



# Rethinking the Indirect Effects of Biofuel

**David Zilberman, Geoff Burrows, Gal Hochman, Deepak Rajagopal**

EBI and Department of Agricultural and Resource Economics, University of California at Berkeley

Presented at the **CRC WORKSHOP ON LIFE CYCLE ANALYSIS OF BIOFUELS**

**Argonne National Laboratory**

**Argonne, IL**

**October 17-19, 2011 October 7-8, 2010**

# overview

- ⦿ On the basic premise
- ⦿ Implementation issues
- ⦿ Why not other indirect effect
- ⦿ What do we lose

# Need to recognize the land use change processes

- ⦿ Different land use dynamics between fully settled countries ( US EU) and countries with expanding agricultural land base, Brazil or Indonesia
- ⦿ In US arable land peaked in 1920
  - Black and Galbraith discovered that prices affect land allocation between crop- not total acreage

# In Brazil settlement continues

- ◎ It was subsidized by government
  - Pig Iron mills were built to use cheap wood
  - New ways to grow soybeans were discovered
  - New roads have been built
- ◎ Deforestation continues: quick earnings are there
  - Soybean is expanding in Cerrado
  - Deforestation & cattle ranching in Brazil may serve to sell wood and attain land rights
  - Sugar cane is far from the forest and affects deforestation minimally
- ◎ Effective anti deforestation policies are the solution- PES, monitoring
- ◎ ILUC will not make a dent

# There is decline in deforestation in Brazil

- Economist Magazine (9.25.2010)- rate of deforestation in Brazil declined drastically after 2006-
- Science: deforestation in the Amazon has declined by 47.5 % last year– 2009
  - Another estimate 60% reduction in deforestation since 2004
- How come we have slower deforestation during a period of high food prices- ?
- Perhaps Brazil is introducing more effective forest conservation policies- they signed and ratified the Kyoto Protocol after all

Impacts on higher prices on GHG depend on technologies and policies

- Higher corn prices increase corn supply by raising corn acreage, fertilizers use adoption of technologies— all affecting GHG emissions differently
- in 1900 change in agricultural output = 10land change
- Policy impacts have drastic effects –example GMO
  - Without GMOs, corn prices would have gone up by 30-40%
    - Cotton (the largest adopter of GM) acreage and price went down mostly during the 2000s.
  - If the EU would have allowed GMO and Africa would have adopted it, the 2007-08 food commodity price spikes would have been mostly avoided.
  - GMO reduced GHG emission by reducing farmed acreage and carbon sequestration

# ILUC parameters are not stable

- ⊙ Different studies have different coefficient
  - Hertel et al. (2010) estimates the magnitude of the ILU effect of biofuel to be 1/3 of the one estimated by Searchinger et al.
  - Tyner found smaller number
- ⊙ But it is not variability around a stable mean
- ⊙ The reality is changing
  - Policies vary
  - Land availability declines
  - New innovation occur
- ⊙ Elasticities are not constant

# Not all Lands Converted to Production Are Alike

- ◎ Impacts of farming on GHG emission and biodiversity vary across locations.
  - The 80/20 rule applies to biodiversity (most biodiversity values are confined to a relatively small subset of the land).
  - The GHG emissions depend on what land is converted to farming—what was it used for before, how is it converted, etc. **It depends on land-use policy on the region where the change occurs.**
  - Not all farmland expansions are bad for the environment—some expansions are actually good—depending on management and time horizon.

# We over stretch our models

- ① We use static models to describe dynamic phenomena with irreversibilities
- ② We assume neo classical production function but have fixed stochastic proportion in the short run

# We ignore

- ⊙ Heterogeneities
- ⊙ dynamics of innovation
  - After SOME periods of high prices acreage decline
- ⊙ Inventories regulation and policies
- ⊙ Food prices are affected by growing demand, technology, Biofuel, exchange rate and inventories
  - Attribution is difficult-
- ⊙ no wonder we have huge variations in predictins

# If we use consider one indirect effect – why not others?

- ⦿ Indirect fuel use
- ⦿ Indirect Opec effect
- ⦿ Indirect by product effect
- ⦿ Any other suggestions?

