Production Distortions and Implications for U.S. Row Crop Acreage and Price

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Presentation to:

IATRC: Subsidized Crop and Revenue Insurance:
Implications for Agriculture in the WTO

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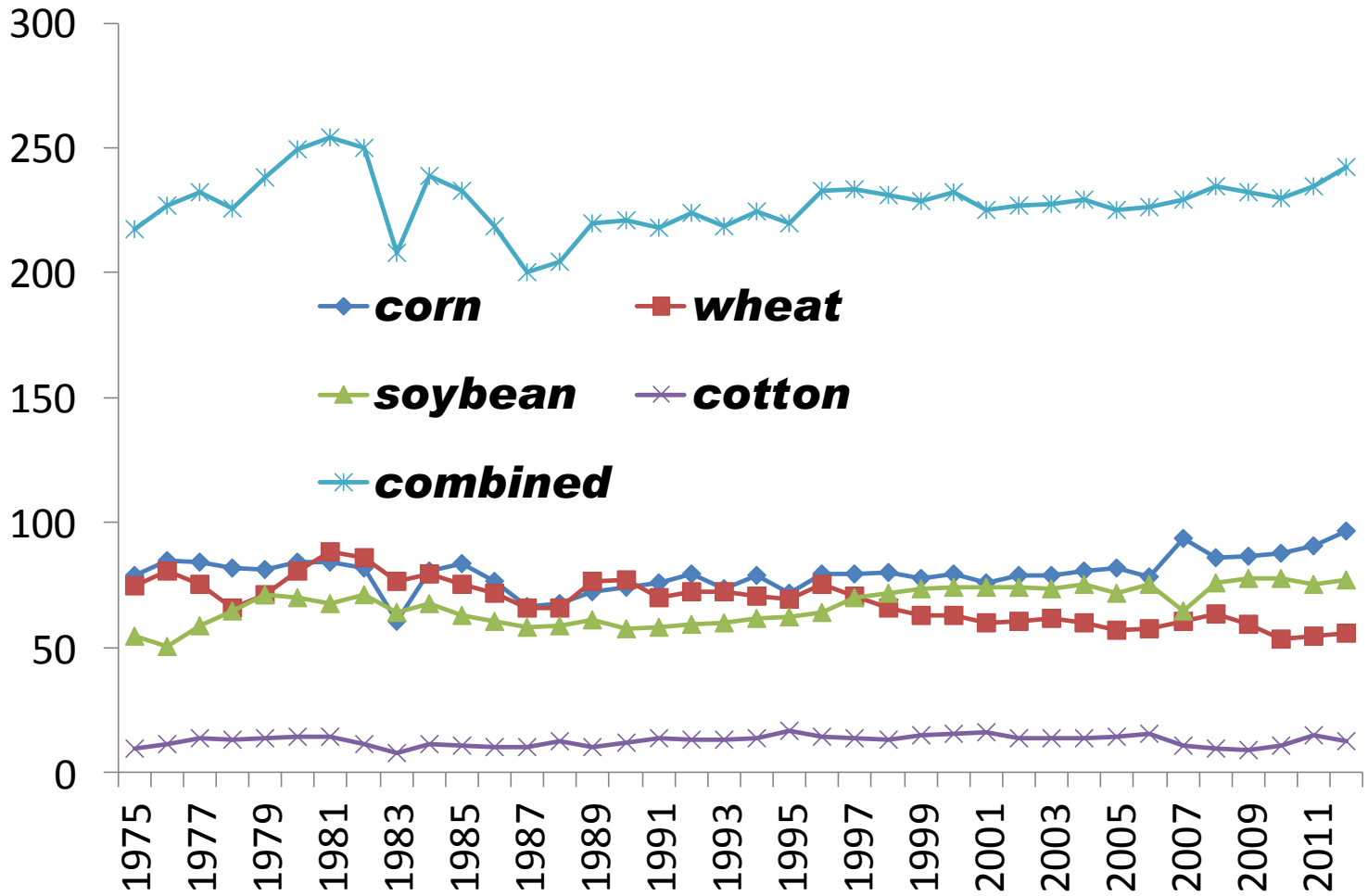
Brief Outline

- **My remarks will focus on the impacts on acreage, price levels, and price volatility of two distinct agricultural policies on the two major U.S. row crops corn and soybeans:**
  1. ***Renewable Fuel Standards Program***
     - RFS1 created under the Energy Policy Act (EPAct) of 2005 required 7.5 billion gallons of renewable- fuel to be blended into gasoline by 2012.
     - RFS2 created under Energy Independence and Security Act (EISA) of 2007 increased the volume of renewable fuel to be blended into gasoline from 9 billion gallons in 2008 to 36 billion gallons by 2022
  2. ***U.S. Crop Insurance Program***
     - Subsidies are paid as % of premium so in rising-price markets means bigger cost to taxpayers. The largest plan is revenue protection that insures expected revenues and, with recent high prices, significant increase in cost to taxpayers
     - **In 2011, $114 billion in liability, $12 billion in premium, with $7.4 billion in premium subsidies.**
     - **New Farmbill likely to make crop insurance the major policy tool**

US Major Row Crop Acreage 1975-2012 (million acres)



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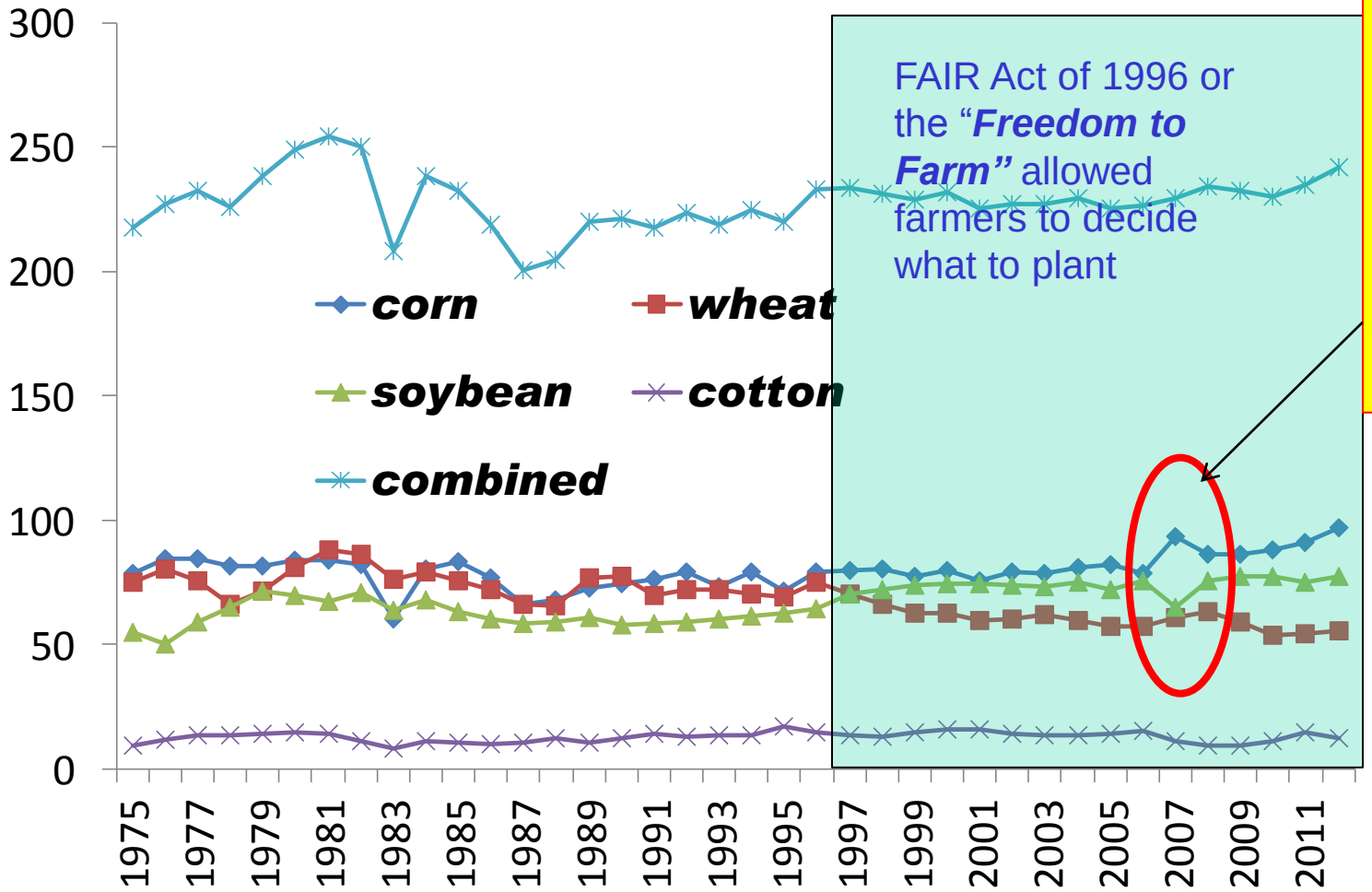


EISA of 2007: increased the volume of renewable fuel required to be blended into transportation fuel from 9 billion gallons in 2008 to 36 billion gallons by 2022

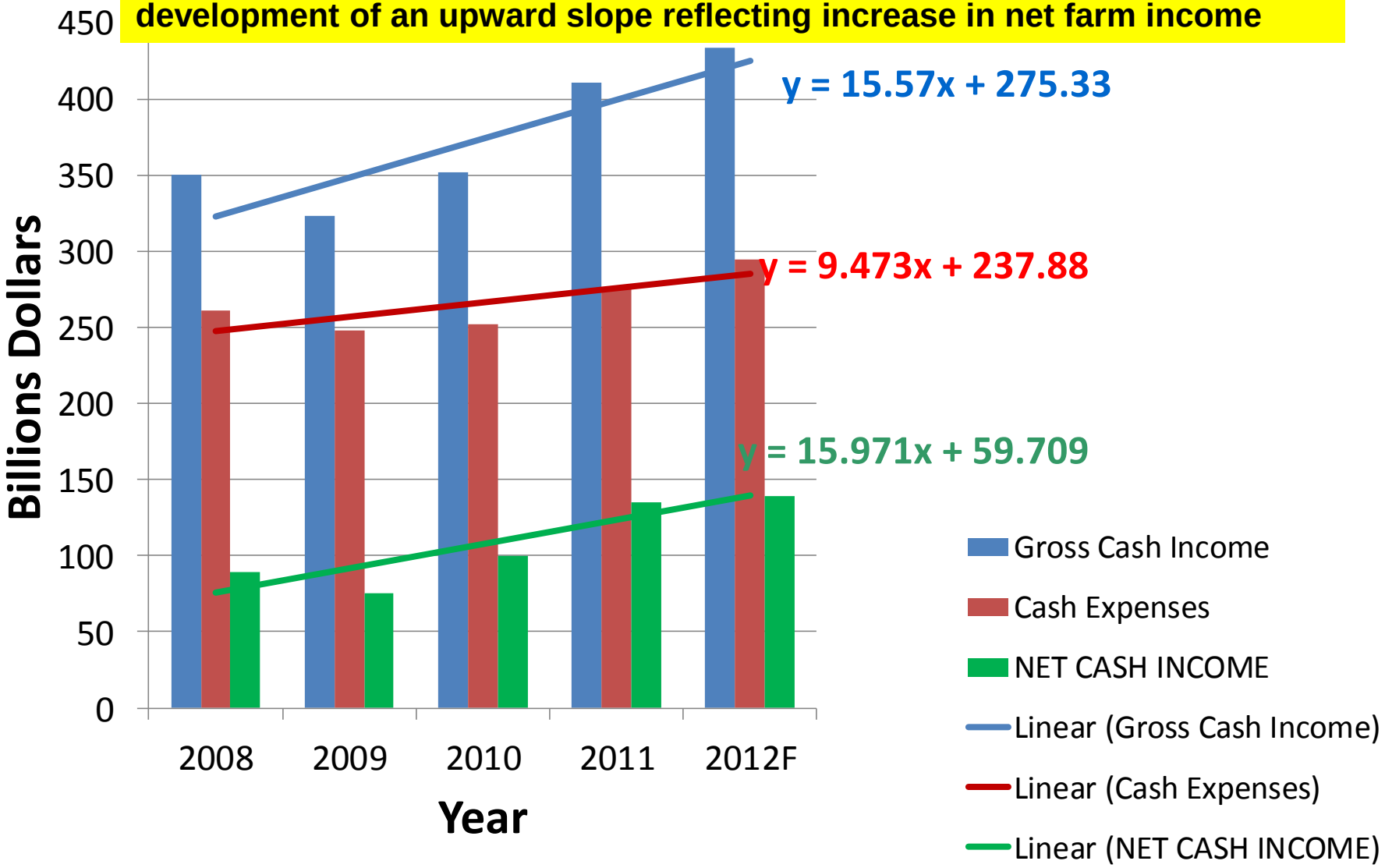
Net Cash Income in 2012F Maintains Near Record Levels

