FAPRI modeling of farm program impacts on U.S. area planted

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FAPRI
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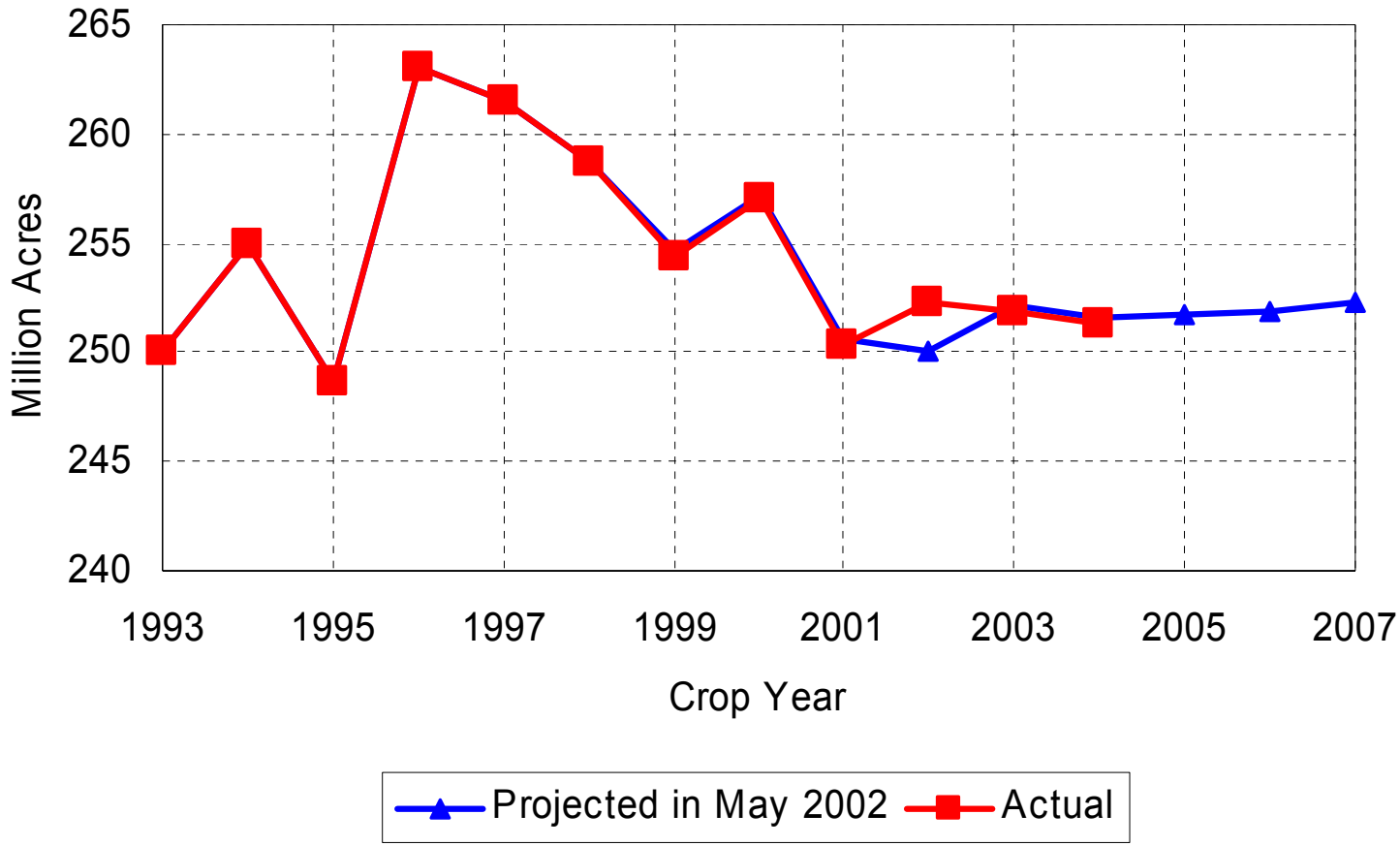
Agenda

- FAPRI approach to determining farm program impacts on area planted
- Some estimated and assumed parameters
- Some results

Some underlying assumptions

- Payments affect production decisions
- The more coupled the payment, the larger the effect on production decisions is likely to be
- Even largely decoupled payments are likely to have some modest impact on production decisions
- Thinking across commodities is critical—total acreage across crops deserves attention
- The world is stochastic, and especially programs with asymmetric effects need to be modeled stochastically

U.S. area planted to 9 major crops



Why worry about total area devoted to major crops?