# Indirect Fuel Use effect Rajagopal, D. and D. Zilberman

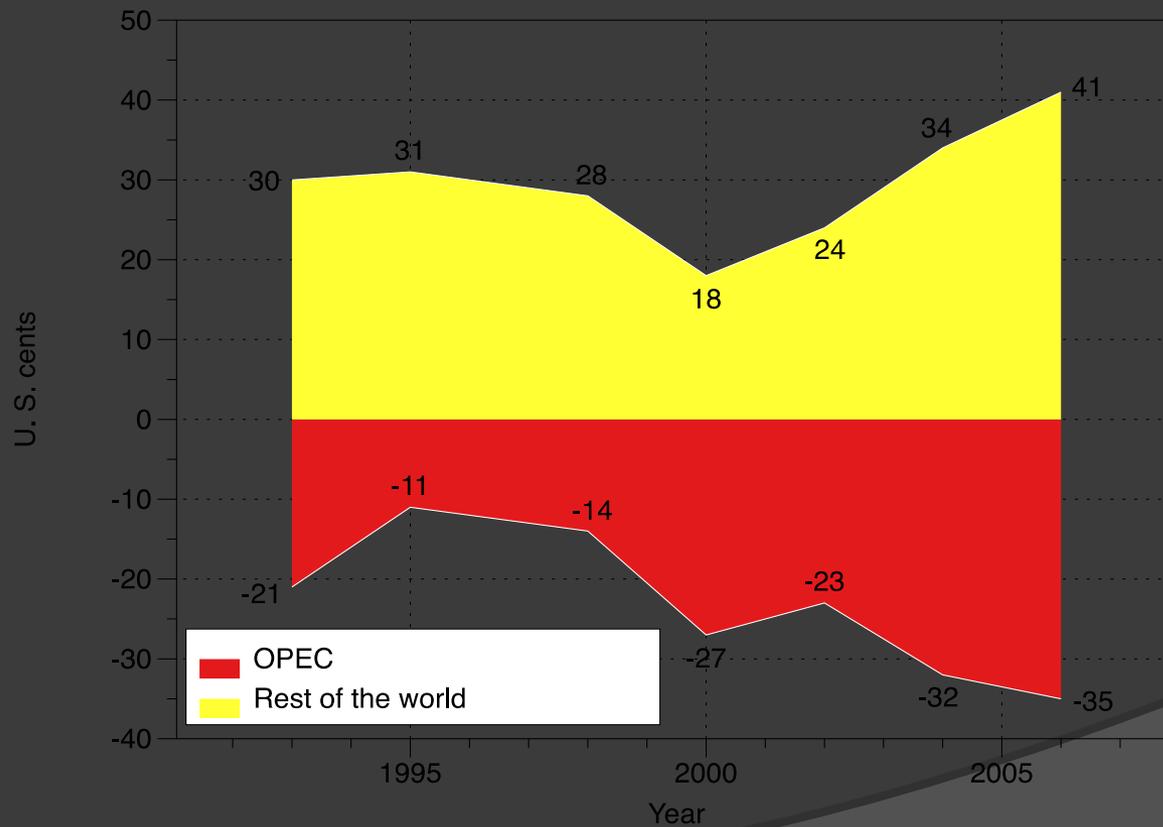
(2010). Indirect fuel use change and the environmental impact of biofuel policies. Energy Policy 2010

- ⦿ Biofuel tends to increase the price of fuel
- ⦿ Price of fuel can be approximated as weighted sum of price of gasoline and ethanol
- ⦿ Higher price of ethanol will increase the price of fuel reducing emission
- ⦿ Lower prices will reduce the prices of fuel
- ⦿ It can be quite significant
- ⦿ Should not be ignored

# Indirect Opec Effect

- ⦿ OPEC behavior can be approximated by maximizing welfare of its members
- ⦿ Prices in OPEC countries are lower than in the rest of the world