Income Statement U.S. Farm Sector 2007-2012F									
	2008	2009	2010	2011	2012F	2009 v. 2008	2010 v. 2009	2011 v. 2010	2012F v. 2011
Cash Receipts	316.4	289.1	321.1	374.3	385.5	-8.6%	11.1%	16.5%	3.0%
Crops	174.8	168.9	179.6	208.3	216.6	-3.4%	6.4%	16.0%	4.0%
Livestock	141.6	120.3	141.6	166.0	169.0	-15.1%	17.7%	17.3%	1.8%
Direct Govt. Pay	12.2	12.2	12.4	10.4	10.9	-0.5%	1.8%	-15.9%	4.2%
Gross Cash Income	350.1	323.3	351.8	410.8	431.3	-7.7%	8.8%	16.8%	5.0%
Cash Expenses	261.1	247.6	252.4	276.1	298.5	-5.2%	1.9%	9.4%	8.1%
NET CASH INCOME	89.0	75.6	99.4	134.7	132.8	-15.0%	31.5%	35.5%	-1.4%

Source: http://ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx#27405

US Net Farm Income 2008-2012F

Parallel lines indicates *flat* net cash income—2010, 2011 & 2012 helped the development of an upward slope reflecting increase in net farm income

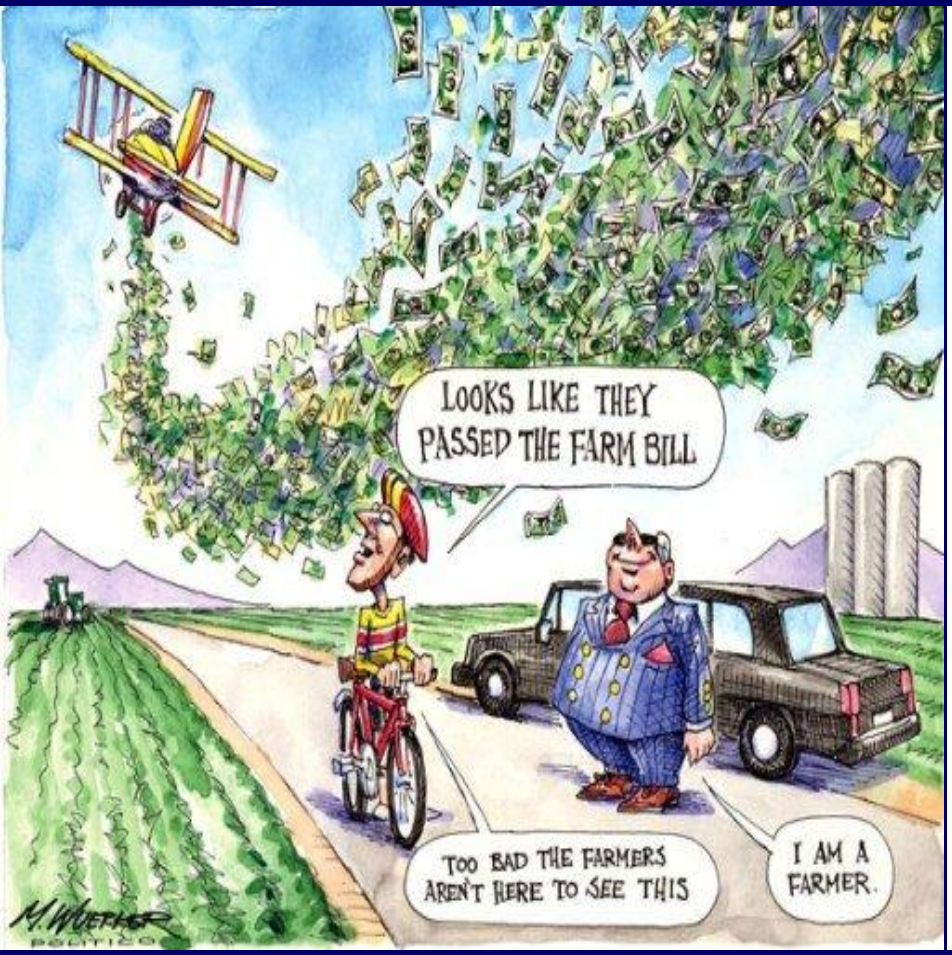


U.S. Farm Sector Cash Receipts 2008-2012F by Crop

U.S. Farm Sector Cash Receipts 2008-2012F by Crop								
Crop Receipts	**2008**	**2009**	**2010**	**2011**	**2012F**	**%**		
						2010 v. 2009	2011 v. 2010	2012F v. 2011
			$ billion					
Corn	48.4	42.5	47.2	63.9	65.8	**11.0%**	**35.4%**	**3.1%**
Soybeans	26.4	33.7	34.5	37.6	41.9	**2.3%**	**9.0%**	**11.5%**
Wheat	15.4	11.7	11.1	14.6	15.9	**-5.6%**	**32.6%**	**8.7%**
Cotton	5.2	4.0	7.6	8.3	7.7	**88.6%**	**10.3%**	**-7.7%**
Sub-total	**95.5**	**91.9**	**100.3**	**124.4**	**131.4**	**9.1%**	**24.1%**	**5.6%**
Cattle and Calves	48.5	43.8	51.5	62.9	65.7	**17.5%**	**22.2%**	**4.3%**
Hogs	16.1	14.7	18.0	21.7	21.3	**22.4%**	**20.7%**	**-1.9%**
Poultry and Eggs	36.8	32.5	35.5	36.4	39.0	**9.3%**	**2.8%**	**7.1%**
Dairy	34.8	24.3	31.4	39.5	37.0	**28.9%**	**26.0%**	**-6.5%**
Sub-total	**136.2**	**115.3**	**136.3**	**160.6**	**162.9**	**18.2%**	**17.8%**	**1.5%**
Total Crops	174.8	168.9	179.6	208.3	216.6	**6.4%**	**16.0%**	**4.0%**
Total Livestock	141.6	120.3	141.6	166.0	169.0	**17.7%**	**17.3%**	**1.8%**
Total Receipts	**316.4**	**289.1**	**321.1**	**374.3**	**385.5**	**11.1%**	**16.5%**	**3.0%**

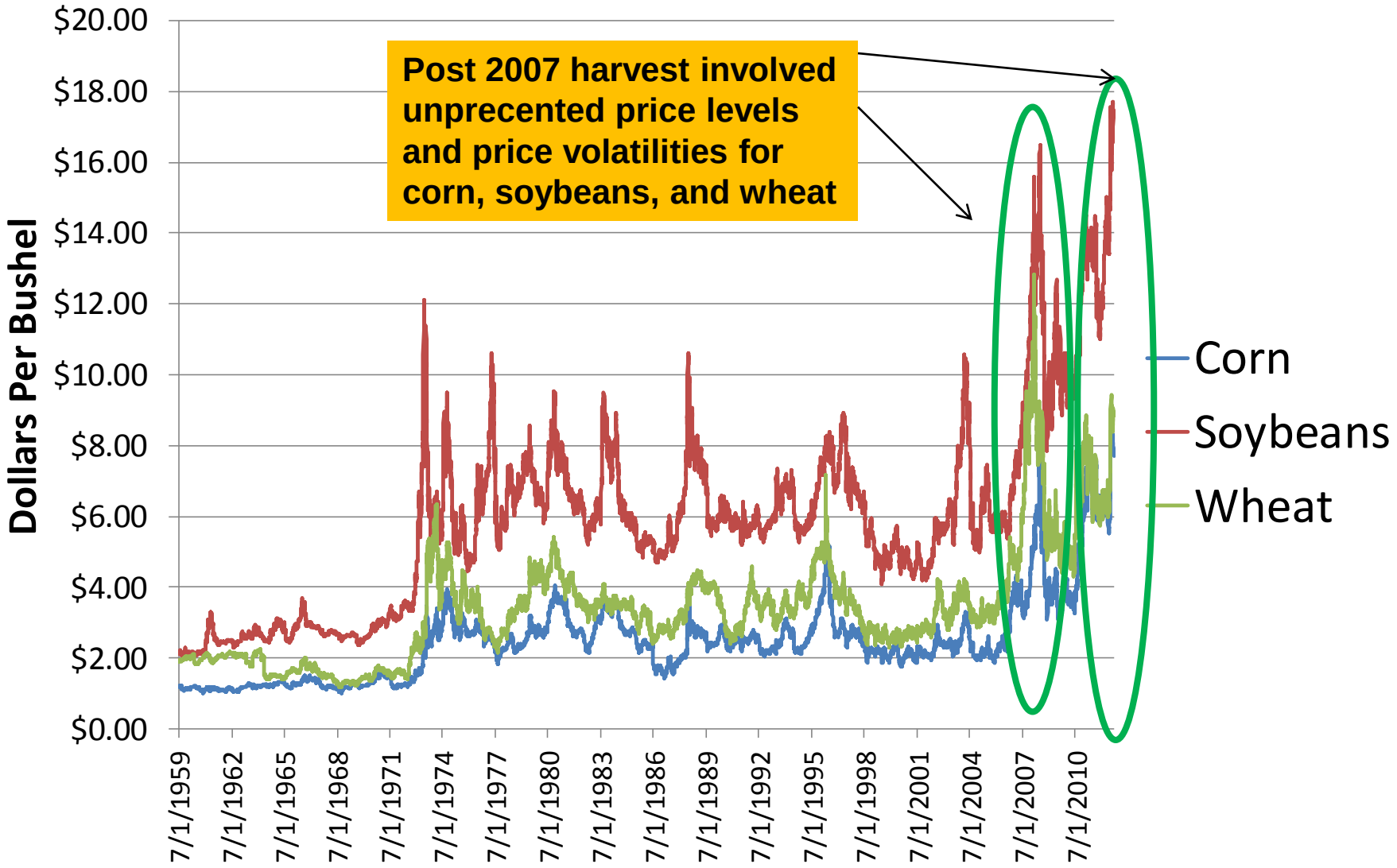
Source: http://ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx#27405

U.S. Farm Policy: 2012F & 2008 reveals that Direct Govt. Paymts. *are around 10%-12%* of Net Farm Income

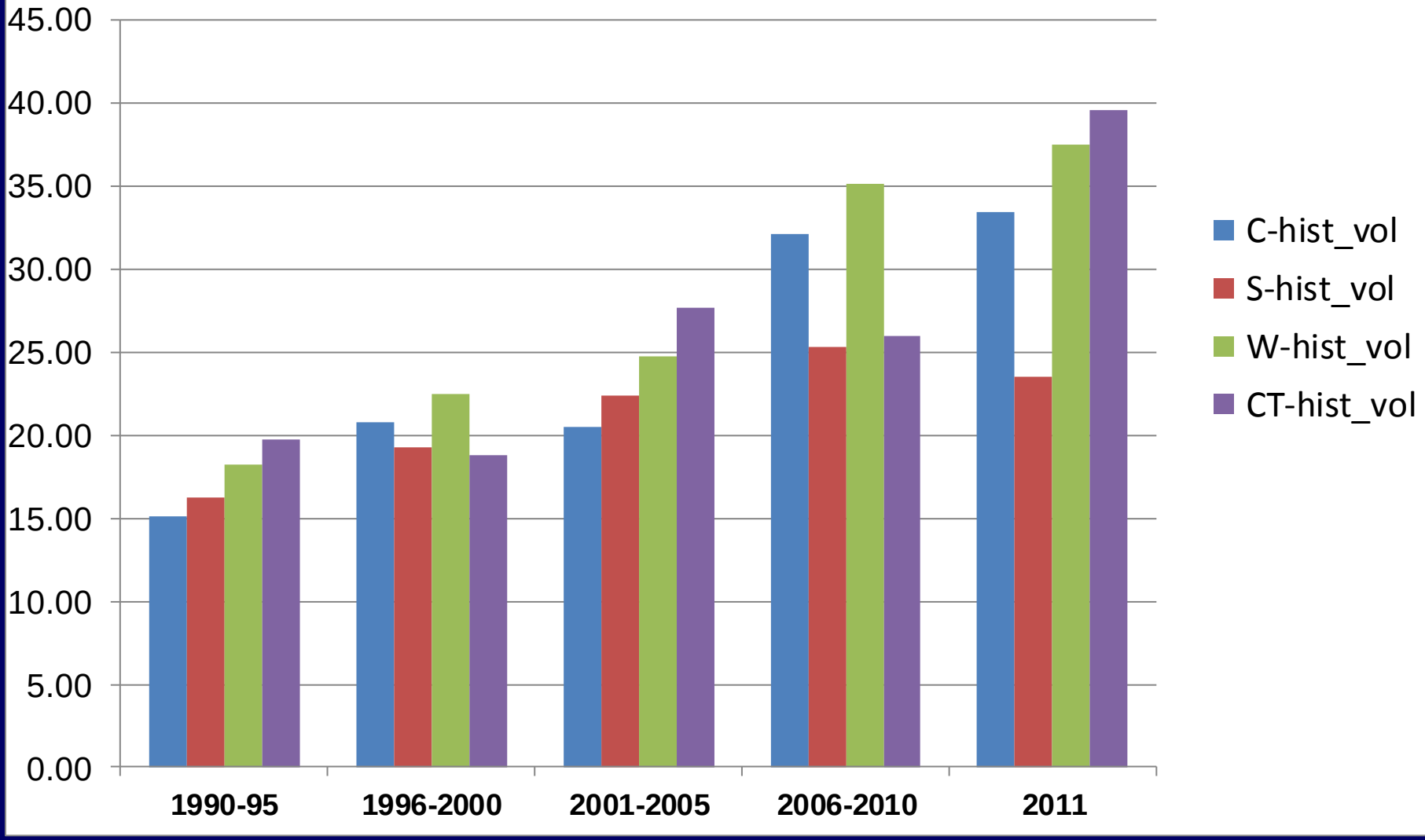


U.S. Farm Policy Less Formally….

