



*Fueling America Through Renewable Resources*

# Policy Options for Integrated Energy and Agricultural Markets

Wally Tyner

Farzad Taheripour

# Market Failures and Policy Pathways

- Both energy security and GHG emissions are examples of situations when markets alone cannot deliver an optimal solution.
- Economists call these externalities, and suggest using taxes, subsidies, or some form of regulation to correct the market failure
- In the U.S., we do not generally use taxes in this situation, so I will focus on subsidies and renewable fuel standards even though they may not be the best options

# Market Integration

- In the past, agricultural markets have been well integrated.
- Markets for different energy commodities, especially liquid energy products, also have been tightly linked.
- But agricultural markets and energy markets have not been closely correlated.

# Agricultural and Energy Historic Price Correlations

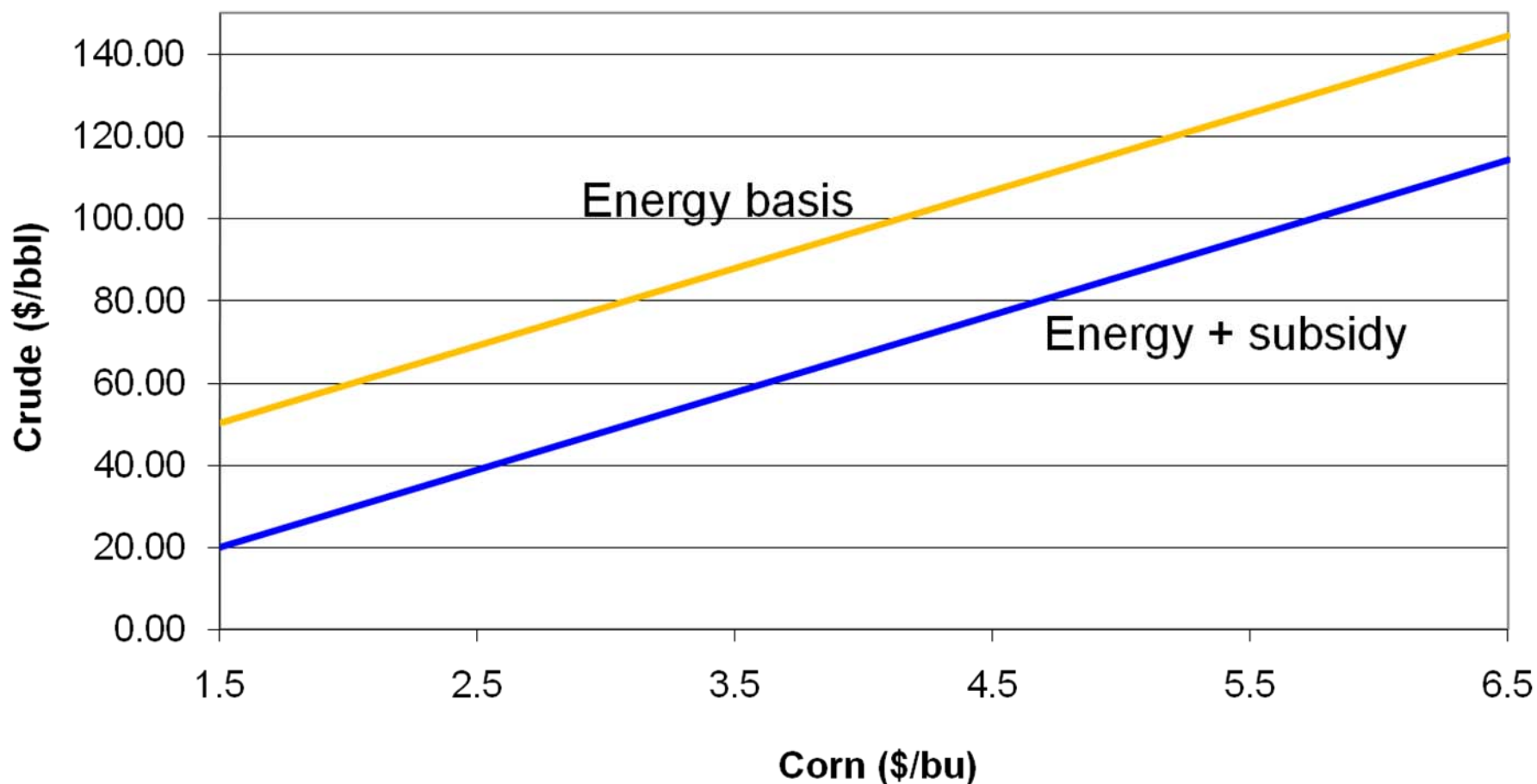
Data Pair	Correlation Coefficient
Crude-gasoline	0.98
Crude-ethanol	0.88
Gasoline-ethanol	0.86
Ethanol-corn	0.25
Crude-corn	0.16
Crude-soybeans	0.13
Corn-soybeans	0.72