# Fuel is subsidized in OPEC countries, relative to the



# Ignoring OPEC overestimates GHG emissions of biofuels

- ◎ Introduction of Biofuel
  - Increases fuel consumption
  - Reduces gasoline and diesel
  - Reduces the price of fuel
  - Increases GHG emission with most biofeuls
- ◎ Opec tends to leads to
  - Lower increase in fuel prices
  - Less GHG emission
- ◎ Ignoring OPEC leads to over estimation of impacts by 30%

# Indirect Byproduct Effect of Biofuels

- The discussion of indirect effects has centered on the consequences of increased biofuel production
- But Gasoline and diesel are derived from crude oil along with byproducts of the refining process, such as jet fuel, heating oil, liquid petroleum gases, petroleum coke, and asphalt.
- Biofuel reduces oil production and the adjustment in biproduct availability may affect biofuels



Gasoline	19.4 gallons
Diesel Fuel & Heating Oil	10.5
Jet Fuel	4.1
Heavy Fuel Oil	1.7
Propane	1.5
Asphalt & Road Oil	1.3
Petrochemical Feedstocks	1.1
Other Products	5.0

# Computation

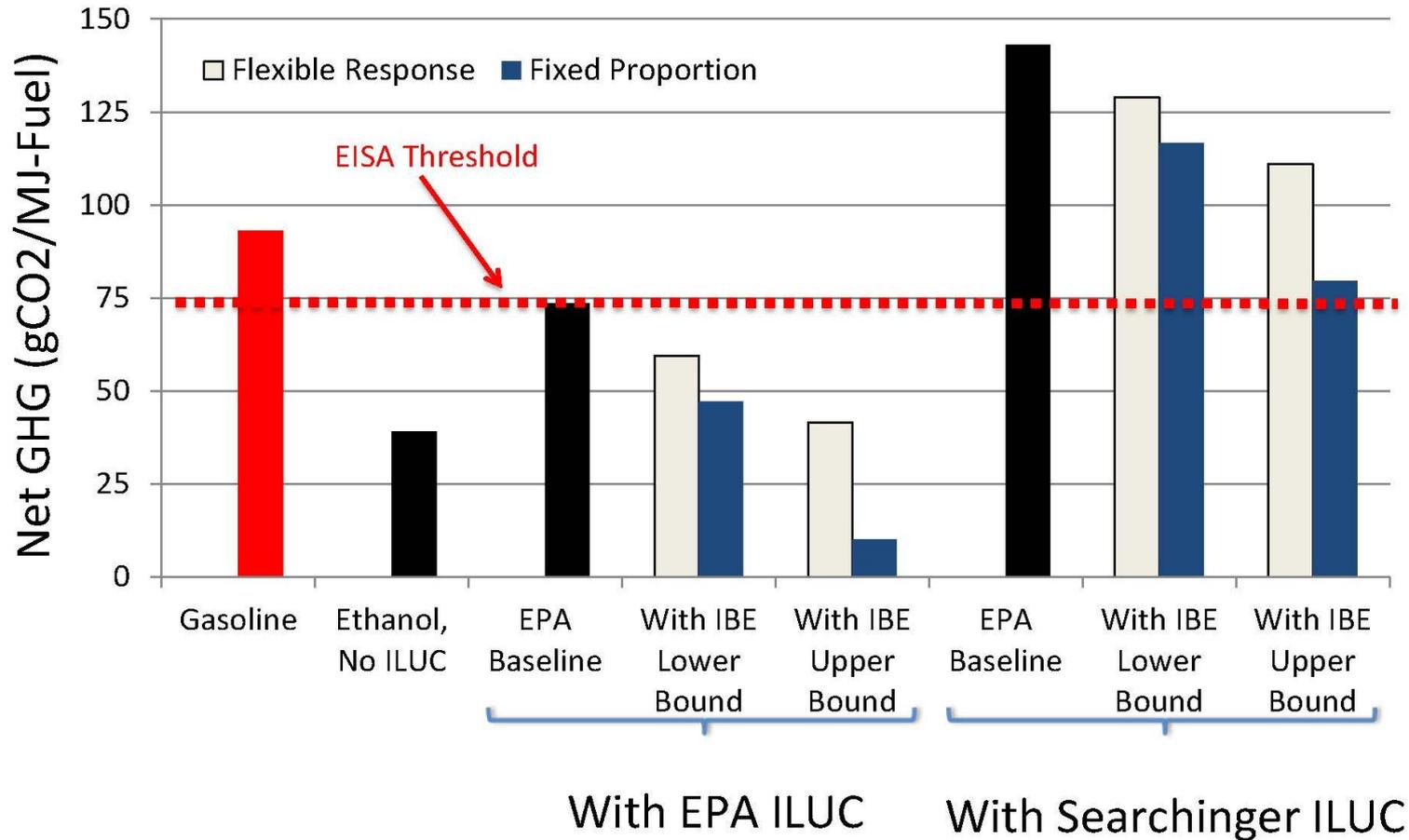
- ◎ We have several scenarios depending whether
  - Adjustment of the system
    - determining whether all or part of the bi-product is eliminated with reduced oil consumption
  - To what extent each bi product are replaced – and by what
    - Upper bound of impact on GHG – no replacement ( best case scenario from GHG emission reduction- “Searchinger like” scenario)
    - Lower bound- full replacement by alternative

