Economics: What have Transgenics Meant for U.S. Farmers?

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Economic analyses of the benefits of transgenic crops

- Transgenic adoption in 2006
- Are transgenics valuable?
- Why do farmers value transgenics?
- How valuable are the non-monetary benefits of transgenics?
- Who captures the value of transgenics?
- Remaining issues economists can address

Adoption of Transgenics

- More rapid than comparable technology changes
- USDA NASS Acreage Report data best
- By state, by crop, by type: herbicide tolerant, insect resistant, stacked, and all biotech: www.nass.usda.gov
- Go to Publications, then Acreage

State	Corn	Soybeans	Cotton
AR		92	94
IL	55	87	
IN	40	92	
IA	64	91	
KS	68	85	
MI	44	81	
MN	73	88	
MS		96	98
MO	59	93	97
NE	76	90	
ND	83	90	
OH	26	82	
SD	86	93	
TX	77		70
WI	50	85	
US	61	89	83

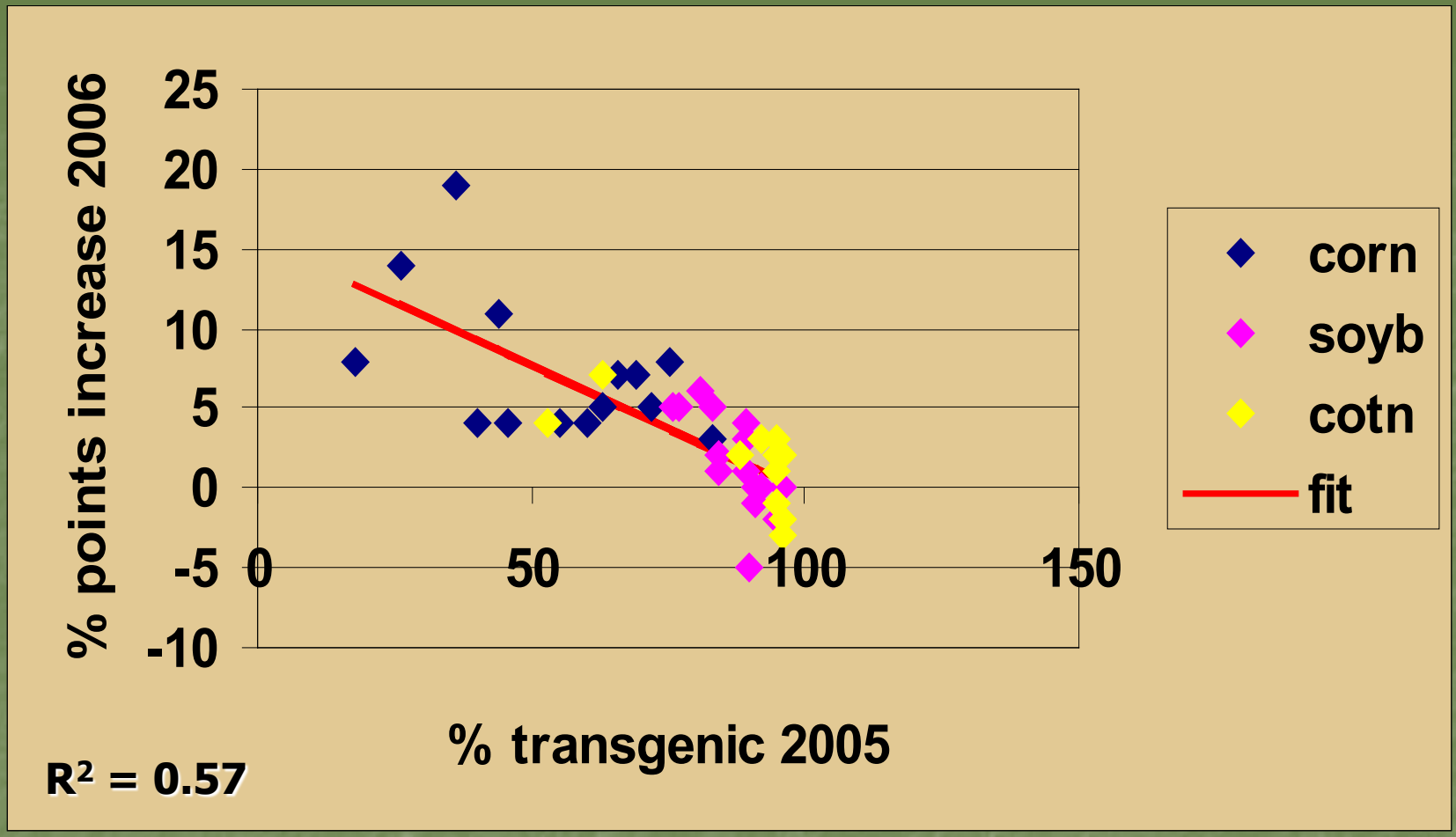
2006 percent planted acres planted with transgenic seed