# Review of Policy Options

- We will review the policy alternatives first from the perspective of a firm in the industry; that is, it is a micro level analysis based on the economic conditions at the firm level
- Then we will use a partial equilibrium model to evaluate many of the same policy alternatives
- With both approaches, we will be able to see the new linkages between energy and agriculture

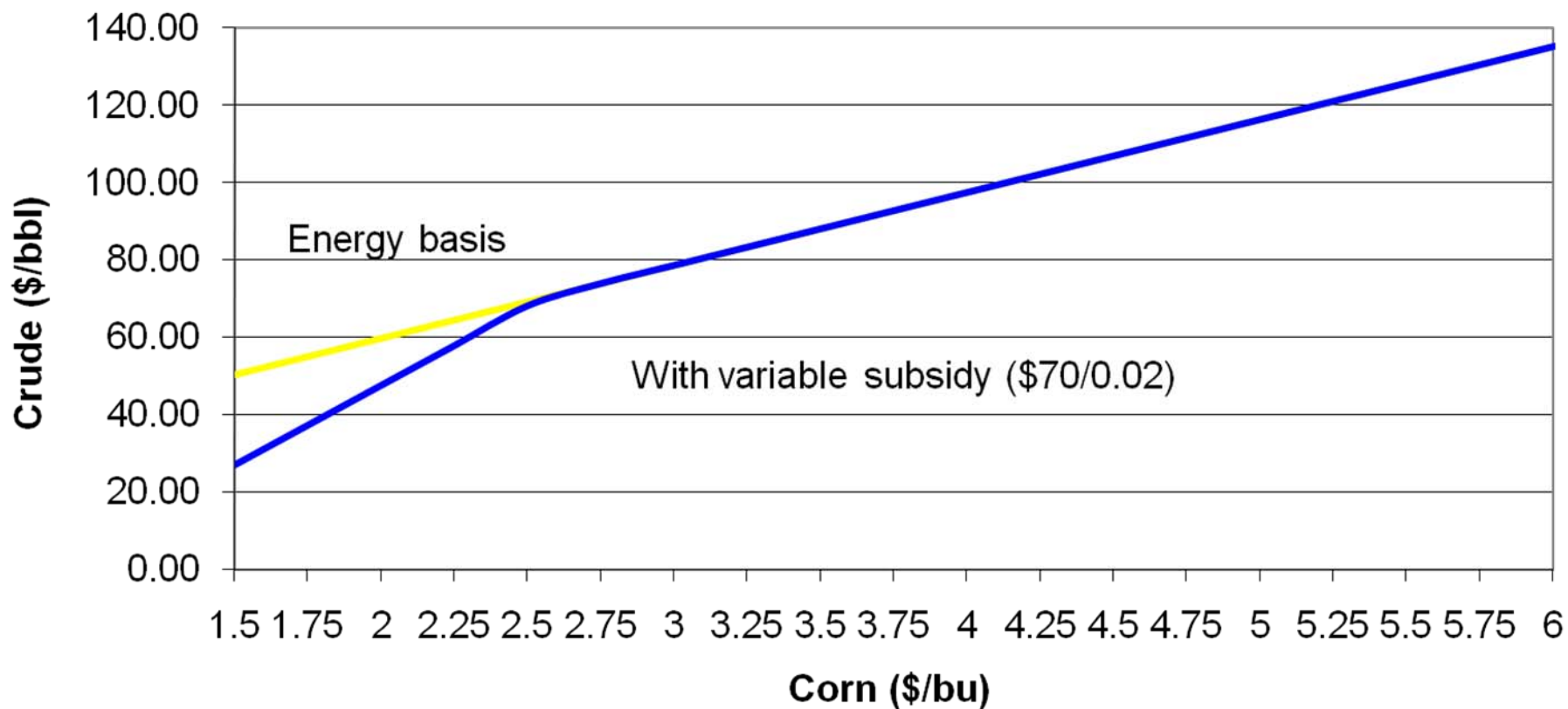
## Breakeven Corn and Crude Prices with Ethanol Priced on Energy Basis with and without Federal Subsidy



# Variable Subsidy

- The energy security externality can be handled through either a fixed or variable subsidy.
- A subsidy that varies with the price of crude oil would be a means of reducing the cost of the government subsidy while still providing a safety net if crude oil prices fall significantly
- The variable subsidy has two parameters:
  - Crude price at which it begins (\$70)
  - Increase in the subsidy for each \$1 crude falls below that price (0.02 cents/\$)

# Breakeven Corn and Crude Prices with Ethanol Priced on Energy Basis plus Variable Ethanol Subsidy





# Renewable Fuel Standard

- The 2007 Energy Independence and Security Act contains a 36 bil. renewable fuel standard by 2022:
  - Current production is about 8 billion
  - 4.5 fold increase in 14 years
  - A max of 15 bil. gal. can come from corn ethanol.
- This level will displace around 15% of 2022 gasoline, depending on the growth in gasoline consumption.
- With a binding mandate in place, it would no longer be necessary to subsidize alternative fuels, although they continue at least through 2010.