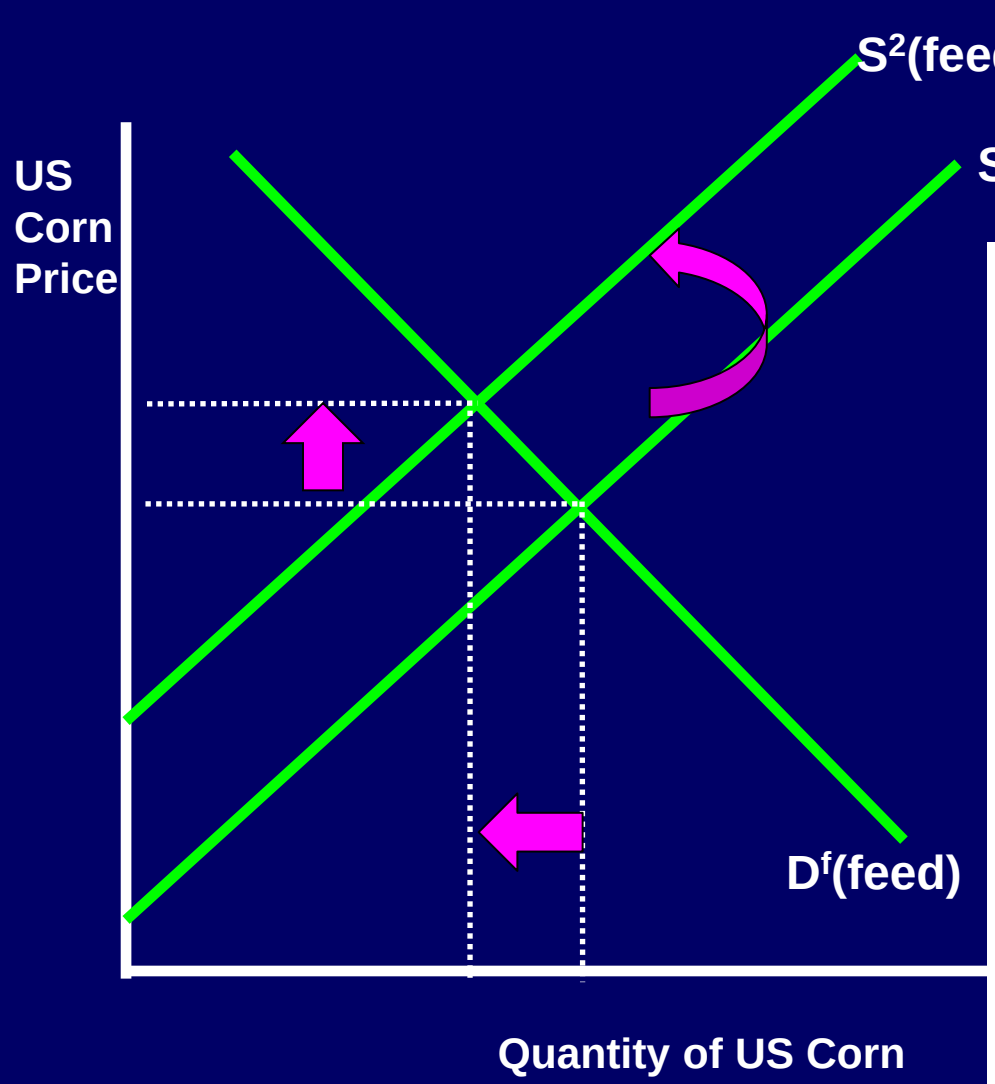
Daily Nearby Futures Prices for US Corn, Soybeans, and Wheat 7/1/1959-9/12/2012



Average Annual Historical Volatilities for Nearby Corn, Soybeans, Wheat, and Cotton Futures for Various Periods 1990-2011



Increased Price Fluctuation in Corn for Feed Market Due to Ethanol Production?



Definitions:

- D^f(feed)=is demand for corn for feed
- S1(feed)= is the "residual" supply of corn to feed market (the total supply of corn minus corn used for other purposes such as sweeteners and industrial products)
- S2(feed)=is the "residual" supply of corn to feed market following an increase in oil prices, assuming no corn is used in ethanol production (supply moves *leftward* (upward) because increased oil prices increases costs of production such as transport costs, machinery use costs and fertilizer prices)

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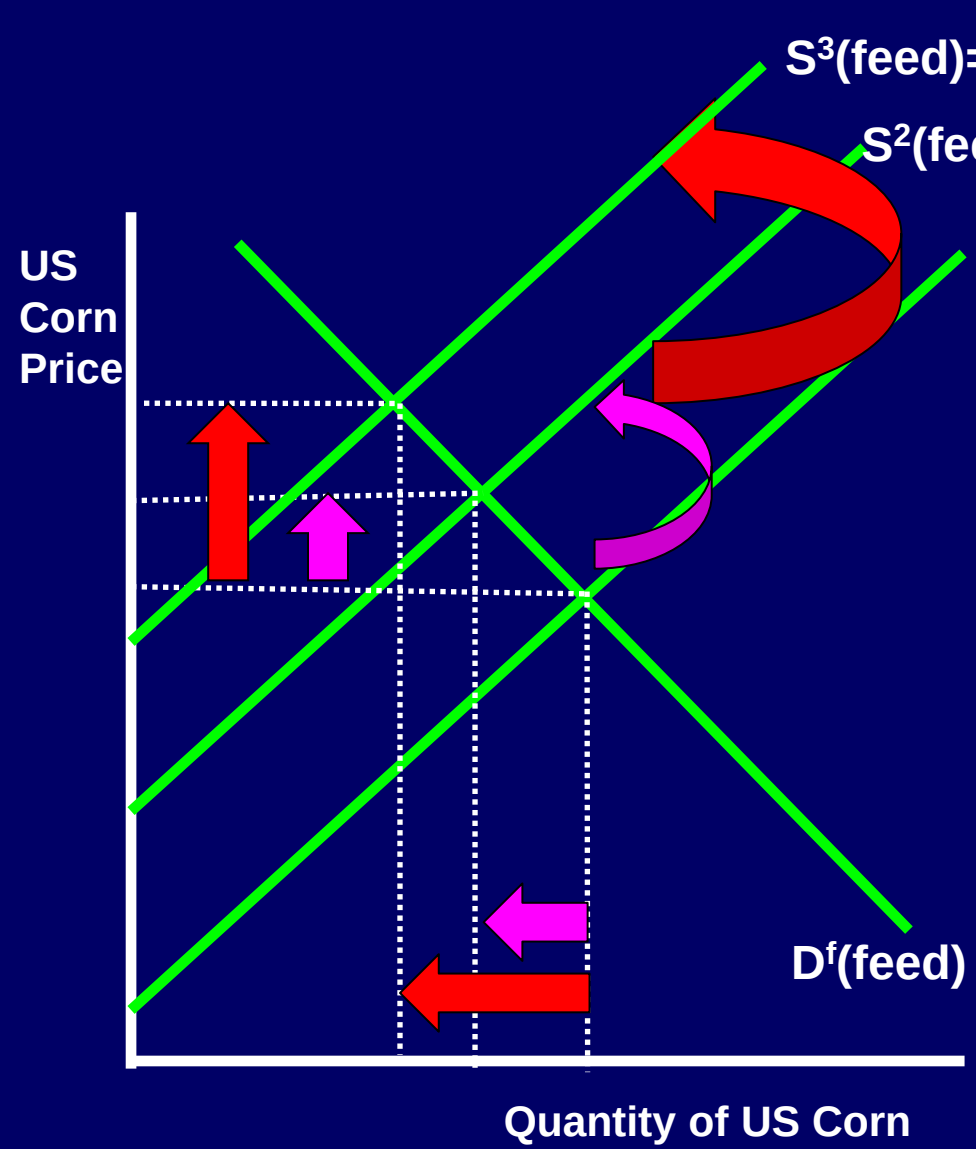

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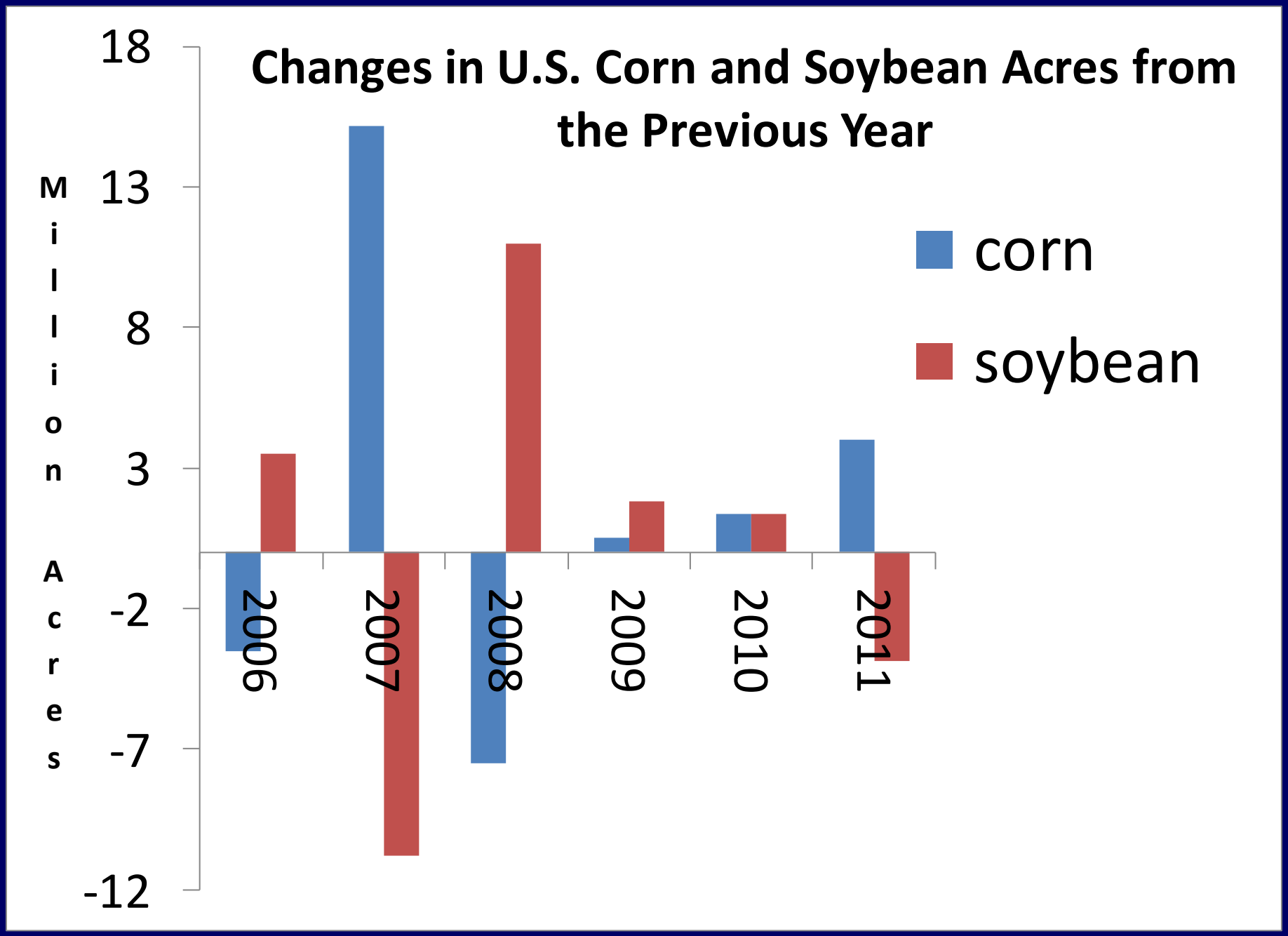
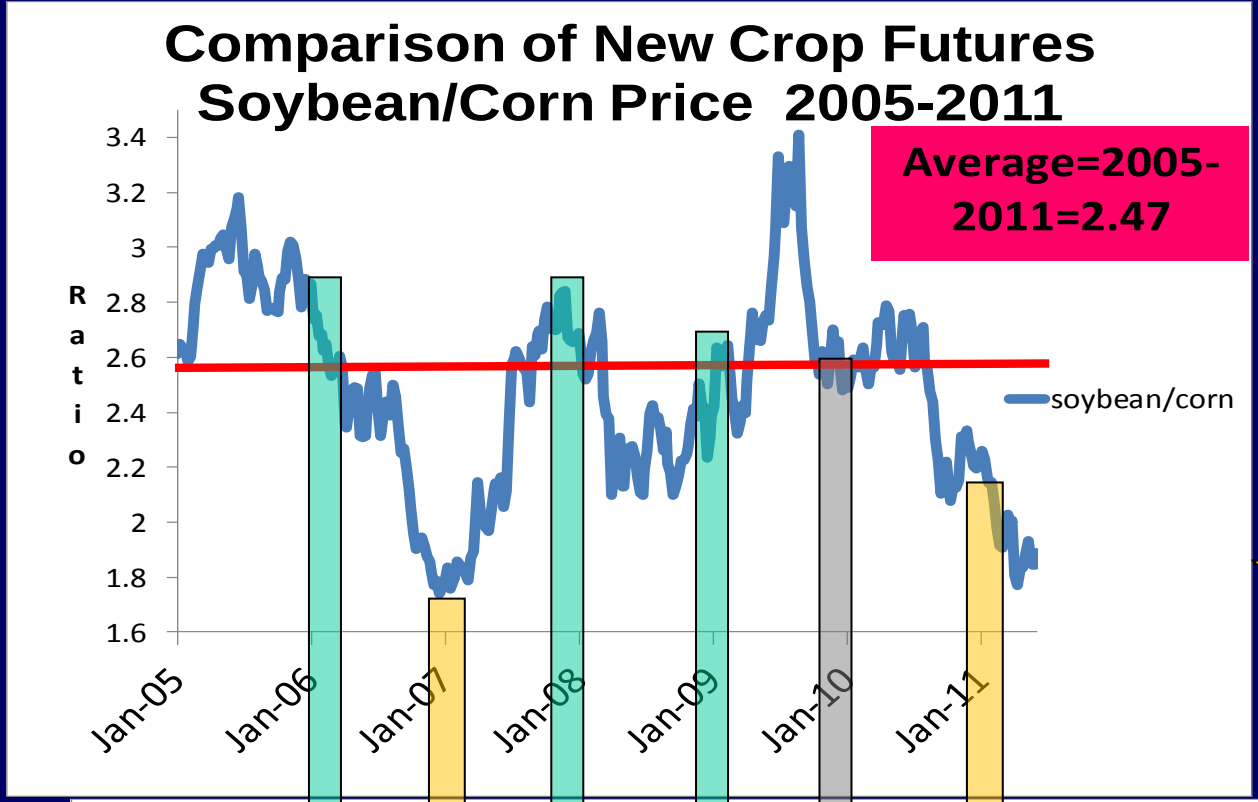
- S^3(feed)=is the "residual" supply of corn to feed market following the *same increase* in oil prices as for S2, ***but allowing for corn being drawn into ethanol production.***