State	Cotton
AL	95
AR	94
CA	57
GA	96
LA	94
MS	98
MO	97
NC	98
TN	93
TX	70
US	83

State	Corn	Soybeans	Cotton
AR		0	-2
IL	19	6	
IN	14	3	
IA	4	0	
KS	5	-5	
MI	4	5	
MN	7	5	
MS		0	2
MO	4	4	2
NE	7	-1	
ND	8	1	
OH	8	5	
SD	3	-2	
TX	5		7
WI	4	1	

Additive percentage increase in transgenic planted acres from 2005 to 2006

State	Cotton
AL	3
AR	-2
CA	4
GA	1
LA	-1
MS	2
MO	2
NC	3
TN	-3
TX	7



Cotton and soybeans have saturated market at 85%-95%

Corn has more growth yet: IL and IN

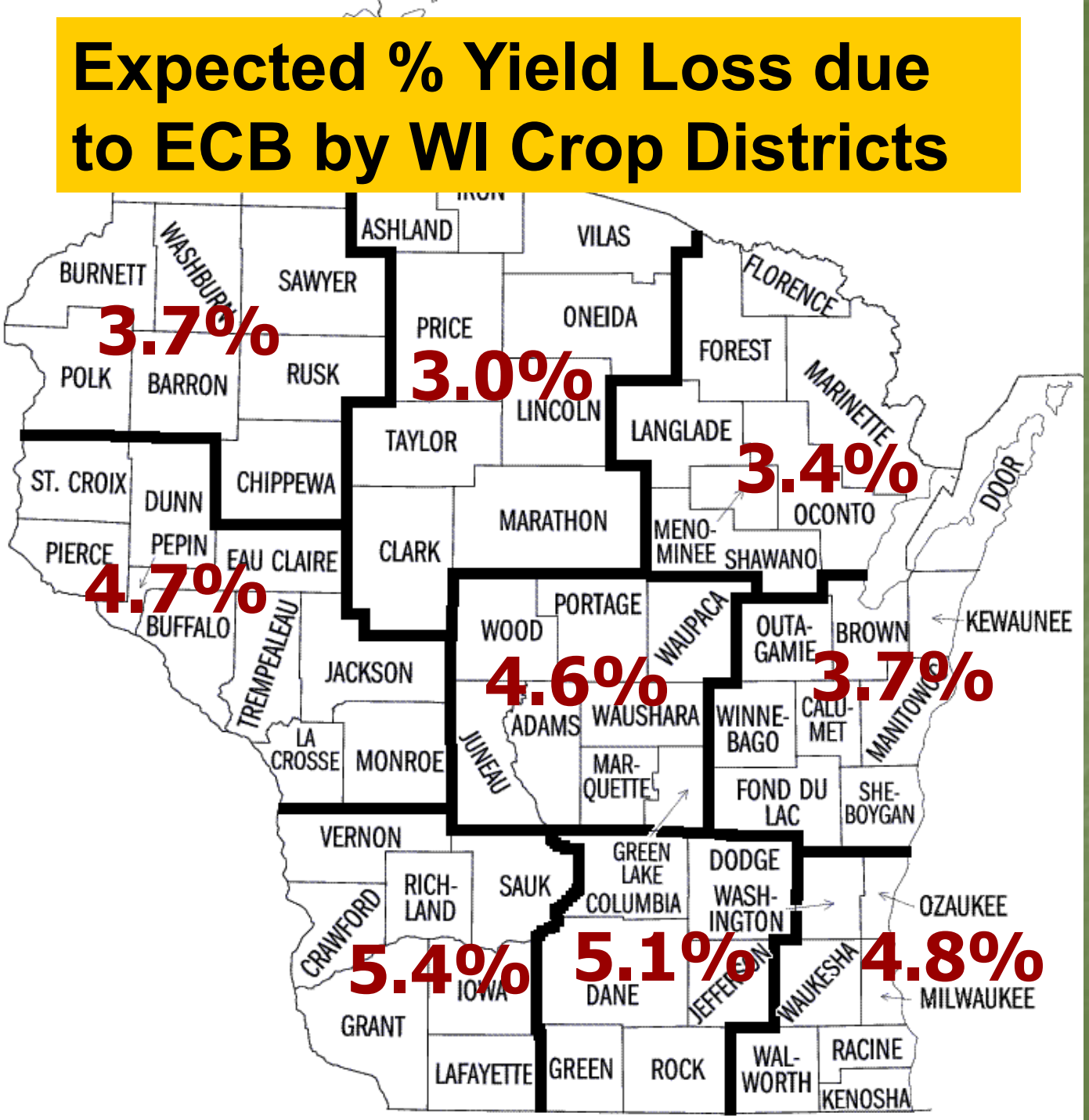
Are transgenics valuable?