# Difference Between a Fuel Standard and a Subsidy

- The fundamental difference between a fuel standard and a subsidy is who pays:
  - With a subsidy, the taxpayers pay the tax credits received by fuel blenders – it is part of the government budget
  - With a fuel standard, consumers see changes in prices at the pump depending on what the alternative fuel costs relative to gasoline from crude oil
- To capture the higher GHG impacts of cellulose ethanol, the standard needs to be partitioned with cellulose receiving a higher proportion as in the bill

# Model Integrating Corn and Energy Markets



- Partial equilibrium model encompassing corn, ethanol and by-products, crude oil and gasoline
- Endogenous variables:
  - Gasoline supply, demand, and price
  - Ethanol supply, demand, and price
  - Corn supply and price
  - Corn use for ethanol, domestic use, and exports
  - DDGS supply and price
  - Operating costs of corn production

# Model Description

Fueling America Through Renewable Resources

- The model is driven and solved by market clearing conditions that corn supply equal the sum of corn demands and that ethanol production expands to the point of zero profit
- Exogenous variables include crude oil price, corn yield, ethanol conversion rate, ethanol subsidy rate and mechanism, and gasoline demand shock



# Policy Simulations



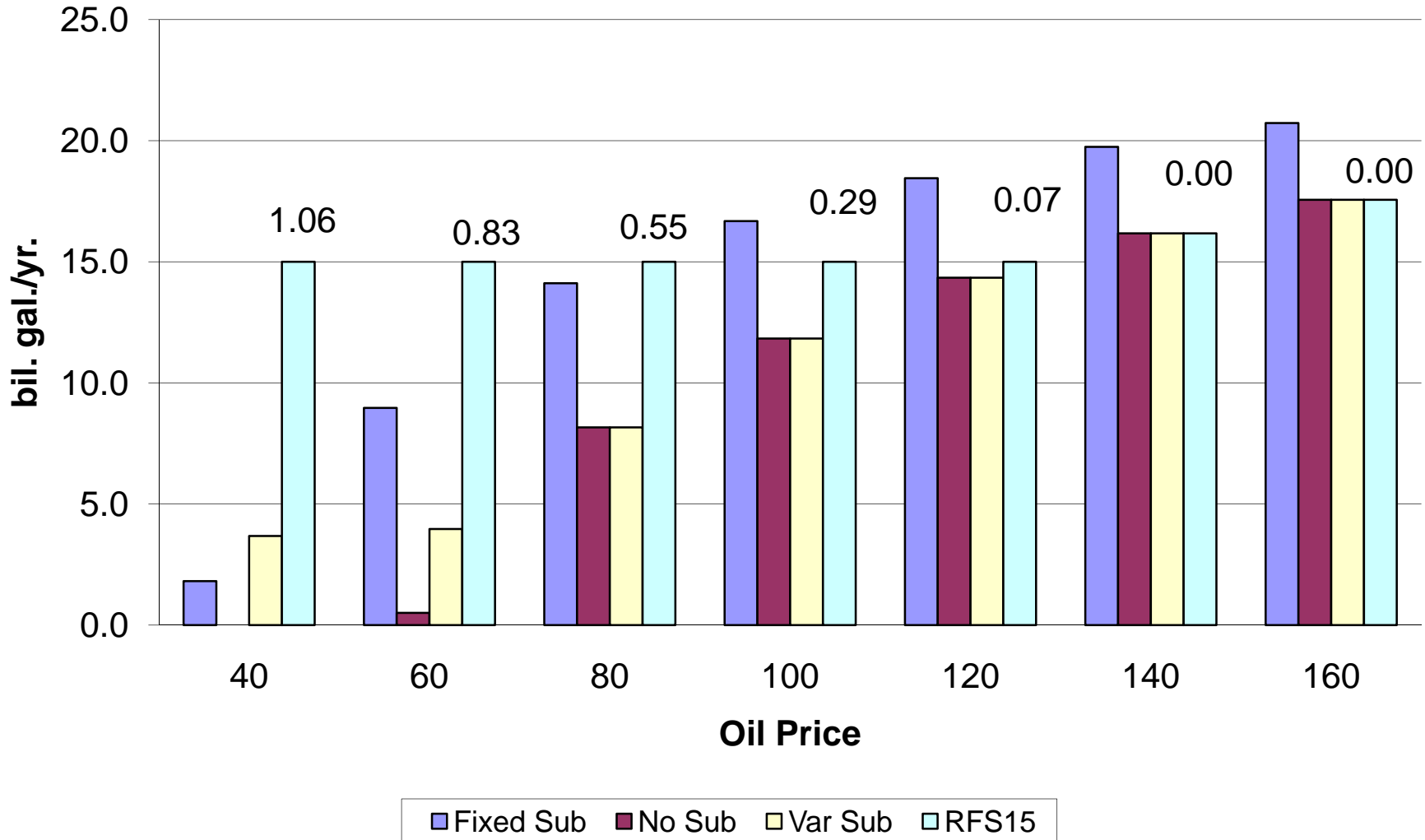
- For each demand scenario, we simulate the following policies:
  - 45 cent/gallon ethanol subsidy (effective Jan. 09)
  - No ethanol subsidy
  - A variable ethanol subsidy beginning at \$70 oil and increasing \$0.0175 for each dollar crude falls below \$70
  - A renewable fuel standard of 15 billion gallons for corn, such as contained in the energy bill
  - Combination of the RFS and subsidy