US Planted Acres of Major Row Crops 1995-2012

Crop	1995	2000	2005	2010	2012	2010 vs. 2005	2012 vs. 2010	2012 vs. 1995
	Millions of Acres							
corn	71.5	79.6	81.8	87.9	96.9	**6.1**	**9.0**	**25.4**
soybean	62.5	74.3	72.0	77.4	77.2	**5.4**	**-0.2**	**14.7**
wheat	69.1	62.6	57.2	53.6	55.7	**-3.6**	**2.1**	**-13.4**
cotton	16.7	15.5	14.3	11.0	12.4	**-3.3**	**1.4**	**-4.4**
combined	219.8	232.0	225.3	229.8	242.2	**4.6**	**12.3**	**22.3**

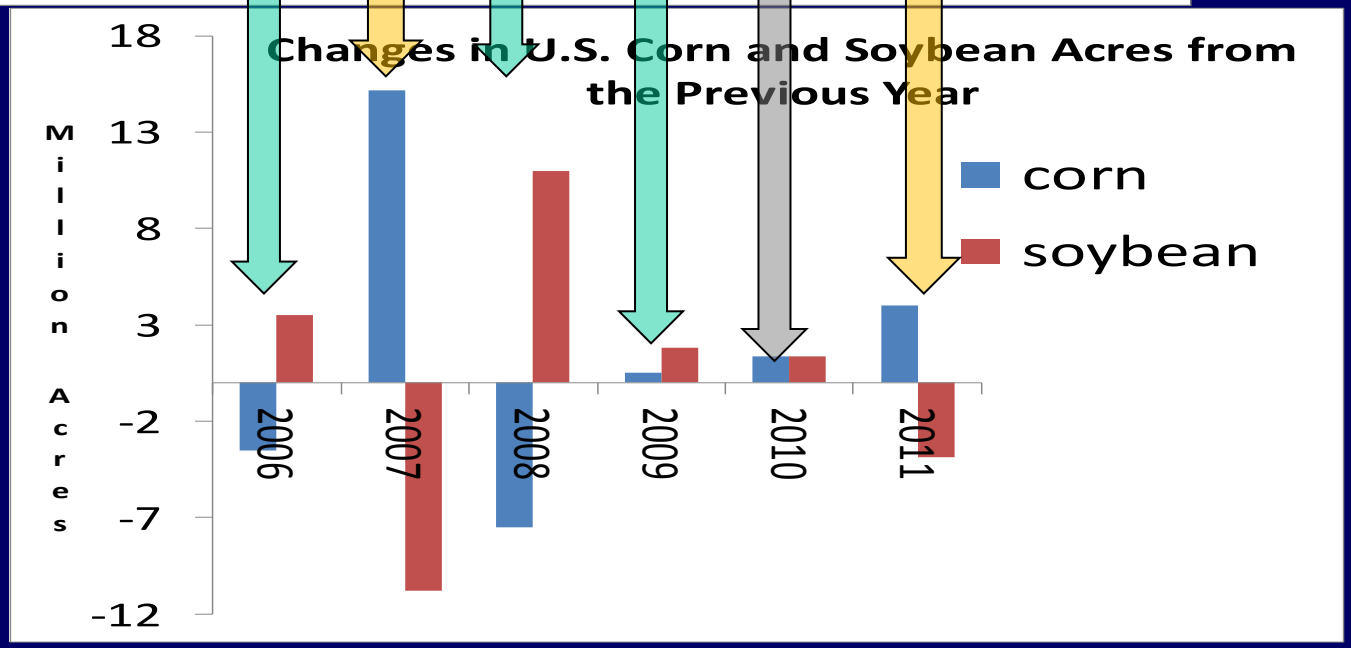

Changes in U.S. Corn and Soybean Acres from the Previous Year
Million Acres
18
13
8
3
-2
-7
-12
2006
2007
2008
2009
2010
2011
corn
soybean

Soy/corn >2.47 and so market bids soybean acres

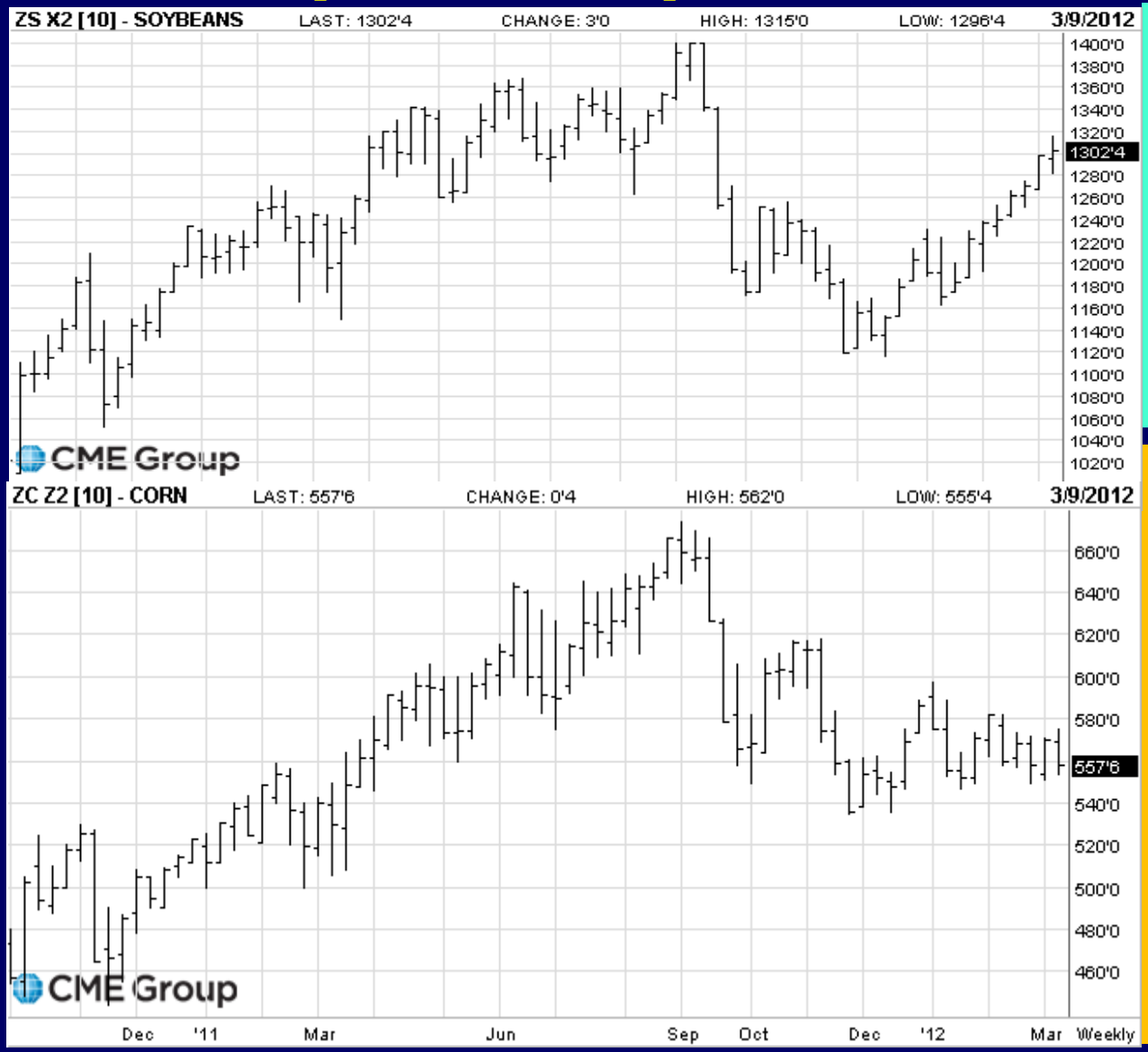


Soy/corn< 2.47 and so market bids corn acres

Soy/corn≅ 2.47 and so market bids are neutral and soybean and corn acres both increase

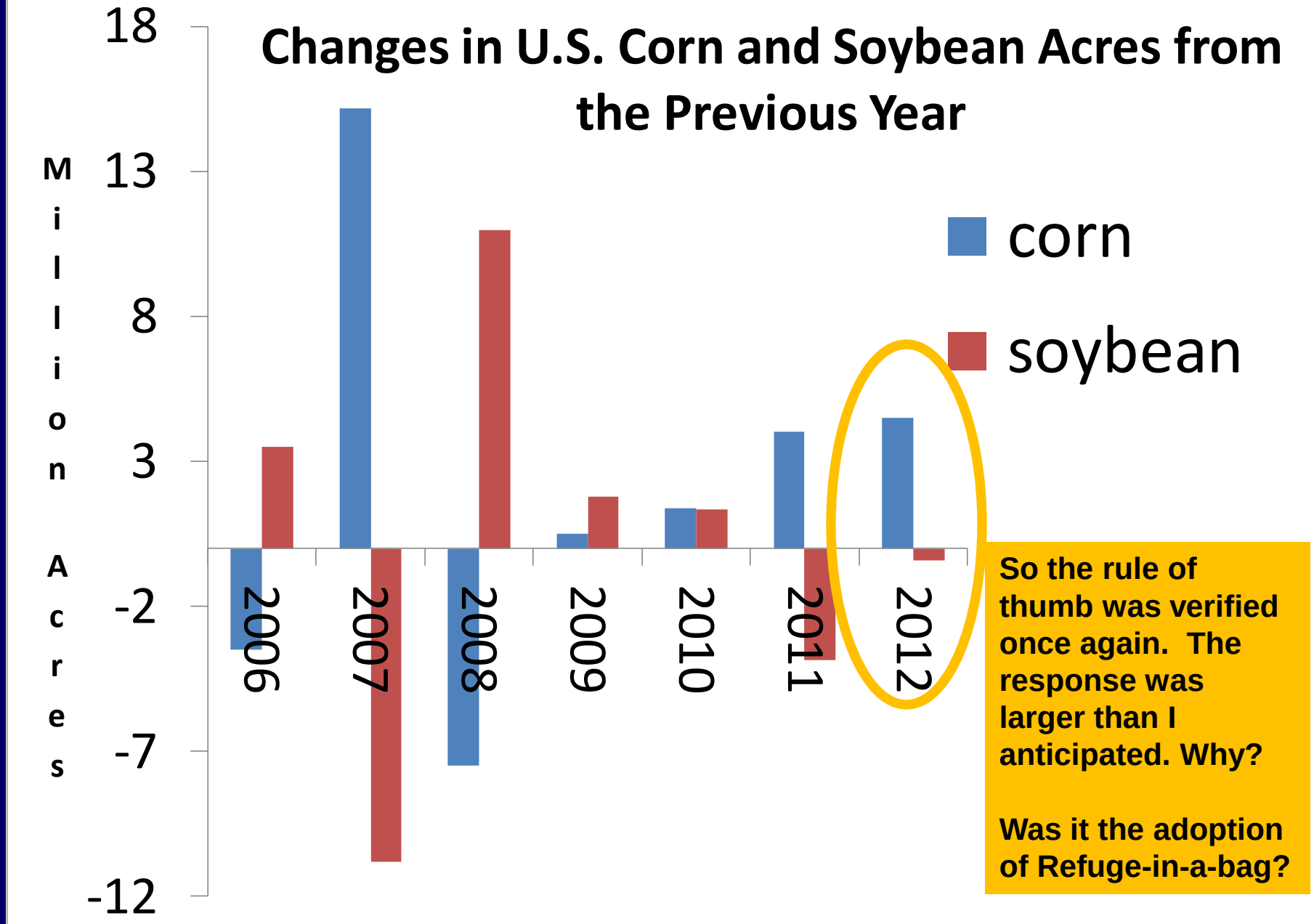


New Crop 2012 Soybean v. Corn (3/9/2012)=$12.99/$5.60=2.30



New crop soybean and corn futures appear to be more highly correlated especially in the Jan-Mar period when bidding for new crop acres.