- Land used for field crop production is not fixed—but most land will be planted to something
- If focus too much on impacts of payments on any one crop, can forget that things have to add up

Basic FAPRI approach

- Try to estimate response of total area to expected returns
- Use this information to calibrate parameters of assumed regional area equations
- Develop national equations consistent with these regional equations for use in stochastic model
- In all cases, incorporate assumptions about how $1 of payments under each program affects production vs. $1 of expected market returns
- Each of these will be discussed in turn

Estimating total area planted

- Use state-level data for 1997-2001 for mixed estimation of regional equations
- Expected net returns = (lagged prices+LDPs) * trend yields – variable expenses + 0.25*(PFC + MLA payments)
- Total area planted to major crops) = f(weighted average expected real net returns, CRP acreage, state dummies)

Elasticities of total area planted w/r/t expected net returns

	Elasticity
Corn Belt	0.02
Central Plains	0.02
Lake States	0.03
Southern Plains	0.06
Southeast	0.09
Delta States	0.13
Northern Plains	0.15
U.S. weighted average	0.06

Note: weighted average CRP effect: -0.77

Problems with the estimation

- Except for N. Plains & Delta, returns variable not statistically significant
- Should be updated to include 2002-2004 data
- Should use same price expectations utilized elsewhere in model—we don't just use lagged prices any more
- 0.25 factor on PFC & MLA payments is arbitrary
- BUT results are plausible (to me, anyway), and haven't caused any huge problems in our projection work

Sidebar—expected prices in the model

- National average expected price = f(lagged price, lagged yield/trend yield)
- Based on estimation of actual national prices as function of lagged price, lagged yield/current yield)
- Regional prices = f (national price, regional production/national production) (estimated)
- Expected regional price = f (expected national price, trend regional share of national production)
- Helps in year like 2004 (farmers should have known bean prices would fall this year) and especially in stochastic work
- Expected price equations have adjustment terms—so can line up to futures, etc. if desired

Regional area equation parameters

- Once we "know" the total area response to changes in returns, we build a matrix of own and cross effects that are consistent with that total area elasticity
- Although not estimated, we do a **lot** of calibration to make sure
  - Own-return elasticities are reasonable (to us)
  - Substitution relationships make sense (to us)
  - Symmetry is imposed
  - Resulting error terms for each area equation are relatively small and random in recent years

Corn Belt area planted coefficients (subset of the full matrix, deterministic model)

	Area						
Net return	Corn	Beans	Sor-ghum	Wheat	…	Coeff. sum	Total elast.
Corn	**4.00**	-3.05	-0.03	-0.19		0.56	
Beans (single)	-3.05	**4.00**	-0.03	-0.20		0.55	
Sorghum	-0.03	-0.03	**0.09**	-0.00		0.03	
Wheat (single)	-0.19	-0.20	-0.00	**0.55**		0.14	
…							
Coefficient sum	0.56	0.55	0.03	0.14		1.34	0.02

U.S. area planted elasticities (subset of the full matrix, stochastic model)

	Area						
Net return	Corn	Beans	Sor-ghum	Wheat	Cotton	…	10 crops
Corn	**0.18**	-0.10	-0.05	-0.05	-0.05		
Beans (single)	-0.06	**0.15**	-0.02	-0.03	-0.04		
Sorghum	-0.00	-0.00	**0.20**	-0.01	-0.01		
Wheat (single)	-0.01	-0.02	-0.05	**0.19**	-0.03		
Cotton	-0.01	-0.01	-0.05	-0.01	**0.21**		
...All 10 crops							**0.06**