# Simulation Assumptions



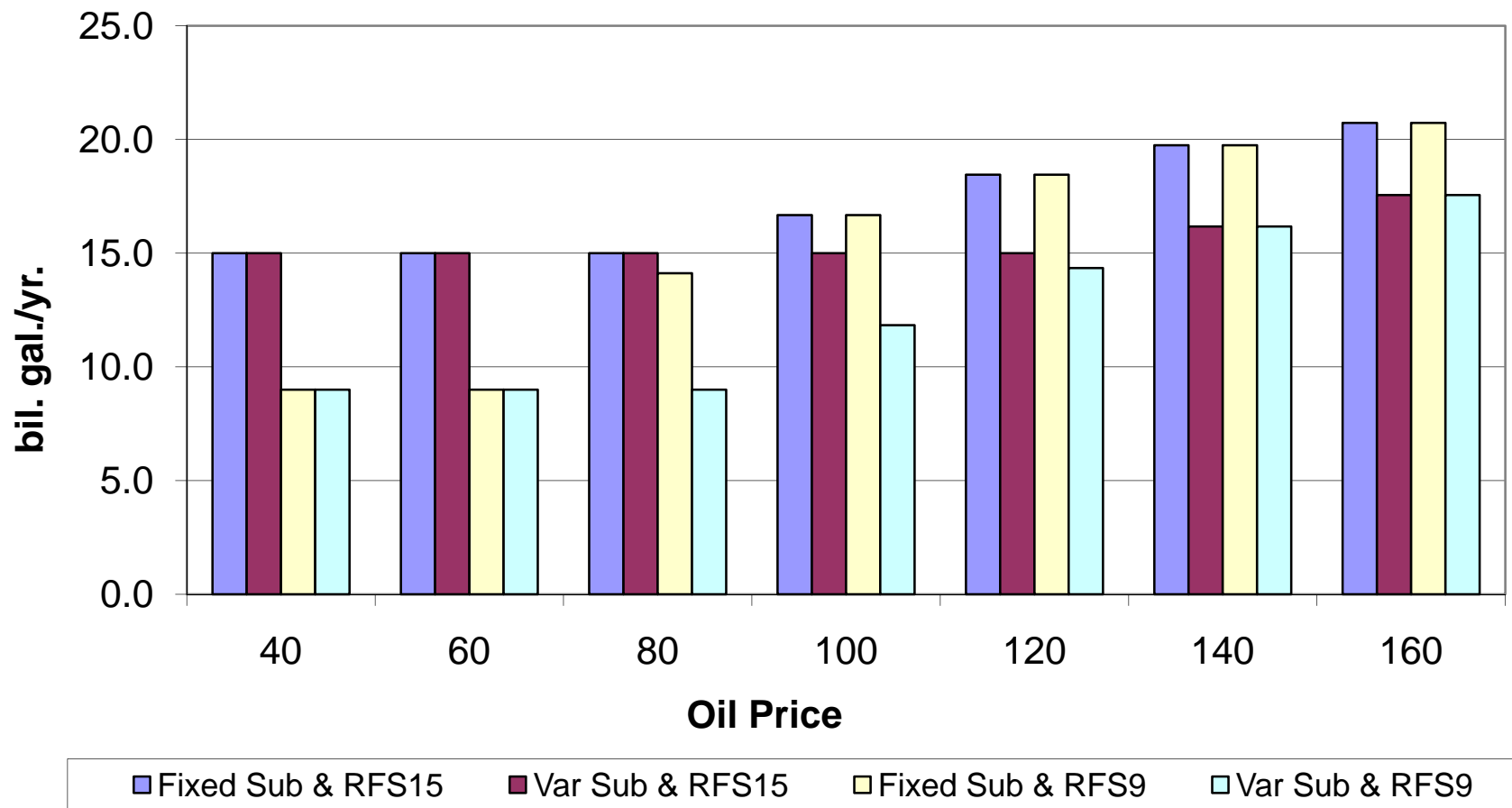
- We assumed a 5% gasoline demand shock to account for income and population growth between now and 2015 – a bit higher demand at any given oil price
- We assumed a 40% export demand shock to account for the fall in value of the US\$
- These shocks were not applied to \$40 and \$60 oil price cases