If previous recent years are reasonable predictors then the current new crop 2012 (3/9/2012) of: soy/corn=2.30<2.47 indicates we should see an increase in corn acres at the expense of soybeans.


Changes in U.S. Corn and Soybean Acres from the Previous Year
Million Acres
18
13
8
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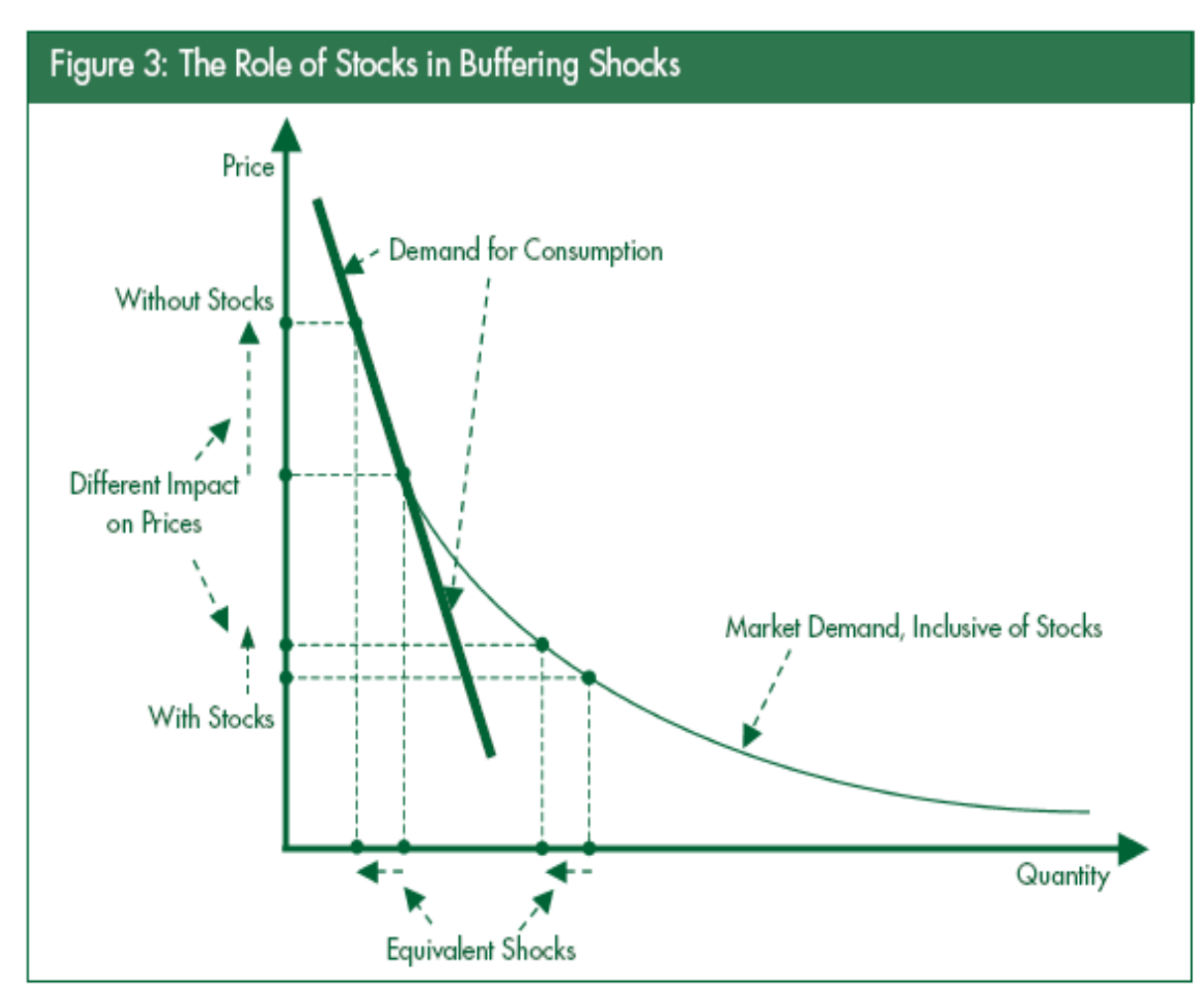
2006
2007
2008
2009
2010
2011
2012
corn
soybean
So the rule of thumb was verified once again. The response was larger than I anticipated. Why?
Was it the adoption of Refuge-in-a-bag?

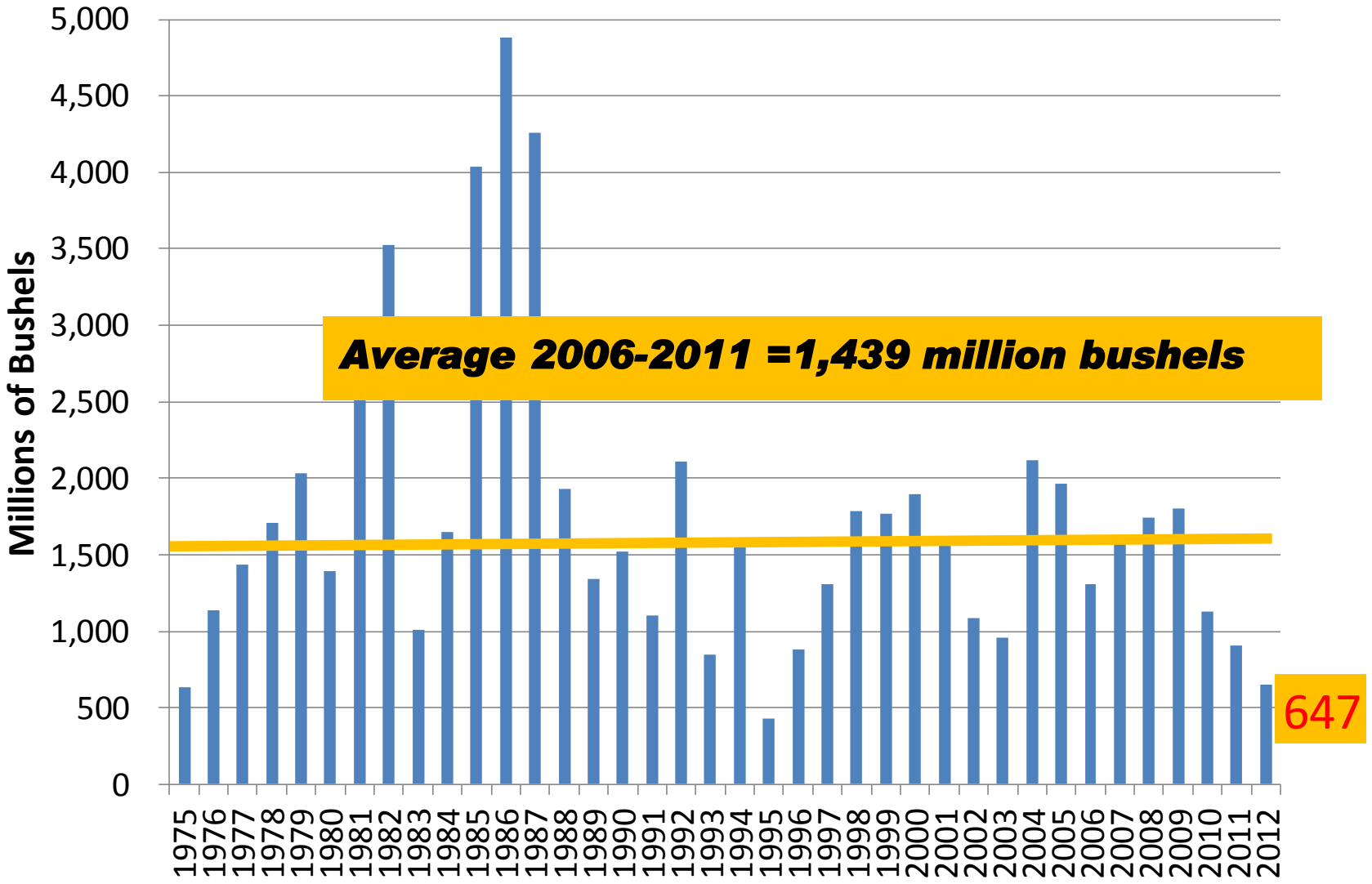
Impacts of equal supply shocks when stocks are low vs when they are high



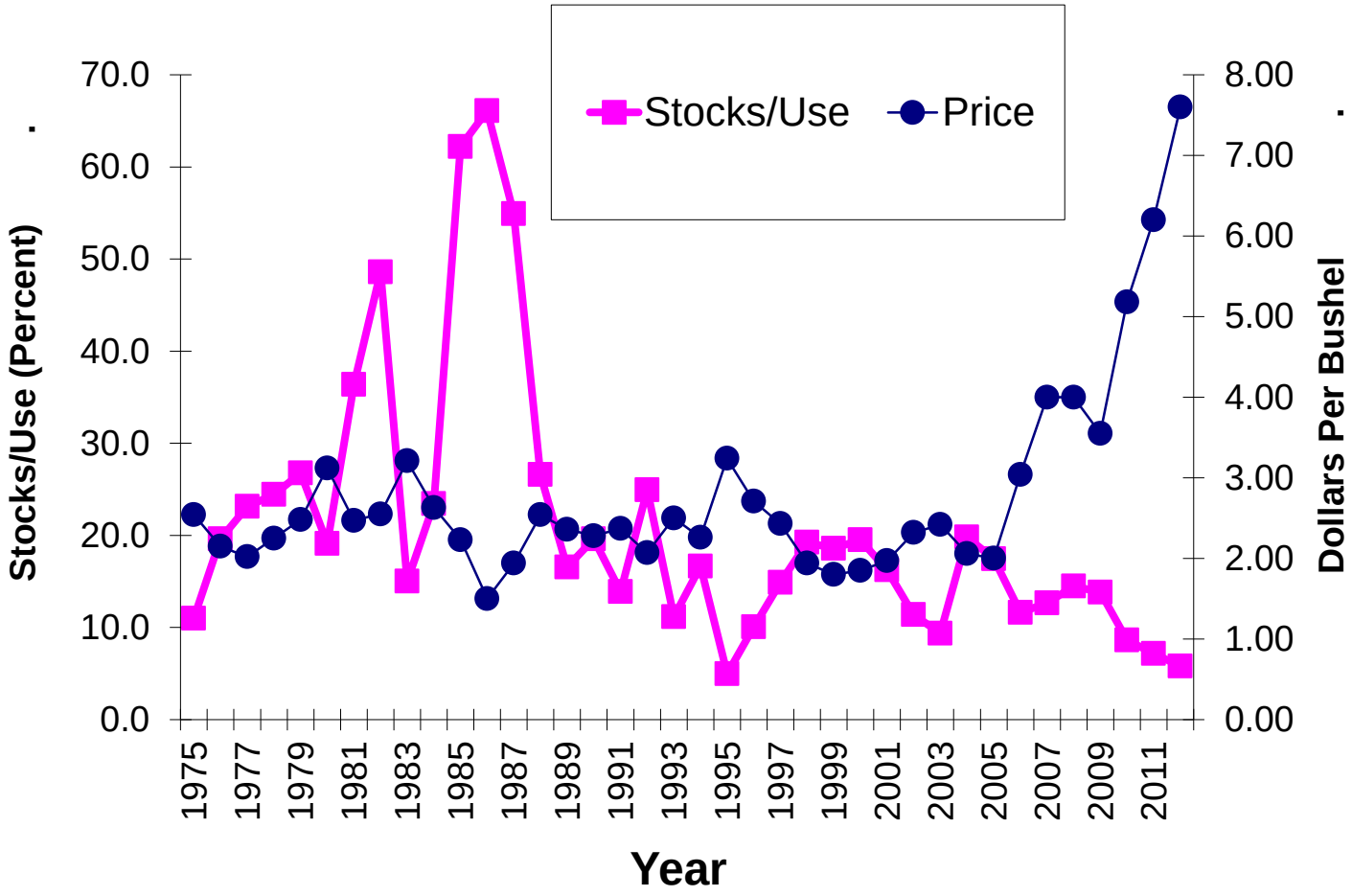
- Aggregate demand for a commodity consists of demand for current consumption and demand for stocks to be put into storage in expectation of future price rises.
- At low prices there tends to be stock build up on the expectation of price rises
- Adding the demand for stocks to demand for current consumption makes the total demand much more elastic compared to high-price periods in which the demand for stocks disappears
- The price impacts of a given supply shock are accordingly much less when prices are relatively low.
- "In 1972/73, a decline in world wheat production of less than 2 percent at a time when stocks were low caused the annual price to more than double."