Note: these are net return elasticities. Gross return or price elasticities would be substantially larger (e.g., corn own-gross return elasticity = 0.39)

Payment effects in the FAPRI model

- Marketing loans: $1 of expected LDP = $1 of expected market net returns
- Direct payments: $1 of DP = same effect on total area as $0.25 of expected market net returns
  - Effect not commodity specific—affects all commodities proportionally, doesn't affect crop mix
  - Tied to total area response—i.e., very small, given small total area elasticity
  - In model, eliminating all DPs would only change total area for all 10 modeled crops by about 1 mil. acres

Payment effects in the FAPRI model

- Counter-cyclical payments: $1 of expected CCPs has same effect as
  - $0.25 of expected market returns on total area (i.e., same as DP effect) PLUS
  - $0.25 of expected market returns on commodity-specific acreage (does affect crop mix)

Payment effects in the FAPRI model

- Mechanically
  - Supply-inducing net returns for each crop =
    - Expected price * trend yield – variable expenses +
    - Expected LDP (based on loan rate, expected price, and avg. historical relationship between prices & LDP rates) +
    - 25% of expected CCP (based on expected prices)
  - Each area equation also includes a "decoupled payment" term
    - Regional/national DPs + expected CCPs per acre for all crops
    - Coefficients for each crop picked so sum of effects across all crops is 25% of effect of similar change in per-acre market & LDP returns

Why these weights on various payments?

- Honest answer: judgment that could change based on new information
- LDPs very coupled, likely to have at least as much impact on production as market returns
- DPs relatively decoupled, but may hold some land in production because of wealth effect on risk behavior, base updating rules…
- CCPs in between
  - Decoupled from production like DPs
  - Have insurance effect that should be crop specific