# Ethanol Production



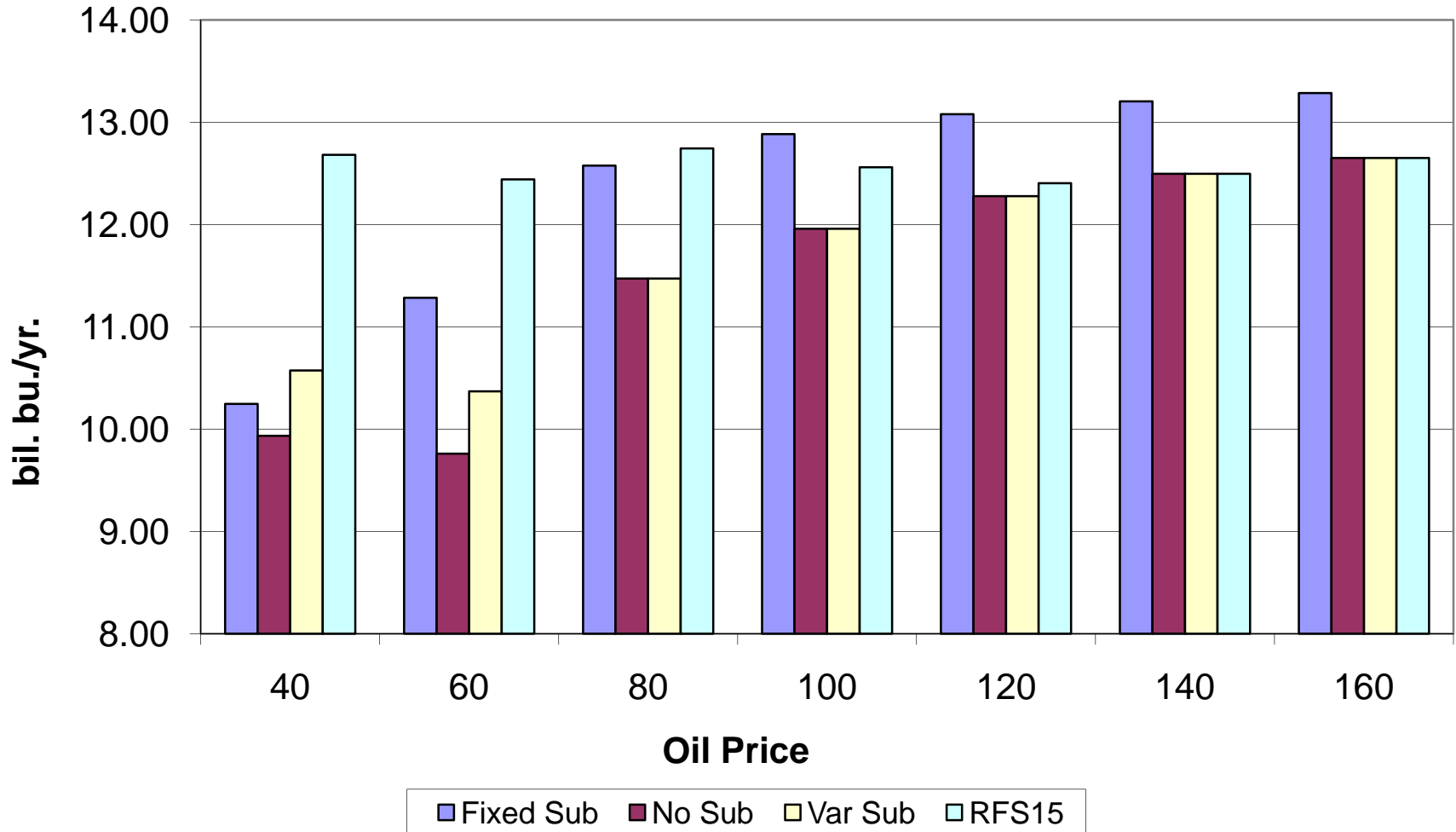
# Ethanol Production

## Fixed and variable subsidies with RFS

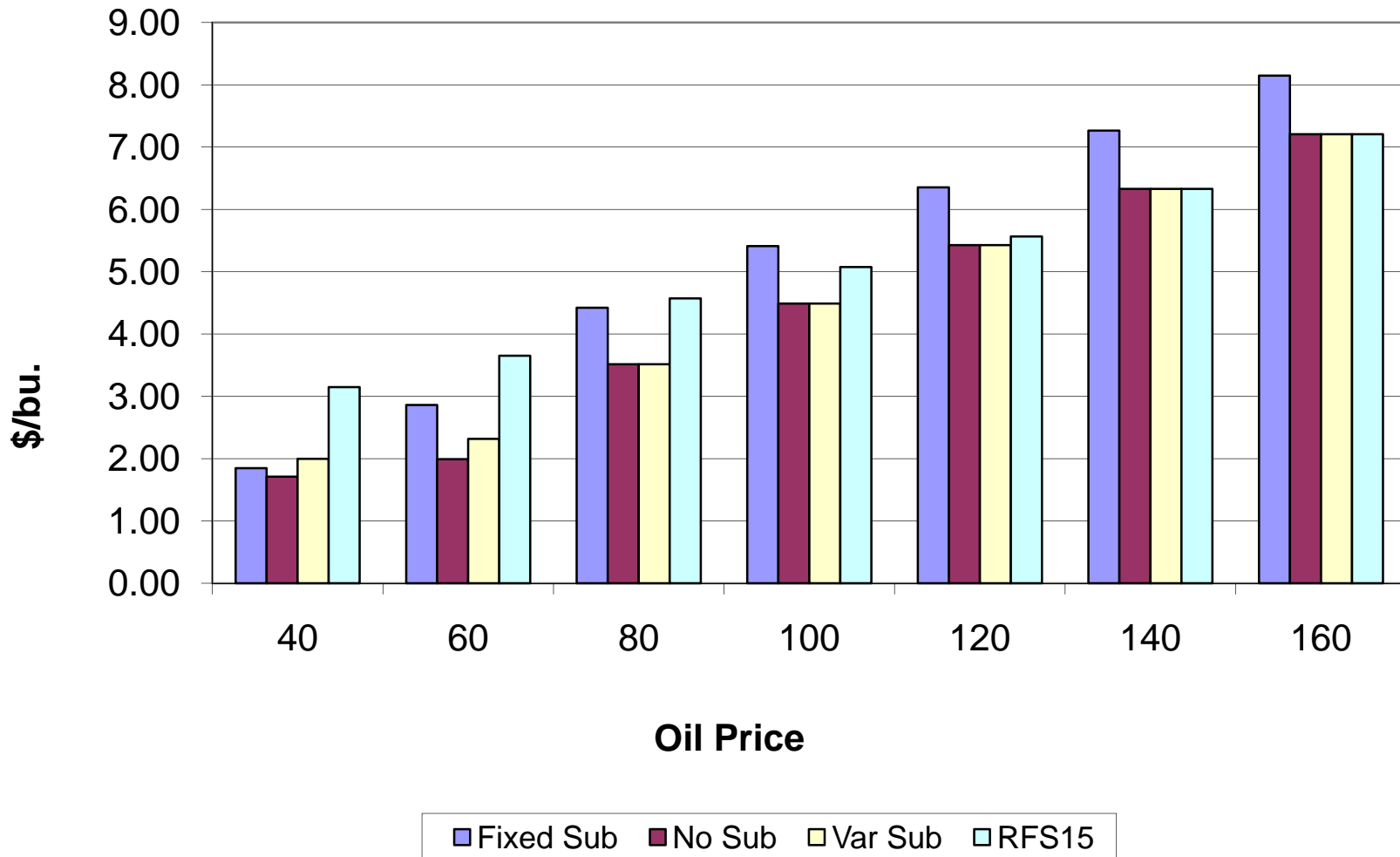




# Corn Production



# Corn Price

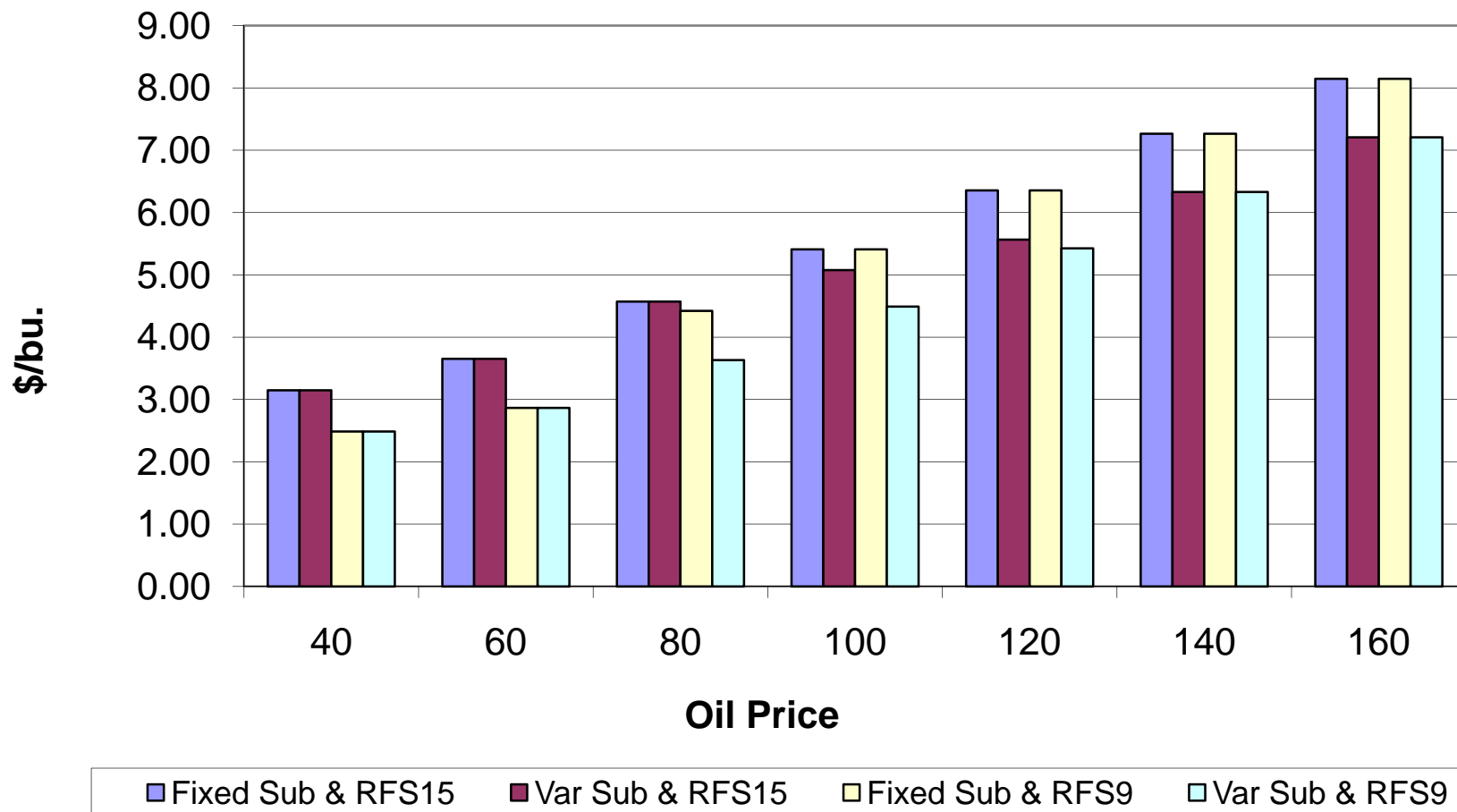


# Oil and Corn Price Link

- Between 2004 and earlier this year, oil went from \$40 to \$120
- Over that same time, corn went from \$2 to \$6
- Of the \$4 corn price increase, this analysis shows that \$1 was due to the ethanol subsidy and \$3 to the oil price increase
- Crude oil price is clearly a major driver of corn price and production