Source: Brian Wright (Dec 2008), Giannini Foundation of Ag Econ, UC

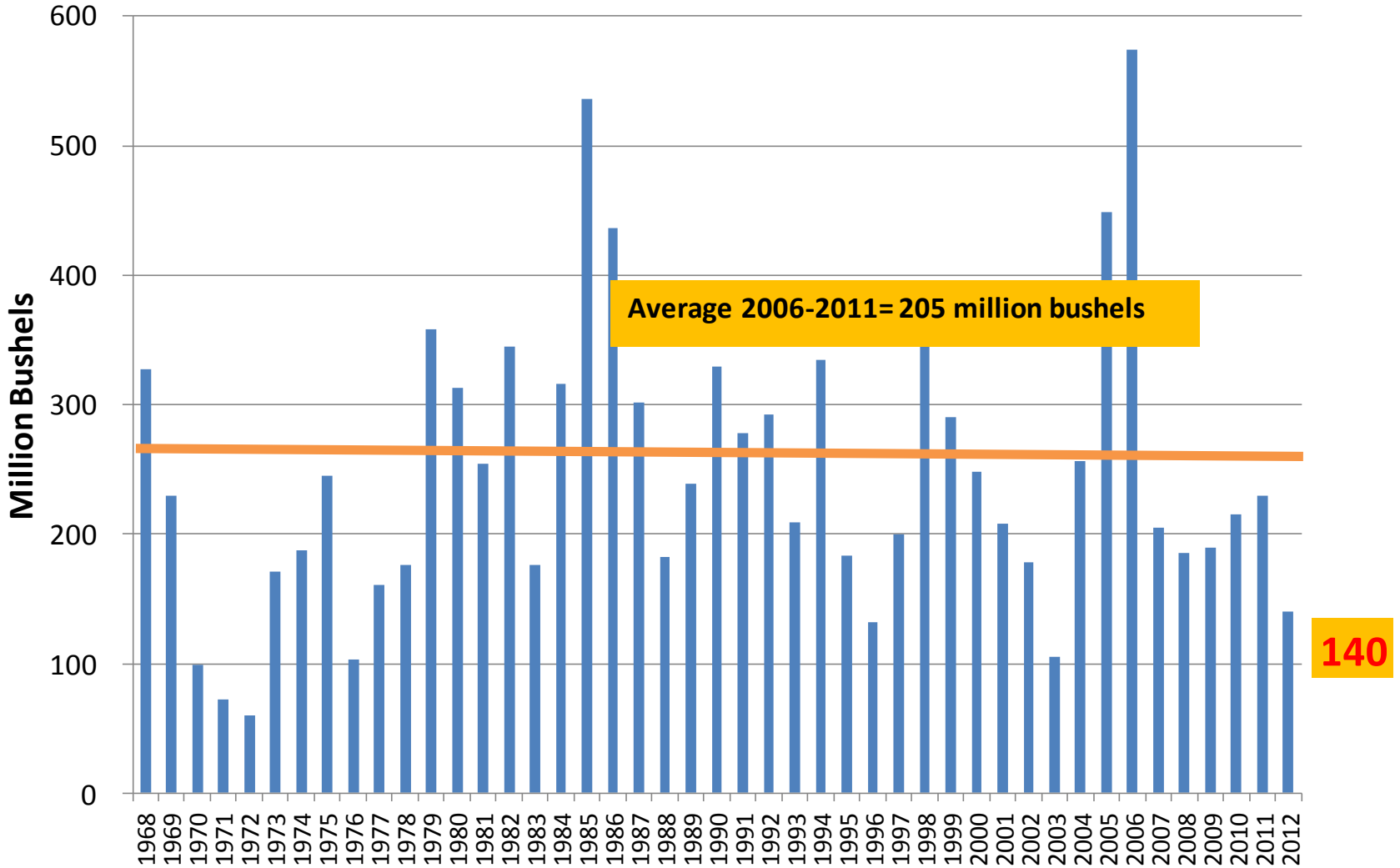
US Corn Ending Stocks 1975-2012



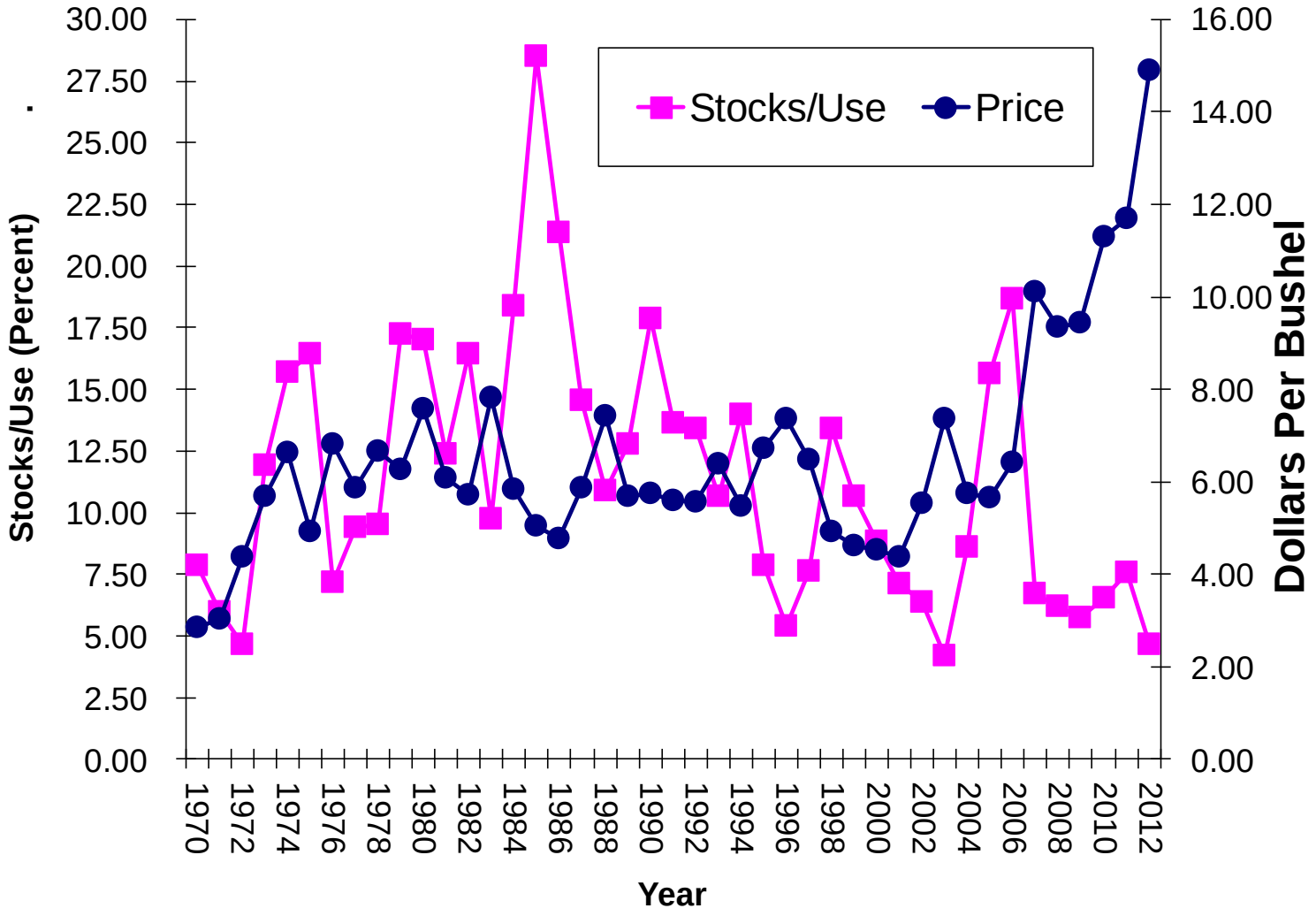
U.S. Corn Stocks/Use and Average Farm Price 1975-2012



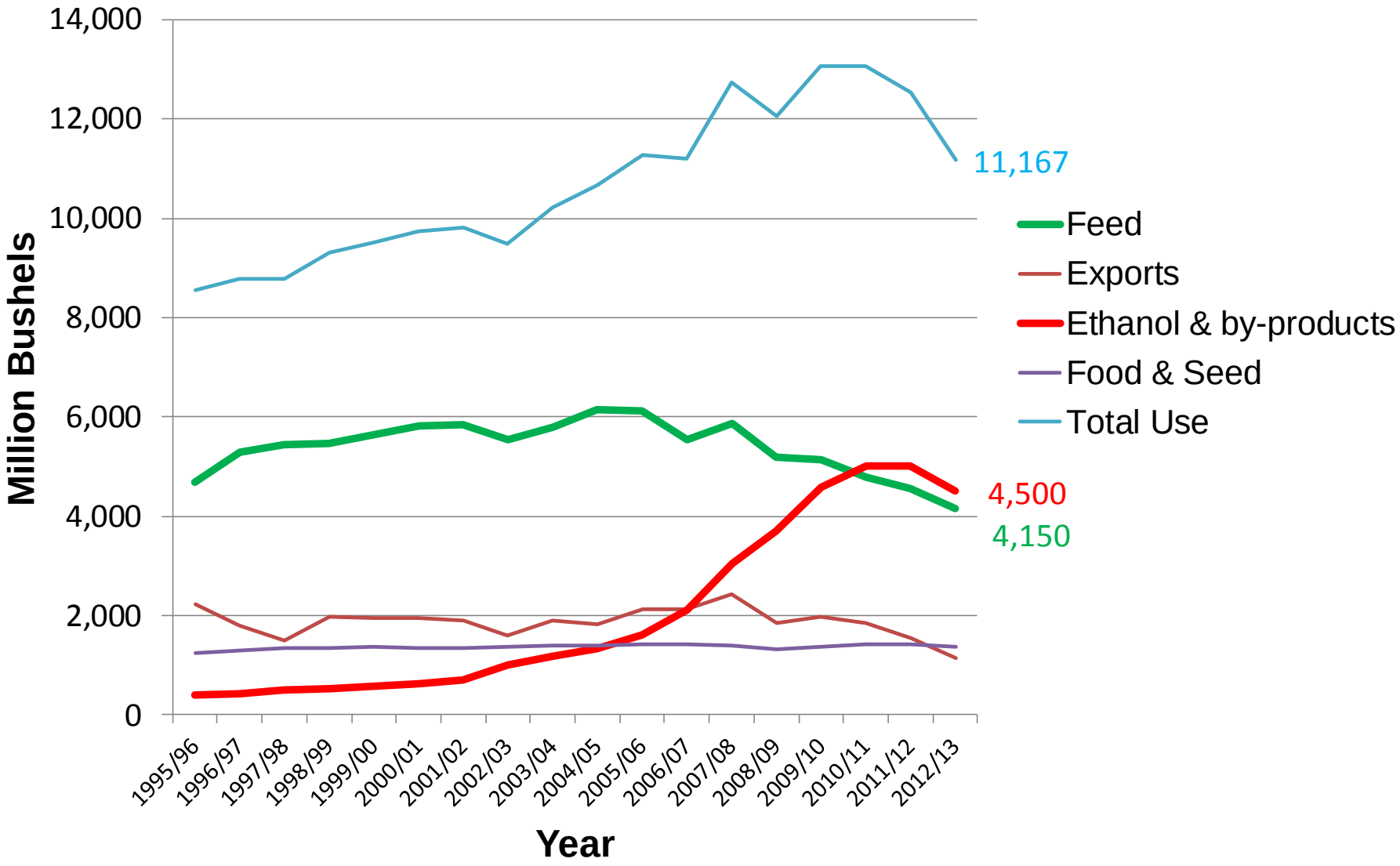
US Soybeans Ending Stocks 1968-2012



U.S. Soybean Stocks/Use and Average Farm Price 1970-2012



U.S. Total Corn Use by Types 1995/96-2012/13



EDM to Evaluate Question of Interest

- Developed an EDM of the corn and soybean complex. This EDM takes account of the following salient features of the markets:
  - soybeans are crushed into meal and oil and exported
    - Exports of meal and oil
  - corns major use is no longer feed but is processed into ethanol and DDGs and is exported
    - Exports of DDG's
  - Supply-side: corn and soybeans compete for acreage
  - Demand-side: DDGs compete with soybean meal in the feed market

- The EDM comprises 29 equations and endogenous variables that can be used to simulate the impacts of a variety of different exogenous shifts on any of the endogenous variables
  - 8 domestic demand elasticities (6 own & 2 cross)
  - 6 export demand elasticities
  - 4 supply elasticities (2 own & 2 cross)
  - 4 acreage response elasticities
  - 8 domestic market shares

Parameterizing EDM & Simulations

❑ Parameters

- Use a baseline of average of the past 3 years 2010/11, 2011/12, 2012/13
- Attempts to econometrically estimate demand, export, supply, and acreage elasticities over the period 1996-2012 were unsuccessful
  - 17 observations insufficient to capture economic relationships
  - Increasing sample size requires going back before 1996 which represents a different regime (see Cooper, Goodwin, Piggott 2012 AAEA meetings paper)
  - Assigned economically plausible values reflecting tight supplies and inelastic demands

❑ Simulations

a. What if crop insurance premium subsidies were reduced in new Farmbill? Represent this change as a commensurate reduction in corn and soybean supplies of 10%, respectively.

b. What if a waiver of the RFS was implemented to allow corn supplies to replenish. Represent this as a commensurate reduction in ethanol demand of 50%.

c. Simulation a. & b. jointly.