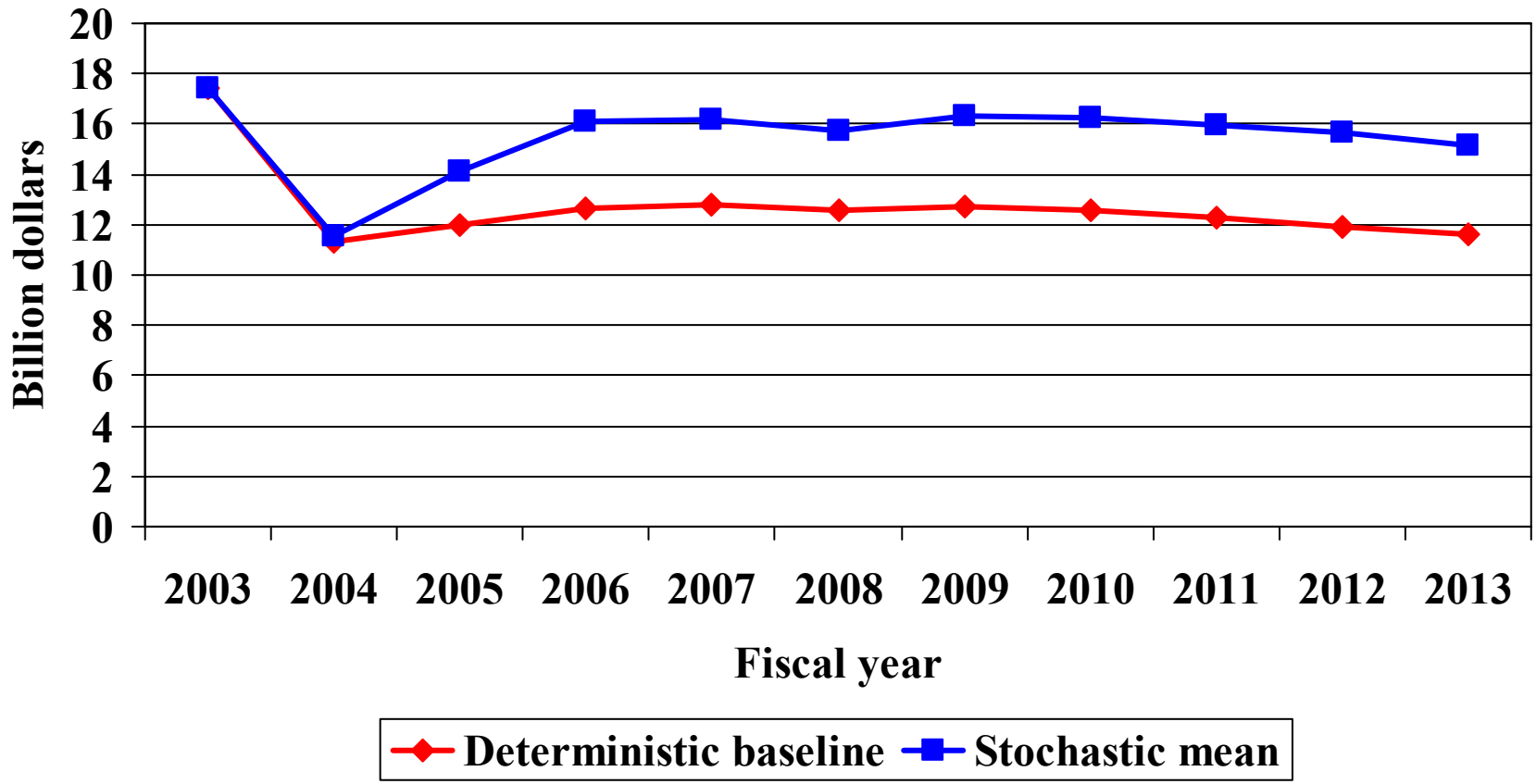
Why FAPRI does stochastic analysis

- Many programs (LDPs, CCPs) have asymmetric effects
  - Payments can get very large when prices low
  - But payments can't be negative when price high
- Inadequate to consider policy scenarios vs. single deterministic baseline
  - Consider change in loan rate
  - If baseline prices a little over loan rate, deterministically a loan rate reduction would have no effect on model
  - But in stochastic world, even if deterministic baseline is mean of prices, will be significant chance of LDP activity
  - If LDPs triggered, has production and price effects