# Alternatives to Bi-product

End-Use Market	Petroleum Byproduct	Alternative Input
Heating Heating	Oil	Natural gas, Wind, Coal
Aviation	Jet fuel	?
Roads	Asphalt	Concrete
Plastics	LPG, Other Products	Natural gas
Power Generation	Petroleum coke	Coal
Cooking	LPG, Kerosine	Natural gas

**LPG = Liquefied petroleum gas**

# Annualized emission for corn based ethanol



# Indirect effect- full employment act for economists

- ⊙ There are many other indirect effect
  - Should we pursue all of them?
  - Analyze the ones that are Significant?
  - Built an industry to refine them?
- ⊙ Did we study how well past ILUC predicted the present?
  - Was Searchinger right?
- ⊙ We need ex post studies

# What is wrong with ILUC-

- It is not cost effective
- It is against basic principles
  - People are responsible to action they control
- It is pretentious
- The ILU Approach Holds U.S. Farmers Responsible for Emissions by Farmers Elsewhere
  - “Since the Brazilian government may not fully control deforestation in the Amazon, we should make sure that U.S. farmers would be held responsible for activities that indirectly may lead agents in Brazil to deforest the Amazon and increase GHG emissions.”
  - It is impractical to assume that by modifying the biofuel policies in the U.S., one can forever protect the tropical forests in Brazil or anywhere.
  - Sacramento can hardly control Oakland – can it control the Amazon?

# What do we lose with ILUC

- ① Create uncertainty to investors and sources of finance
  - Delays investment and learning
    - There is learning by doing in biofuels
    - Total ethanol production costs 60% the 1980s to 2005.
- ② Increase costs of doing business and regulations
- ③ Shift attention from real problems
  - How to evaluate and control deforestation
    - PES, certification of forest product, better regulations
  - How to develop sustainable biofuels and reduce GHG emission in general

# The ILUC Concept Reflects Good Intentions, But Has Many Logical Flaws

- It is better to establish regulations based on direct land use and at the same time strive to develop a better set of complete global policies that will lead to changes in other activities that contribute to global warming.
- ILUC provides useful insights- but can it provide useful harmonized number? Does such number exist?
- Well-intentioned unilateral activities in controlling one aspect of the problem may be counterproductive.
- .

# Serious Problems Require Serious Solutions

- ⦿ ILUC are difficult to compute-they are uncertain and unstable
- ⦿ ILUC introduce uncertainty that may slow innovation.
- ⦿ They increase transaction costs
- ⦿ They diffuse lines of responsibility
  - They over-reach
- ⦿ They shift attention from real problems