Simulation Results

			a. Reduction in Crop Insurance Subsidy (10% decrease in supply of corn & soybeans)			b. Waiver of the RFS (50% decrease in demand for ethanol)			a. & b.		
	Name & Units	Baseline	% Δ	Δ	New	% Δ	Δ	New	% Δ	Δ	New
B	total quantity of soybeans produced (mil. Bu)	3,131	-10.6	-333	2,798	2.7	84	3,216	-10.2	-320	2,812
BD	quantity of soybeans sold in domestic (U.S.) market (mil. Bu)	3,118	-8.1	-252	2,867	0.9	30	3,148	-6.5	-203	2,915
BX	quantity of soybeans exported (mil. Bu)	1,376	-16.4	-226	1,150	6.7	92	1,468	-18.6	-256	1,120
C	total quantity of corn produced (mil. Bu)	11,843	-8.4	-993	10,850	-3.9	-462	11,381	-8.9	-1,048	10,795
CF	quantity of corn feed in domestic (U.S.) market (mil. Bu)	4,497	-3.3	-146	4,351	5.4	242	4,739	-2.8	-127	4,370
CFS	quantity of corn food & seed in domestic (U.S.) market (mil. Bu)	1,400	-3.3	-46	1,354	5.4	75	1,475	-2.8	-40	1,360
CDE	quantity of corn converted to ethanol & DDG's in U.S. market (mil. Bu)	4,843	-7.1	-345	4,498	-33.2	-1,608	3,236	-10.1	-490	4,353
CX	quantity of corn exported (mil. Bu)	1,509	-32.5	-491	1,018	53.8	812	2,321	-28.3	-427	1,082
PM	price of soybean meal ($/s.t.)	$403.02	3.9	$15.71	$418.72	-2.9	-$11.56	$391.46	5.8	$23.56	$426.57
P0	price of soybean oil (c/lb)	$52.70	6.8	$3.60	$56.30	-0.8	-$0.42	$52.28	5.5	$2.91	$55.61
PB	farm price of soybeans ($/bu)	$12.90	3.3	$0.42	$13.32	-1.3	-$0.17	$12.73	3.7	$0.48	$13.38
PD	price of DDG's ($/ton)	$223.84	4.0	$9.04	$232.88	13.2	$29.46	$253.30	-12.0	-$26.82	$197.01
PE	price of ethanol ($/gal)	$2.49	4.7	$0.12	$2.61	-11.2	-$0.28	$2.21	6.7	$0.17	$2.66
PC	farm price of corn ($/bu)	$6.33	6.5	$0.41	$6.75	-10.8	-$0.68	$5.65	5.7	$0.36	$6.69
AB	planted acres of soybeans (mil. Acres)	76.5	-0.9	-0.7	75.8	4.4	3.4	79.9	-0.2	-0.2	76.4
AC	planted acres of corn (mil. Acres)	92.3	2.9	2.7	95.0	-6.9	-6.3	86.0	2.1	1.9	94.3
AT	total planted acres of corn and soybeans (mil. Acres)	168.9	1.2	2.0	170.8	-1.7	-2.9	165.9	1.0	1.8	170.6

Final Remarks

- Reduction in crop insurance premium subsidy (simulated as 10% reduction in supply of corn and soybeans) will lead to further increases in corn (6.5%) and soybean (3.3%) prices
  - $6.75/bu corn & $13.32/bu soybeans
- Reduction in RFS (simulated as 50% reduction in ethanol demand will lead to some price relief with corn (-10.8%) and soybean (-1.3%) price declines with some additional corn supplied for feed to livestock producers with 242 mil. bu increase
  - $5.65 corn & $12.73 soybeans
- The two scenarios combined, confirms even if a. & b. occurred jointly we are in a new regime of higher corn prices (5.7%) and soybean prices (3.7%), and with more total acres (1%).
  - $5.69 corn & $13.38 soybeans
  - 76.4 & 94.3 (=170.6) mil acres of corn & soybeans, respectively
- The toll of the aggressive biofuels policy is evident on corn prices which impacts a multitude of food products. Furthermore, a reduction of crop insurance subsidies on premiums only worsens this inflationary impact & presumably the volatility as well.

Appendix

Endogenous Variables (29 total)

1. B = total quantity of soybeans produced
2. B^D = quantity of soybeans sold in domestic (U.S.) market
3. B^X = quantity of soybeans exported
4. O = quantity of soybean oil produced
5. O^D = quantity of soybean oil sold in domestic (U.S.) market
6. O^X = quantity of soybean oil exported
7. M = quantity of soybean meal produced
8. M^D = quantity of soybean meal sold in domestic (U.S.) market
9. M^X = quantity of soybean meal exported
10. C = total quantity of corn produced
11. C^F = quantity of corn feed in domestic (U.S.) market
12. C^{FS} = quantity of corn food & seed in domestic (U.S.) market
13. C^{DE} = quantity of corn converted to ethanol & DDG's in U.S. market
14. C^X = quantity of corn exported
15. D = quantity of DDG's produced
16. D^D = quantity of DDG's sold in domestic (U.S.) market
17. D^X = quantity of DDG's exported
18. E = quantity of ethanol produced
19. E^D = quantity of ethanol sold in domestic (U.S.) market
20. E^X = quantity of ethanol exported
21. P_M = price of soybean meal
22. P_0 = price of soybean oil
23. P_B = farm price of soybeans
24. P_D = price of DDG's
25. P_E = price of ethanol
26. P_C = farm price of corn
27. A^B = planted acres of soybeans
28. A^C = planted acres of corn
29. A^T = total planted acres of corn and soybeans

m^B = crushing margin for soybeans[1]

m^C = crushing margin for corn[2]

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[1] When a bushel of soybeans weighing 60 pounds is crushed, it produces 44 lbs of 48% protein soybean meal, 11 lbs of soybean oil, 4 pounds of hulls, and 1 pound of waste:

Soybean Crush=Price soybean meal ($/ton)*0.022 (=44/2000) + Price soybean oil in $/cwt (cents/lbs)*11 – Price of soybeans ($/bu)

[2] When a bushel of corn weighing 56 pounds is processed for ethanol it yields 2.8 gallons of ethanol and 17 pounds of Distillers Dry Grains (DDG's):

Corn Crush=Price of DDG's ($/ton)*0.0085(=l7/2000) + Price of Ethanol ($/gal)*2.8 – Price of Corn ($/bu)

Appendix….

$M^D = \mathrm{M}(P_M, P_D, t_{M^D})$	[Domestic Demand for soybean meal]
$O^D = \mathrm{O}(P_O, t_{O^D})$	[Domestic Demand for soybean oil]
$M = \alpha_{\mathrm{M}}(t_{\alpha M})B^D$	[Production of soybean meal]
$O = \alpha_{\mathrm{O}}(t_{\alpha O})B^D$	[Production of soybean oil]
$P_B = \mathrm{P}_{\mathrm{B}}(P_M, P_O, \alpha_M(t_{\alpha M}), \alpha_O(t_{\alpha O}), m^B(t_{m^B}))$	[Crush demand for soybeans]
$M^X = \mathrm{M}(P_{M,} t_{M^X})$	[Export Demand for soybean meal]
$O^X = \mathrm{O}(P_O, t_{O^X})$	[Export Demand for soybean oil]
$B^X = \mathrm{B}^X(P_B, t_{B^X})$	[Export demand for soybeans]
$M = M^D + M^X$	[Total demand for soybean meal]
$O = O^D + O^X$	[Total demand for soybean oil]
$B = B^D + B^X$	[Total demand for soybeans]
$B = \mathrm{B}(P_B, P_C, t_B)$	[Supply of soybeans]
$D^D = \mathrm{D}(P_D, P_M, t_{D^D})$	[Domestic Demand for DDG's]
$E^D = \mathrm{E}(P_E, t_{E^D})$	[Domestic Demand for ethanol]
$E = \beta_{\mathrm{E}}(t_{\beta E})C^{DE}$	[Production of ethanol]
$D = \beta_{\mathrm{D}}(t_{\beta D})C^{DE}$	[Production of DDG's]
$P_C = \mathrm{P}_{\mathrm{C}}(P_D, P_E, \beta_{\mathrm{D}}(t_{\beta D}), \beta_{\mathrm{E}}(t_{\beta E}), m^C(t_\beta))$	[Processing demand for corn]
$D^X = (D_D, t_{D^X})$	[Export Demand for DDG's]
$E^X = E(P_E, t_{E^X})$	[Export Demand for soybean oil]
$C^F = \mathrm{C}^{\mathrm{F}}(P_C)$	[Domestic Demand for corn feed]
$C^{FS} = \mathrm{C}^{\mathrm{FS}}(P_C)$	[Domestic Demand for corn food & seed]
$C^X = \mathrm{C}^{\mathrm{X}}(P_C, t_{C^X})$	[Export demand for corn]
$D = D^D + D^X$	[Total demand for DDG's]
$E = E^D + E^X$	[Total demand for ethanol]
$C = C^F + C^{FS} + C^{DE} + C^X$	[Total demand for corn]
$C = C(P_C, P_B, t_C)$	[Supply of corn]
$A^B = \mathrm{A}^{\mathrm{B}}(P_B, P_C)$	[Soybean Acreage]
$A^C = \mathrm{A}^{\mathrm{C}}(P_C, P_B)$	[Corn Acreage]
$A^T = A^B + A^C$	[Total Acreage]

Appendix….

$M^D = \mathrm{M}(P_M, P_D, t_{M^D})$	[Domestic Demand for soybean meal]
$O^D = \mathrm{O}(P_O, t_{O^D})$	[Domestic Demand for soybean oil]
$M = \alpha_{\mathrm{M}}(t_{\alpha M})B^D$	[Production of soybean meal]
$O = \alpha_{\mathrm{O}}(t_{\alpha O})B^D$	[Production of soybean oil]
$P_B = \mathrm{P}_{\mathrm{B}}(P_M, P_O, \alpha_M(t_{\alpha M}), \alpha_O(t_{\alpha O}), m^B(t_{m^B}))$	[Crush demand for soybeans]
$M^X = \mathrm{M}(P_{M,} t_{M^X})$	[Export Demand for soybean meal]
$O^X = \mathrm{O}(P_O, t_{O^X})$	[Export Demand for soybean oil]
$B^X = \mathrm{B}^X(P_B, t_{B^X})$	[Export demand for soybeans]
$M = M^D + M^X$	[Total demand for soybean meal]
$O = O^D + O^X$	[Total demand for soybean oil]
$B = B^D + B^X$	[Total demand for soybeans]
$B = \mathrm{B}(P_B, P_C, t_B)$	[Supply of soybeans]
$D^D = \mathrm{D}(P_D, P_M, t_{D^D})$	[Domestic Demand for DDG's]
$E^D = \mathrm{E}(P_E, t_{E^D})$	[Domestic Demand for ethanol]
$E = \beta_{\mathrm{E}}(t_{\beta E})C^{DE}$	[Production of ethanol]
$D = \beta_{\mathrm{D}}(t_{\beta D})C^{DE}$	[Production of DDG's]
$P_C = \mathrm{P}_{\mathrm{C}}(P_D, P_E, \beta_{\mathrm{D}}(t_{\beta D}), \beta_{\mathrm{E}}(t_{\beta E}), m^C(t_\beta))$	[Processing demand for corn]
$D^X = (D_D, t_{D^X})$	[Export Demand for DDG's]
$E^X = E(P_E, t_{E^X})$	[Export Demand for soybean oil]
$C^F = \mathrm{C}^{\mathrm{F}}(P_C)$	[Domestic Demand for corn feed]
$C^{FS} = \mathrm{C}^{\mathrm{FS}}(P_C)$	[Domestic Demand for corn food & seed]
$C^X = \mathrm{C}^{\mathrm{X}}(P_C, t_{C^X})$	[Export demand for corn]
$D = D^D + D^X$	[Total demand for DDG's]
$E = E^D + E^X$	[Total demand for ethanol]
$C = C^F + C^{FS} + C^{DE} + C^X$	[Total demand for corn]
$C = C(P_C, P_B, t_C)$	[Supply of corn]
$A^B = \mathrm{A}^{\mathrm{B}}(P_B, P_C)$	[Soybean Acreage]
$A^C = \mathrm{A}^{\mathrm{C}}(P_C, P_B)$	[Corn Acreage]
$A^T = A^B + A^C$	[Total Acreage]