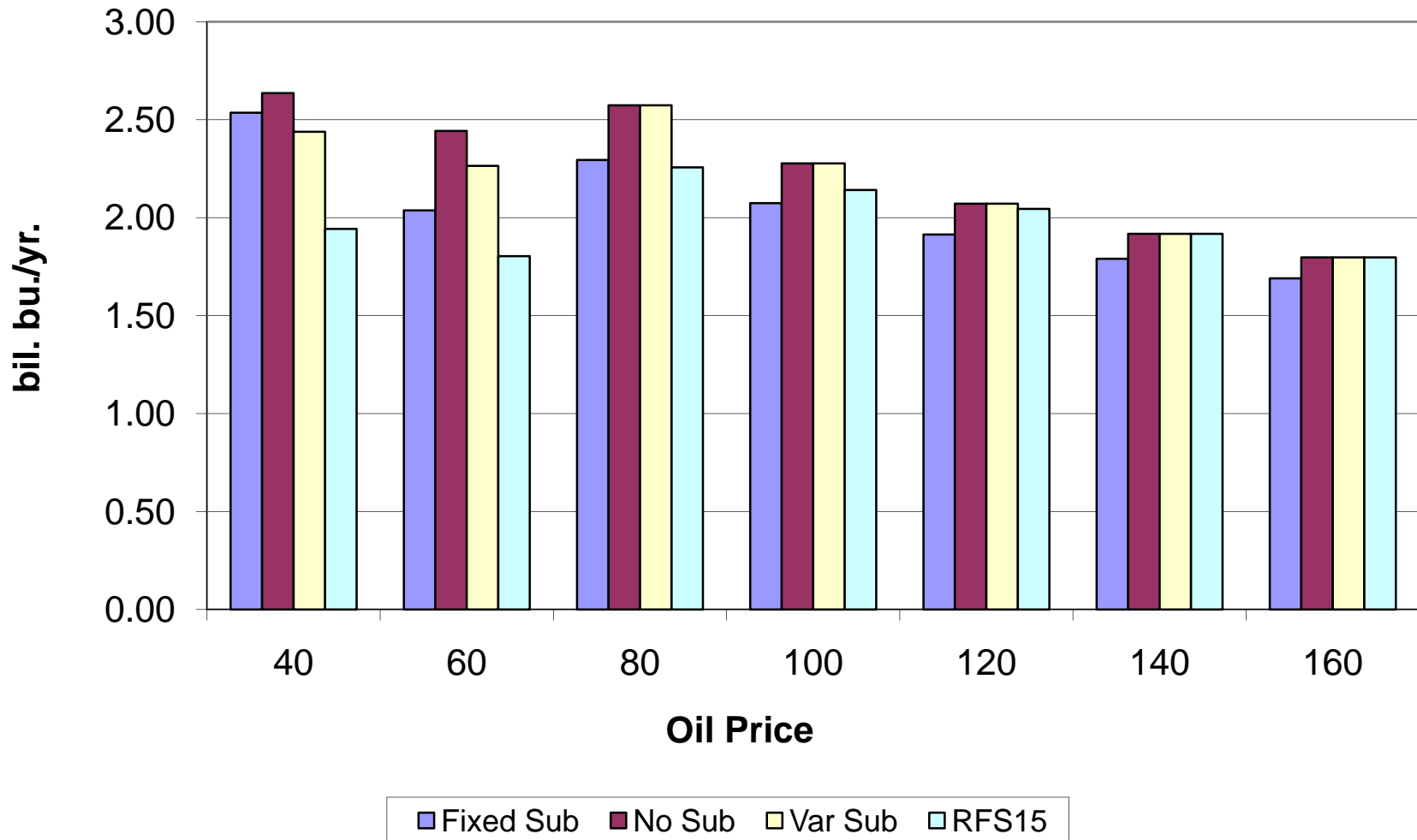
# Corn Price

Fixed and variable