How FAPRI does stochastic analysis

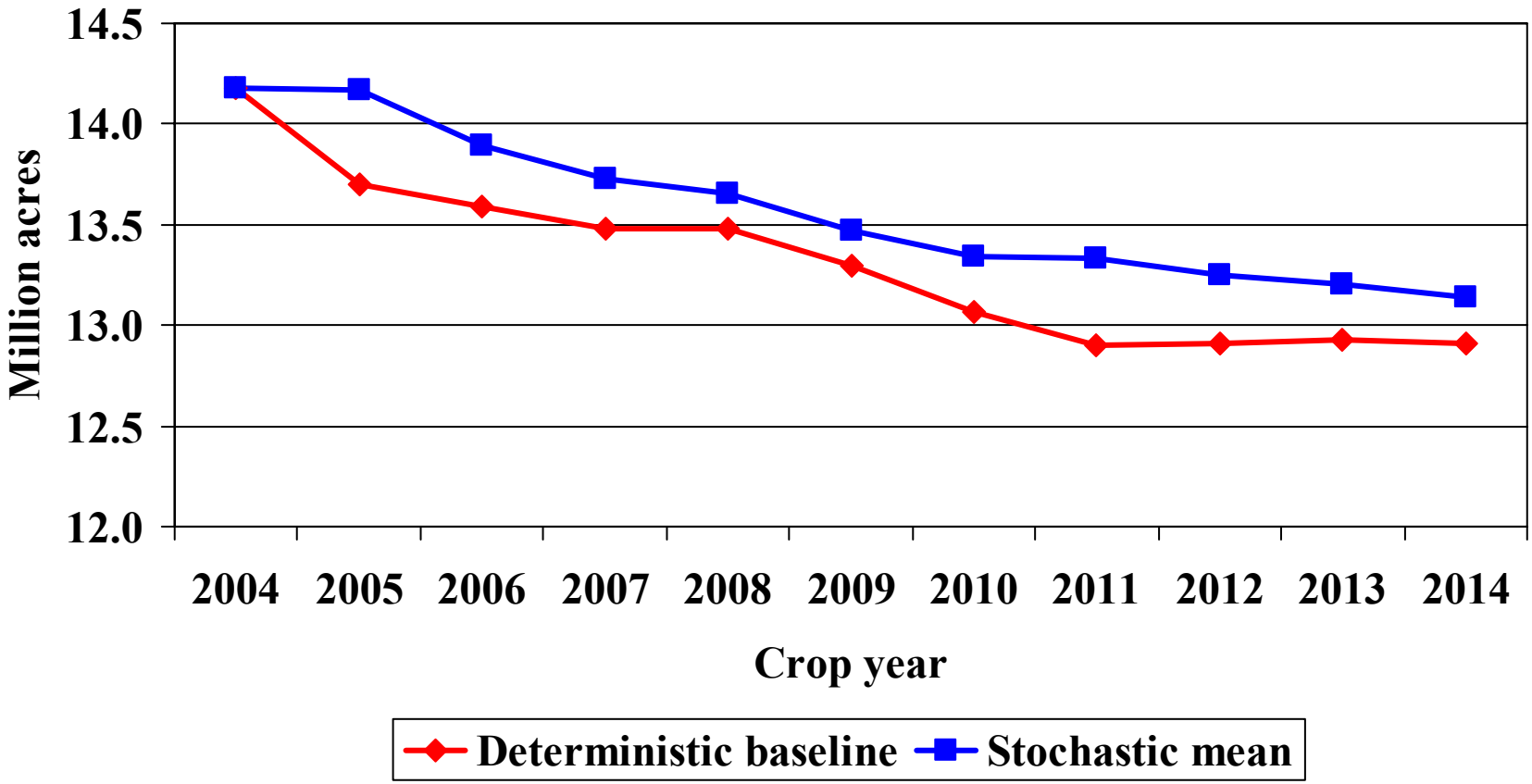
- Not time/place for full discussion
- In brief
  - Make correlated draws from deviations from trend yields, error terms from other important supply and demand equations
  - Solve model for each of 500 draws
  - Uses simplified version of FAPRI system
    - About 900 crop-livestock-accounting equations
    - Only national acreage—not regional as in deterministic model
    - Rest of world represented in reduced-form trade equations
    - Centered so at deterministic baseline values for all exogenous variables, get back deterministic baseline supply and demand

