Biofuels Extension:
The Effect of Trade Assumptions on Land Use Change

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Background

- Explore the Integrated World Market (IWM) vs. Armington Assumption
  - What happens if you relax the Armington Assumption for agricultural commodities?
  - What are the potential effects on land use change and CO_2 emissions in the U.S. and ROW?
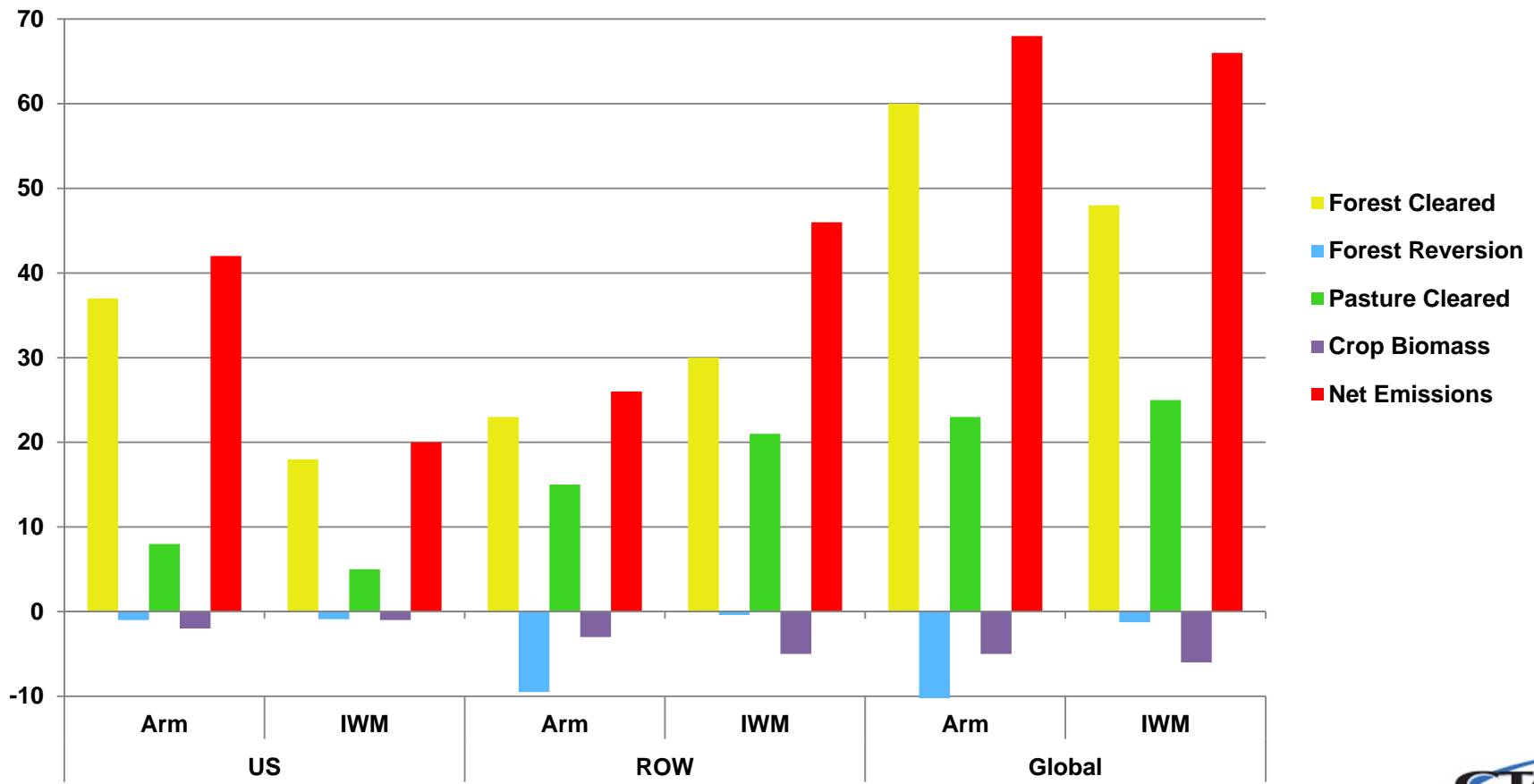
Hypothesis