- Adoption data would seem to say YES!
- Yield Trial and Survey Data
  - Fernandez-Cornejo and Caswell (2006) summarize 29 studies of both types
  - HT crops yield: mixed with more positive
  - HT crops returns: split 50:50 positive:none
  - Bt crops: yield increased
  - Bt cotton returns: increased
  - Bt corn returns mixed: It Depends!

My work on Bt corn

- Bt corn increase net returns, depending on
  - pest pressure, yield potential, tech fee, price
  - Simple tool based on historical ECB data
- Yield effect from isoline trials in Iowa
  - Control for ECB tunneling, still have 1.65% yield increase for Bt even if no ECB damage
  - Source: 1st generation ECB control, secondary pest control, differential genetics?

Expected % Yield Loss due to ECB by WI Crop Districts



Why do farmers value transgenics?

- Fernandez-Cornejo and Caswell (2006) based on ARMS 2001-2003 surveys
- HT and Bt cotton
  - Increased yields: 59-67%
  - Save mngmt time/easier practices: 15-26%
  - Decrease pesticide input costs: 11-17%
- Bt corn (ECB only)
  - Increased yields: 79%
  - Save mngmt time/easier practices: 9%
  - Decrease pesticide input costs: 6%

How valuable are the non-monetary benefits of transgenics?

- Marra and Piggott (2006)
  - Decompose willingness to pay for trangenics crops (above tech fee) into its components
- US RR soybeans, North Carolina HT crops
  - Convenience 53-58%
  - Operator/worker safety 21-22%
  - Environmental safety 20-25%
- CRW Bt Corn
  - Improved standability 34%
  - Time savings; Equipment savings; Operator/worker safety; Environmental safety: Each 14-19%

Who gets the value of transgenics?

- Price et al. (2003) analyze World Social Surplus
- If willing to pay $15/ac for Bt corn, but actually pay $10/ac, have $5 of surplus
- Comparable version for seller's too
- Transgenics decrease crop prices, change seed demands, affect world consumers and farmers
- Price et al. build system to analyze these issues, plus compare their results to others'
- Three crops: Bt cotton, RR cotton, RR soybeans

Price et al. (2003)

