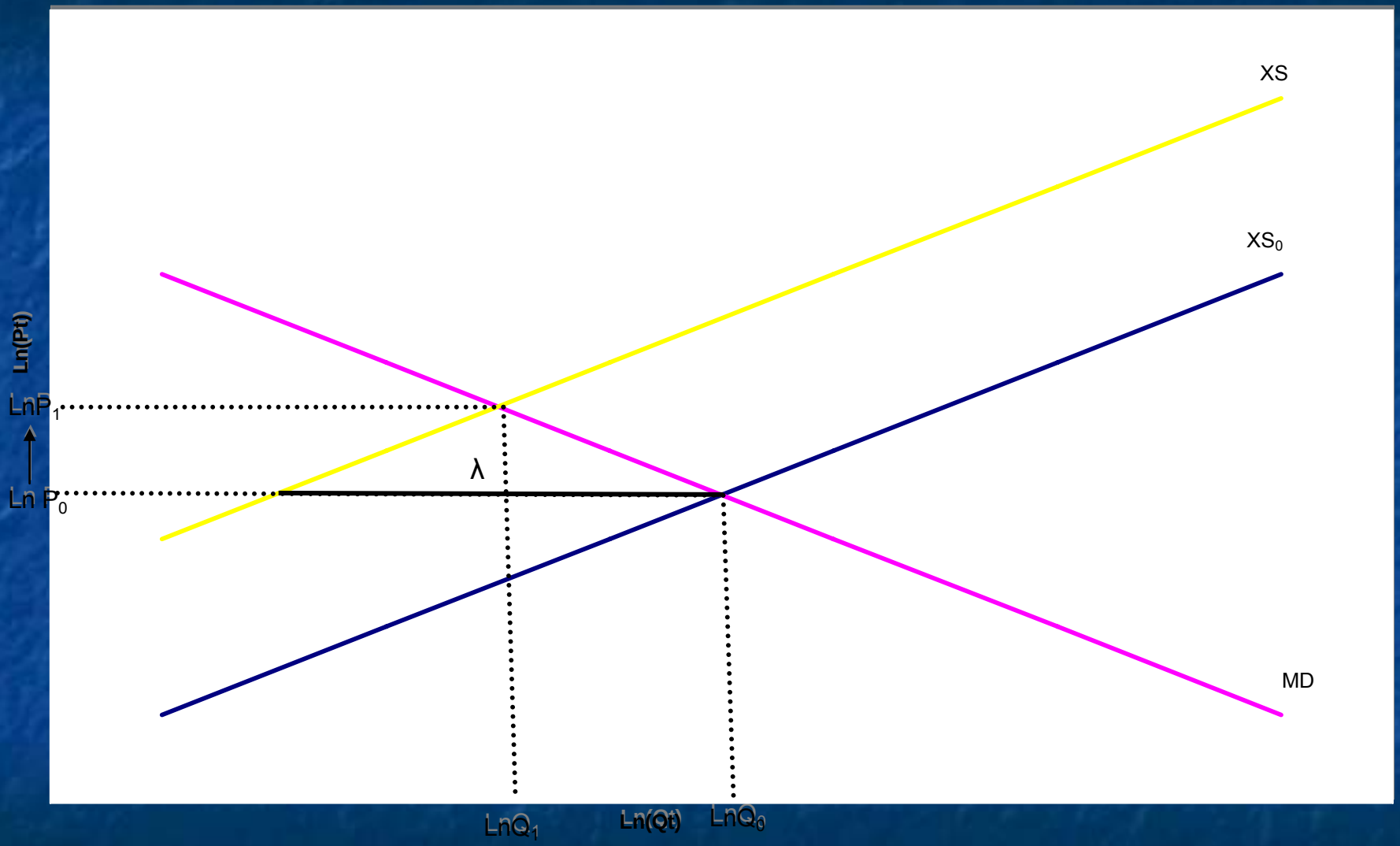
- Demand Equation

$$Ln(Q_t) = \beta_1 Ln(R_t) + \beta_2 Ln(GDP) + \beta_3 Ln(Currex) + \beta_4 Ln(Pop_t) + V_t$$

Results

- Regressions were performed on data from 1970-2006 for each commodity
- XS and MD curves were derived
- Based on XS and MD curves, the price effect of an exogenous shift in the XS curve, λ, was calculated
- λ represents a percent decrease in supply at a given global price

Global Export Supply/Demand



Results

	Short Run	Long Run
Rice α_1	.0537	.2556
Rice β_1	-0.0838	-0.0838
Maize α_1	.1291	0.3651
Maize β_1	-0.1305	-0.1305
$\%\Delta P/d\lambda$, Rice	7.2727	3.2321
$\%\Delta P/d\lambda$, Maize	3.8521	2.0178
$\%\Delta Q/d\lambda$, Rice	-.6109	-.2469
$\%\Delta Q/d\lambda$, Maize	-.5027	-.2631
DWL Rice	$2.216Q_tP_t\lambda$	$.3990Q_tP_t\lambda$
DWL Maize	$.967691Q_tP_t\lambda$	$.2657Q_tP_t\lambda$

Discussion

- In the short run, price response elasticity to exogenous shocks are 7.27 for rice, and 3.85 for Maize. Looking at the long run price responsiveness, a %1 decrease in exports, caused by policy, should result in a 3.23% and 2.02% increase in prices for rice and maize respectively.
- Interesting to note, in terms of tonnage, the maize export market was 3.12 times as large as the rice export market in 2006. Given that the rice market appears to be more sensitive to shocks in both the long and short run, this is likely because the global rice export market is much more shallow and less elastic than the global maize market and thus much less able to absorb any kinds of exogenous shocks.

Conclusion

- Large exporting nations possess significant market shares in global commodity markets
- Protectionist policies raise global prices and reduce welfare for poor, importing nations
- Possible Solutions?