Appendix….

$$\tilde{M}^{D} - \eta_{MM}\tilde{P}_{M} - \eta_{MD}\tilde{P}_{D} = \varphi_{M^{D}t_{M^{D}}}\tilde{t}_{M^{D}}$$

$$\tilde{O}^{D} - \eta_{OO}\tilde{P}_{O} = \varphi_{O^{D}t_{O^{D}}}\tilde{t}_{O^{D}}$$

$$\tilde{M} - \tilde{B}^{D} = \varphi_{\alpha_{M}t_{\alpha}}\tilde{t}_{\alpha}$$

$$\tilde{O} - \tilde{B}^{D} = \varphi_{\alpha_{O}t_{\alpha}}\tilde{t}_{\alpha}$$

$$\tilde{P}_{B} - \left(\frac{P_{M}M}{P_{B}B^{D}}\right)\tilde{P}_{M} - \left(\frac{P_{o}O}{P_{B}B^{D}}\right)\tilde{P}_{O} = \varphi_{\alpha_{M}t_{\alpha M}}\tilde{t}_{\alpha M} + \varphi_{\alpha_{O}t_{\alpha O}}\tilde{t}_{\alpha O} + \varphi_{mm^{B}}$$

$$\tilde{M}^{X} - \mu_{MM}\tilde{P}_{M} = \varphi_{M^{X}M^{X}}\tilde{t}_{M^{X}}$$

$$\tilde{O}^{X} - \mu_{OO}\tilde{P}_{O} = \varphi_{O^{X}O^{X}}\tilde{t}_{O^{X}}$$

$$\tilde{B}^{X} - \mu_{BB}\tilde{P}_{B} = \varphi_{B^{X}B^{X}}\tilde{t}_{B^{X}}$$

$$\tilde{M} - k_{M}\tilde{M}^{D} - (1-k_{M})\tilde{M}^{X} = 0$$

$$\tilde{O} - k_{O}\tilde{O}^{D} - (1-k_{O})\tilde{O}^{X} = 0$$

$$\tilde{B} - k_{B}\tilde{B}^{D} - (1-k_{B})\tilde{B}^{X} = 0$$

$$\tilde{B} - \varepsilon_{BB}\tilde{P}_{B} - \varepsilon_{BC}\tilde{P}_{C} = \varphi_{Bt_{B}}\tilde{t}_{B}$$

$$\tilde{D}^{D} - \eta_{DD}\tilde{P}_{D} - \eta_{DM}\tilde{P}_{M} = \varphi_{D^{D}t_{D^{D}}}\tilde{t}_{D^{D}}$$

$$\tilde{E}^{D} - \eta_{EE}\tilde{P}_{E} = \varphi_{E^{D}t_{E^{D}}}\tilde{t}_{E^{D}}$$

$$\tilde{D} - \tilde{C}^{DE} = \varphi_{\alpha_{D}t_{\beta}}\tilde{t}_{\beta}$$

$$\tilde{E} - \tilde{C}^{DE} = \varphi_{\alpha_{E}t_{\beta}}\tilde{t}_{\beta}$$

$$\tilde{P}_{C} - \left(\frac{P_{D}D}{P_{C}C^{DE}}\right)\tilde{P}_{D} - \left(\frac{P_{E}E}{P_{C}C^{DE}}\right)\tilde{P}_{E} = \varphi_{\beta_{D}t_{\beta D}}\tilde{t}_{\beta D} + \varphi_{\beta_{E}t_{\beta}}\tilde{t}_{\beta E} + \varphi_{mm^{C}}$$

$$\tilde{D}^{X} - \mu_{DD}\tilde{P}_{D} = \varphi_{D^{X}D^{X}}\tilde{t}_{D^{X}}$$

$$\tilde{E}^{X} - \mu_{EE}\tilde{P}_{E} = \varphi_{E^{X}E^{X}}\tilde{t}_{E^{X}}$$

$$\tilde{C}^{F} - \eta_{C^{F}P_{C}}\tilde{P}_{C} = 0$$

$$\tilde{C}^{FS} - \eta_{C^{FS}P_{C}}\tilde{P}_{C} = 0$$

$$\tilde{C}^{X} - \mu_{CC}\tilde{P}_{C} = \varphi_{C^{X}t_{C^{X}}}\tilde{t}_{C^{X}}$$

$$\tilde{D} - k_{D}\tilde{D}^{D} - (1-k_{D})\tilde{D}^{X} = 0$$

$$\tilde{E} - k_{E}\tilde{E}^{D} - (1-k_{E})\tilde{E}^{X} = 0$$

$$\tilde{C} - k_{C^{F}}\tilde{C}^{F} - k_{C^{FS}}\tilde{C}^{FS} - k_{C^{DE}}\tilde{C}^{D} - k_{C^{X}}\tilde{C}^{X} = 0$$

$$\tilde{C} - \varepsilon_{CC}\tilde{P}_{C} - \varepsilon_{CB}\tilde{P}_{B} = \varphi_{Ct_{C}}\tilde{t}_{C}$$

$$\tilde{A}^{B} - \pi_{BB}\tilde{P}_{B} - \pi_{BC}\tilde{P}_{C} = 0$$

$$\tilde{A}^{C} - \pi_{CC}\tilde{P}_{C} - \pi_{CB}\tilde{P}_{B} = 0$$

Appendix….

Endogenous Variable	Name & Units	2010/11	2011/12	2012/13	Baseline
	total quantity of soybeans produced (mil. Bu)	3,329	3,094	2,971	**3,131**
BD	quantity of soybeans sold in domestic (U.S.) market (mil. Bu)	3,280	3,155	2,920	**3,118**
BX	quantity of soybeans exported (mil. Bu)	1,501	1,362	1,265	**1,376**
O	quantity of soybean oil produced (mil. lbs)	18,888	19,740	17,830	**18,819**
OD	quantity of soybean oil sold in domestic (U.S.) market (mil. lbs)	20,028	19,774	19,200	**19,667**
OX	quantity of soybean oil exported (mil. lbs)	3,233	1,464	1,200	**1,966**
M	quantity of soybean meal produced (000's s.t.)	39,251	41,025	37,150	**39,142**
MD	quantity of soybean meal sold in domestic (U.S.) market (000's s.t.)	30,301	31,550	29,500	**30,450**
MX	quantity of soybean meal exported (000's s.t.)	9,081	9,741	7,900	**8,907**
C	total quantity of corn produced (mil. Bu)	12,447	12,358	10,725	**11,843**
CF	quantity of corn feed in domestic (U.S.) market (mil. Bu)	4,795	4,547	4,150	**4,497**
CFS	quantity of corn food & seed in domestic (U.S.) market (mil. Bu)	1,406	1,426	1,367	**1,400**
CDE	quantity of corn converted to ethanol & DDG's in U.S. market (mil. Bu)	5,019	5,011	4,500	**4,843**
CX	quantity of corn exported (mil. Bu)	1,834	1,543	1,150	**1,509**
D	quantity of DDG's produced (mil. Metric. tons)	35.40	35.40	31.60	**34.13**
DD	quantity of DDG's sold in domestic (U.S.) market (mil. Metric. tons)	28.4	29.2	25.5	**27.7**
DX	quantity of DDG's exported (mil. Metric. tons)	8.3	7.5	7.5	**7.8**
E	quantity of ethanol produced (mil gals)	13,811	13,790		**13,801**
ED	quantity of ethanol sold in domestic (U.S.) market (mil. gals)	14,590	14,879		**14,735**
EX	quantity of ethanol exported (mil. gals)	0	0		**0**
PM	price of soybean meal ($/s.t.)	345.52	393.53	470.00	**403.02**
P0	price of soybean oil (c/lb)	53.20	51.90	53.00	**52.70**
PB	farm price of soybeans ($/bu)	11.30	12.50	14.90	**12.90**
PD	price of DDG's ($/ton)	178.08	216.83	276.60	**224**
PE	price of ethanol ($/gal)	2.56	2.46	2.46	**2.49**
PC	farm price of corn ($/bu)	5.18	6.22	7.60	**6.33**
AB	planted acres of soybeans (mil. Acres)	77.4	75.0	77.2	**76.5**
AC	planted acres of corn (mil. Acres)	88.2	91.9	96.9	**92.3**
AT	total planted acres of corn and soybeans (mil. Acres)	165.6	166.9	174.1	**168.9**

Appendix….

Exogenous Variables					
mB	crushing margin for soybeans ($/bu)	2.15	1.87	1.27	**1.76**
mC	crushing margin for corn ($/bu)	3.50	2.51	1.64	**2.55**
αM	proportion of meal produced per unit of soybean	0.733	0.733	0.733	**0.733**
αO	proportion of oil produced per unit of soybean	0.183	0.183	0.183	**0.183**
βE	proportion of ethanol produced per unit of corn	0.696	0.696	0.696	**0.696**
βD	proportion of DDG produced per unit of corn	0.304	0.304	0.304	**0.304**
	November 2012 (WASDE)				
	DDG's S & D				
	Ethanol S & D				
	Price of DDG's				
	Price of ethanol				
Domestic Demand Elasticities		Guestimates	Estimated	Used in M	
η_{MM}	the own-price elasticity of demand for soybean meal	**-0.80**		**-0.80**	
η_{MD}	the cross-price elasticity of demand for soybean meal with respect to changes in DDG prices	**0.40**		**0.40**	
η_{OO}	the own-price elasticity of demand for soybean oil	**-0.80**		**-0.80**	
η_{DD}	the own-price elasticity of demand for DDG's	**-1.50**		**-1.50**	
η_{DM}	the cross-price elasticity of demand for DDG's with respect to changes in soybean meal prices	**0.40**		**0.40**	
η_{EE}	the own-price elasticity of demand for ethanol	**-1.50**		**-1.50**	
η_{FC}	the elasticity of the demand for feed corn with respect to the price of corn	**-0.50**		**-0.50**	
η_{SC}	the elasticity of the demand for food and seed with respect to the price of corn	**-0.50**		**-0.50**	
Export Demand Elasticities					
μ_{MM}	the own-price elasticity of export demand for soybean meal	**-5.00**		**-5.00**	
μ_{OO}	the own-price elasticity of export demand for soybean oil	**-5.00**		**-5.00**	
μ_{BB}	the own-price elasticity of export demand for soybeans	**-5.00**		**-5.00**	
μ_{DD}	the own-price elasticity of export demand for DDG's	**-5.00**		**-5.00**	
μ_{EE}	the own-price elasticity of export demand for ethanol	**-5.00**		**-5.00**	
μ_{CC}	the own-price elasticity of export demand for corn	**-5.00**		**-5.00**	
Supply Elasticities					
ε_{BB}	the own-price elasticity of supply for soybeans	**0.40**		**0.40**	
ε_{BC}	the cross-price elasticity of supply for soybeans with respect to the price of corn	**-0.30**		**-0.30**	
ε_{CC}	the own-price elasticity of supply for corn	**0.40**		**0.40**	
ε_{CB}	the cross-price elasticity of supply for corn with respect to the price of soybeans	**-0.30**		**-0.30**	
Acreage Response Elasticities					
π_{BB}	the own-price acreage response to the price of soybeans	**0.70**		**0.70**	
π_{BC}	the cross-price elasticity of acreage response for soybeans with respect to the price of corn	**-0.50**		**-0.50**	
π_{CC}	the own-price elasticity of acreage response for corn	**0.70**		**0.70**	
π_{CB}	the cross-price elasticity of acreage response for corn with respect to the price of soybeans	**-0.50**		**-0.50**	
	Best guestimate				
k_M	share of meal used in domestic market				**0.774**
k_O	share of oil used in domestic market				**0.909**
k_B	share of beans used in domestic market				**0.694**
k_F	share of corn feed in domestic market				**0.367**
k_{FS}	share of corn used in food and seed in domestic market				**0.114**
k_{DE}	share of corn converted to ethanol and DDG's in domestic market				**0.395**
k_X	share of corn exported				**0.123**
k_D	share of DDG's used in domestic market				**0.781**
k_E	share of ethanol used in domestic market				**1.000**
k_{AB}	share of ethanol used in domestic market				**0.453**
k_{AC}	share of ethanol used in domestic market				**0.547**