- Bt Cotton: $212-300 million in 1997
  - US farmers 29-39% (small yield effect on cotton price and pesticide costs drop)
  - US consumers: 14-17%
  - Monsanto 21-29%
  - Delta and Pine Land 4-6%
  - Rest of World farmers and consumers 19-22%
  - Big losers: ROW farmers lose $135-235 million
  - Big winners: ROW consumers $181-291 million
  - Decreased world cotton price 0.5-0.8 ¢/lb

Price et al. (2003)

- RR Cotton: $231 million in 1997
  - US farmers 4% (high tech fee and seed price and lower cotton price)
  - US consumers 57% (Big Winners)
  - Monsanto 5%
  - Delta and Pine Land 2%
  - Rest of World farmers and consumers 33%
  - Big losers: ROW farmers lose $733 million
  - Big winners: ROW consumers $809 million
  - Decreased world cotton price 2.5 ¢/lb

Price et al. (2003)

- RR Soybeans: $308 million in 1997
  - US farmers 20% (small yield increase, small herbicide savings, lower price)
  - US consumers 5%
  - Monsanto 28% (not including Roundup sales)
  - Seed companies 40% (minus licensing fees)
  - Rest of World farmers and consumers 6%
  - Big winners: Seed companies & Monsanto
  - Decreased world soybean price 1.2 ¢/bu

Bt corn: My guess

- Bt corn has a yield increasing effect, which suppresses prices some
- Bt corn tech fees transfer some, but not all, Bt value to companies
- Companies supply Bt competitively
- Not lots insecticide used before
- Winners: consumers and farmers
- Losers: ROW farmers (price effect)
- Companies: get some surplus, but not lots

Summary

- Adoption saturation in soybeans and cotton, corn continuing to increase
- Adoption data and many analyses show transgenics are valuable: how much?
- Source of value is more than yield/profit: time/management convenience, safety
- Who gets benefits varies among crops
  - Bt cotn: 1/3 farmers 1/3 innovator 1/3 consumers
  - RR cotn: 90% consumers 5% innovator 5% farmers
  - RR soyb: 20% farmers 70% innovator 10% consumers

Remaining Economic Issues

Raise three that economists can play role in

- Transgenics and pesticide use
- Resistance management and mitigation
- Transgenics and IPM

Transgenics and Pesticide Use

- Do transgenics reduce pesticide use?
- Economic models using experimental data or econometric analyses of survey data
- Fernandez-Cornejo and Caswell (2006)
  - Debated, but generally find (small) decrease
- Lots potential for transgenics to reduce pesticide use
  - RW Bt corn and 2006 IL and IN adoption
  - Insect Resistant Soybeans
  - Why Bt sweet corn and not Bt potatoes?

Resistance and Transgenics

- When will resistance/field failures occur?
- Weed shifts due to RR system
- Roundup resistant mare's tail
- Expect more with long-term widespread use
- Secondary pest problems due to Bt cotton without refuge in China (Wang et al. 2006)
- Bt crops in USA—no resistance yet!

Resistance Management

- Why no weed resistance management?
  - Use economic incentives to promote?
- Is the compliance assurance program (CAP) sufficient for IRM in Bt crops?
  - Do we need something different/stronger?
- With multiple pests, multiple toxins, multiple crops, does refuge still work?
- Economics of resistance mitigation plans
  - Ecological-Economic model to determine

IPM and transgenic crops

- Why no IPM for transgenic crops?
  - Bt and RR crops over 10 years, no IPM!
  - NC IPM Grant: IPM for RW Bt corn t control rotation resistant Western CRW
  - Regional ECB population forecast to make regional recommendations for Bt use
  - Economics of regional/areawide pest management via transgenics
  - Regional pest suppression via Bt cotton in AZ

Citations

- USDA NASS Acreage Report
  - www.nass.usda.gov→Publications→Acreage
- USDA-ERS reports: www.ers.usda.gov
  - First Decade of Genetically Engineered Crops in the U.S. (F-C and Caswell 2006)
  - Size and Distribution of Market Benefits From Adopting Biotech Crops (Price et al. 2003)
- Regulating Agricultural Biotechnology: Economics and Policy, Just et al. 2006
  - Marra and Piggott, Wang et al.

Questions?

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