Importance of stochastic analysis: Projections of net CCC outlays



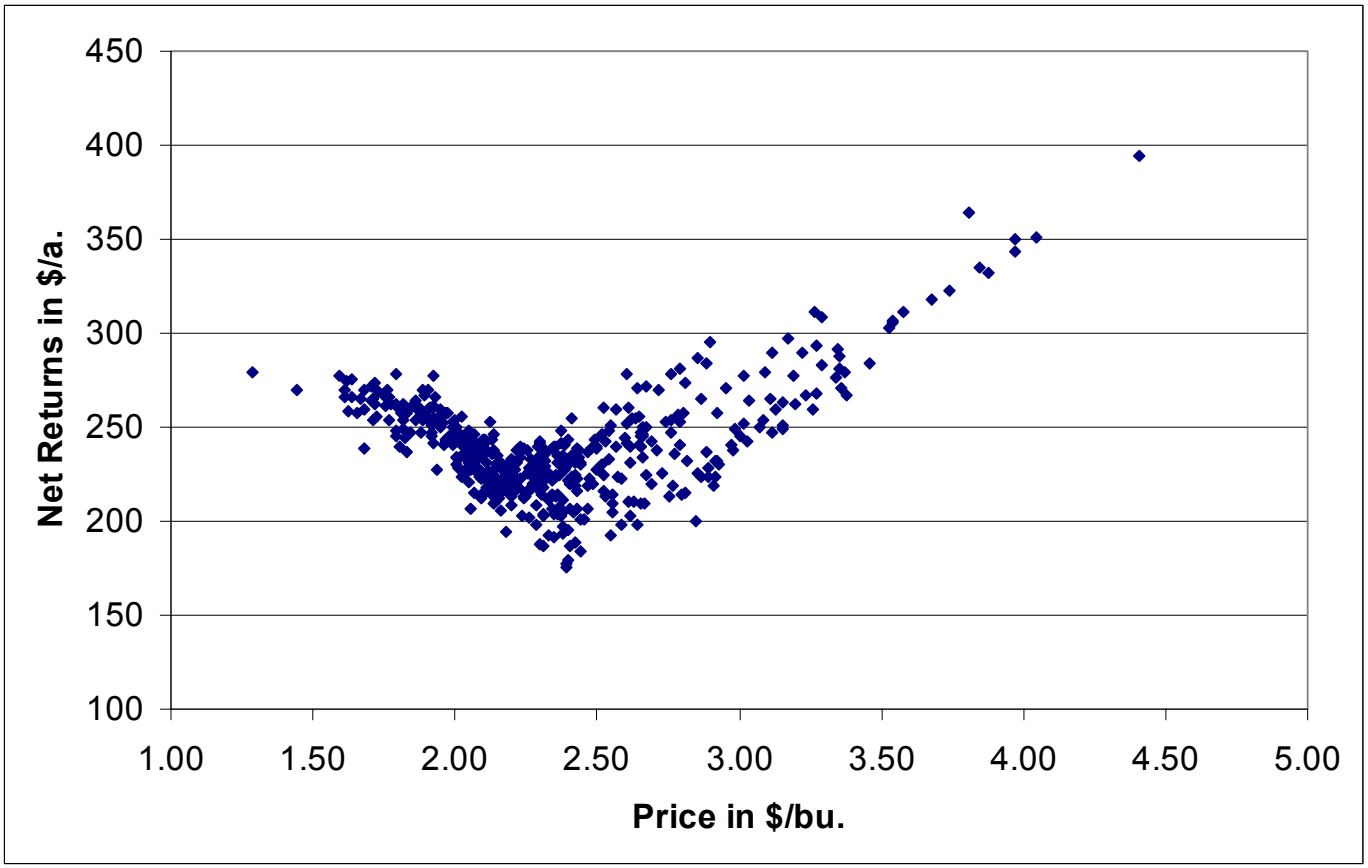
Source: FAPRI January 2004 baseline

Importance of stochastic analysis: Projections of U.S. cotton area planted



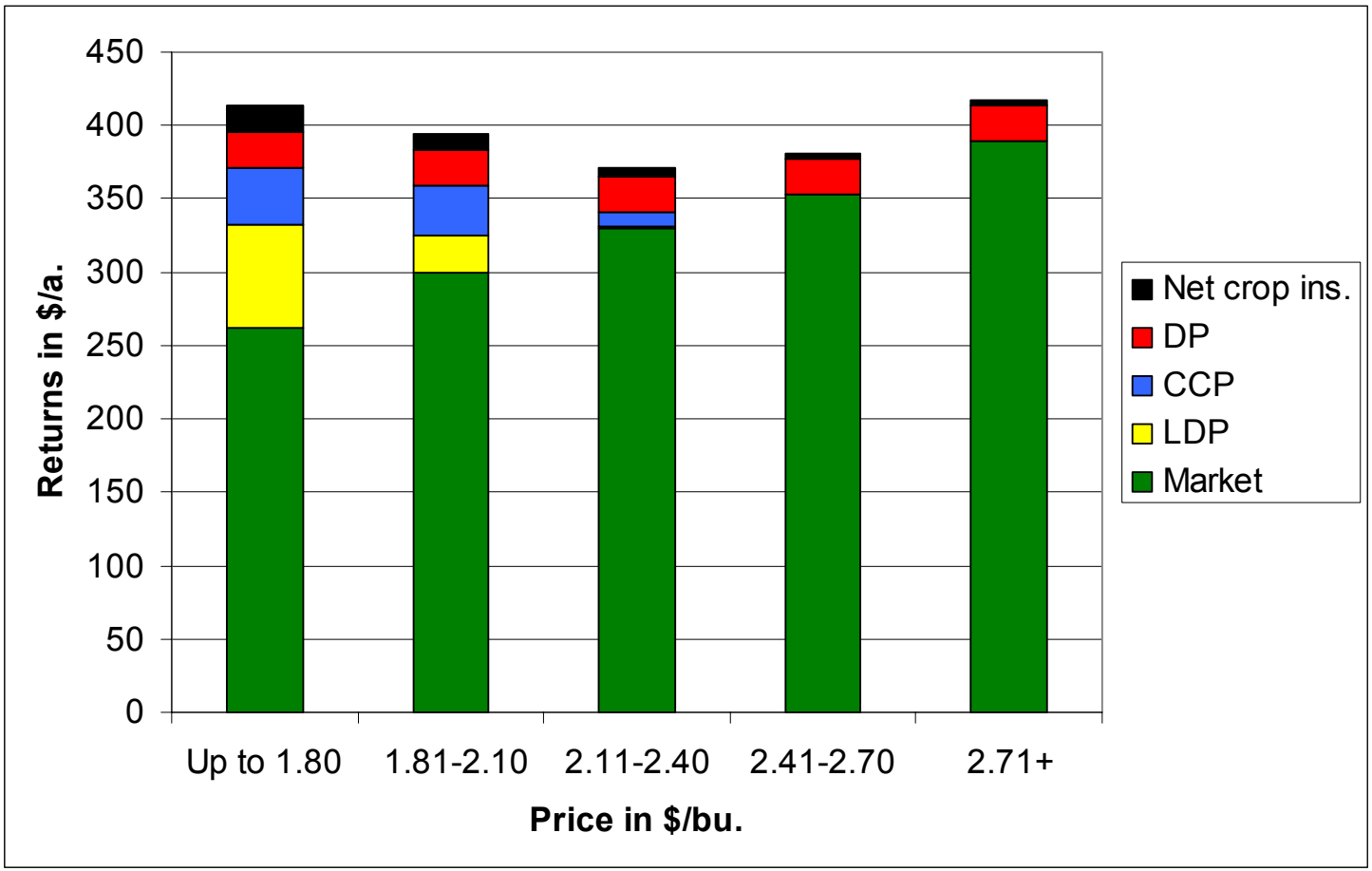
Source: FAPRI January 2004 baseline

Corn net returns* and market prices: 500 possible outcomes for 2005/06



* National average net returns over variable expenses from market and payments for a corn base acre planted to corn

Corn gross returns* in 2005/06: 500 outcomes grouped by market price



*National averages for a corn base acre planted to corn

Measures of uncertainty associated with 2005/06 corn returns

	Mean	Standard deviation	St. dev./ mean
Gross market returns (price * yield)	$331.86/a.	$42.35/a.	0.128
Net market returns (gross-var. costs)	$181.92/a.	$42.91/a.	0.236
Net market returns + LDP	$193.37/a.	$32.81/a.	0.170
Net market returns + CCP	$196.16/a.	$32.96/a.	0.168
Net market returns + LDP + CCP	$207.61/a.	$29.03/a.	0.140
Net mkt. ret. + LDP + CCP + DP	$231.99/a.	$29.03/a.	0.125

Source: FAPRI January 2004 stochastic baseline

Final comments

- We're still learning and modifying
  - Expected price approach just added this year
  - We're not set on current approach to modeling payments
    - Nothing magical about current parameters
    - Some things could be (re-)estimated
    - We'll look at non-econometric evidence, too
  - Stochastic modeling still as much an art form as science