- Relaxing the Armingtons will
  - Increase the ability of the model to transmit the price shock externally
  - For the case of Ethanol mandates,
    - see price changes in ROW
    - consequential land use adjustments

Methodology

- Expand U.S. corn ethanol use in accordance with 2015 mandated levels
  - Output: 1.75BG ⟶ 2.75BG
- Economic Instruments
  - Tax on liquid transportation fuels
  - Subsidy on corn ethanol
- Assume cereal grain, other grains, oilseeds, sugarcane are perfectly substitutable on world market

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Results

Graph 1. GHG emissions due to a 1 BGY increase in U.S. corn ethanol production (mill tCO$_2$)

Results *cont'd*

Table 1*. Change in harvested area (by crop) for the U.S.

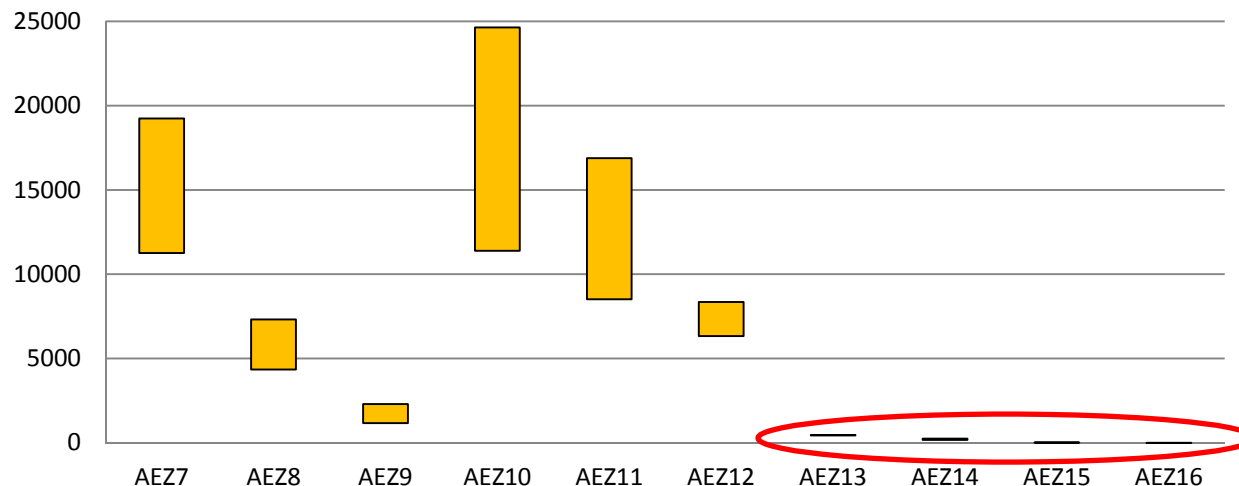|	Coarse Grains		Oilseeds		Sugarcane		Other Grains	
Output (% change)	1.33	**0.79**	-0.4	**-0.35**	-0.1	**-0.01**	-0.65	**-0.39**
Yield (% change)	0.1	**0.04**	-0.04	**-0.05**	0.07	**-0.02**	-0.02	**-0.01**
Intensive Margin	0.21	**0.12**	0.09	**0.04**	0.12	**0.07**	0.06	**0.03**
Extensive Margin	-0.11	**-0.08**	-0.12	**-0.09**	-0.05	**-0.04**	-0.04	**-0.03**
Area (% change)	1.23	**0.74**	-0.38	**-0.3**	-0.17	**-0.07**	-0.66	**-0.39**
Harvested Area (per 1000 hectares)	450	**273**	-121	**-96**	-2	**-1**	-200	**-114**

*Armington values in regular text, **IWM results in bold**

Sensitivity Analysis

- ## How much variance is associated with the Land use CET parameter (ETRAE1)?

  ETRAE1 = -0.2, choose [-0.1, -0.3]

  Table 2. Simulated changes in harvested crop land area for the U.S. (per hectare)

Preliminary Conclusions

- GTAP is an ideal model for analyzing international land use changes resulting from biofuel policies
- Two factors in particular affect GTAP predicted responses
  - Armington Elasticities
  - CET structure of land use
- Relaxing both of these assumptions yields expected results
  - Armington: Increasing elasticity parameters results in increased land use change (LUC) estimates in ROW
  - CET: The LUC estimate is sensitive to values of this

Questions?