subsidies with RFS

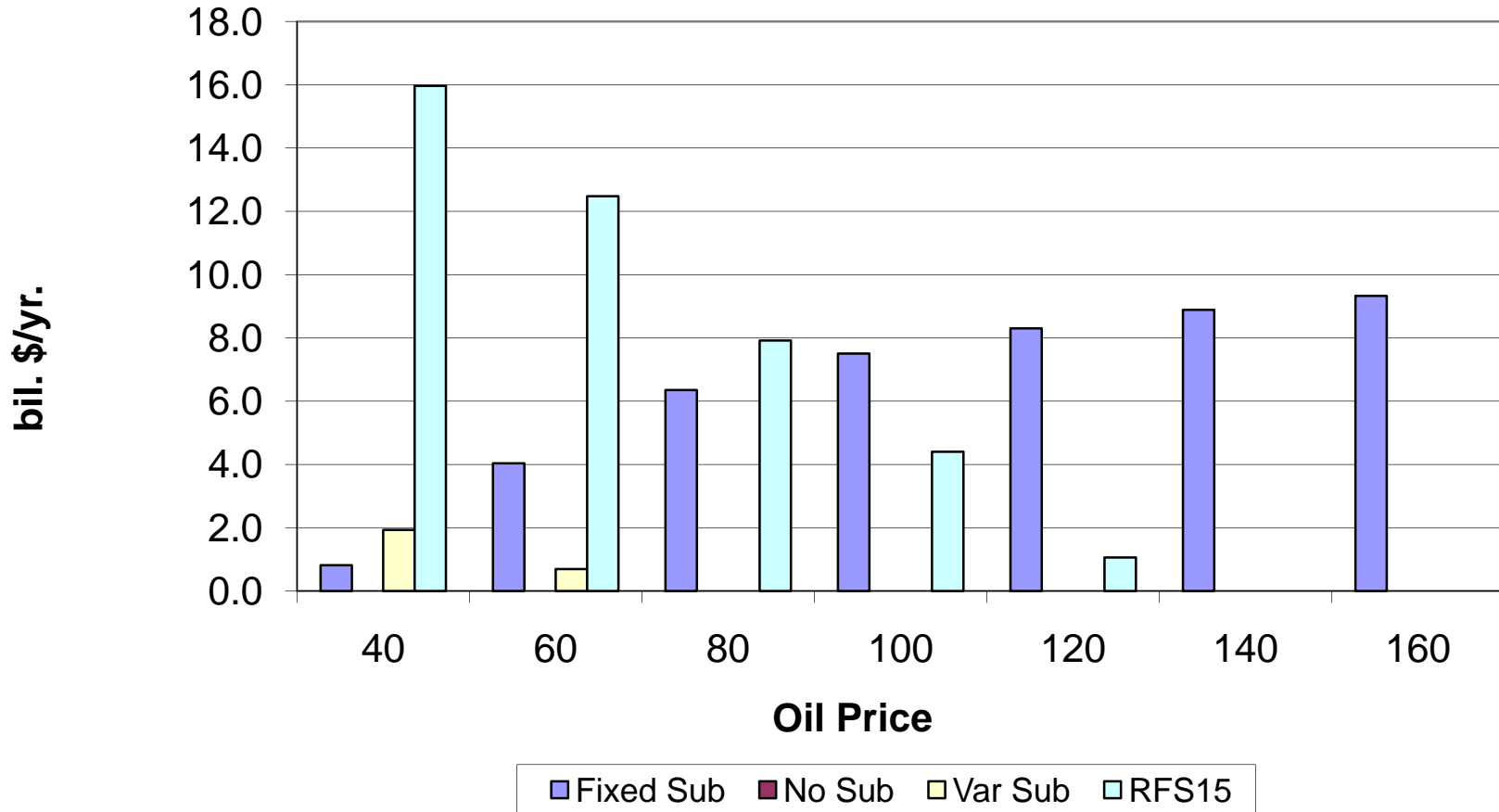




# Corn Exports

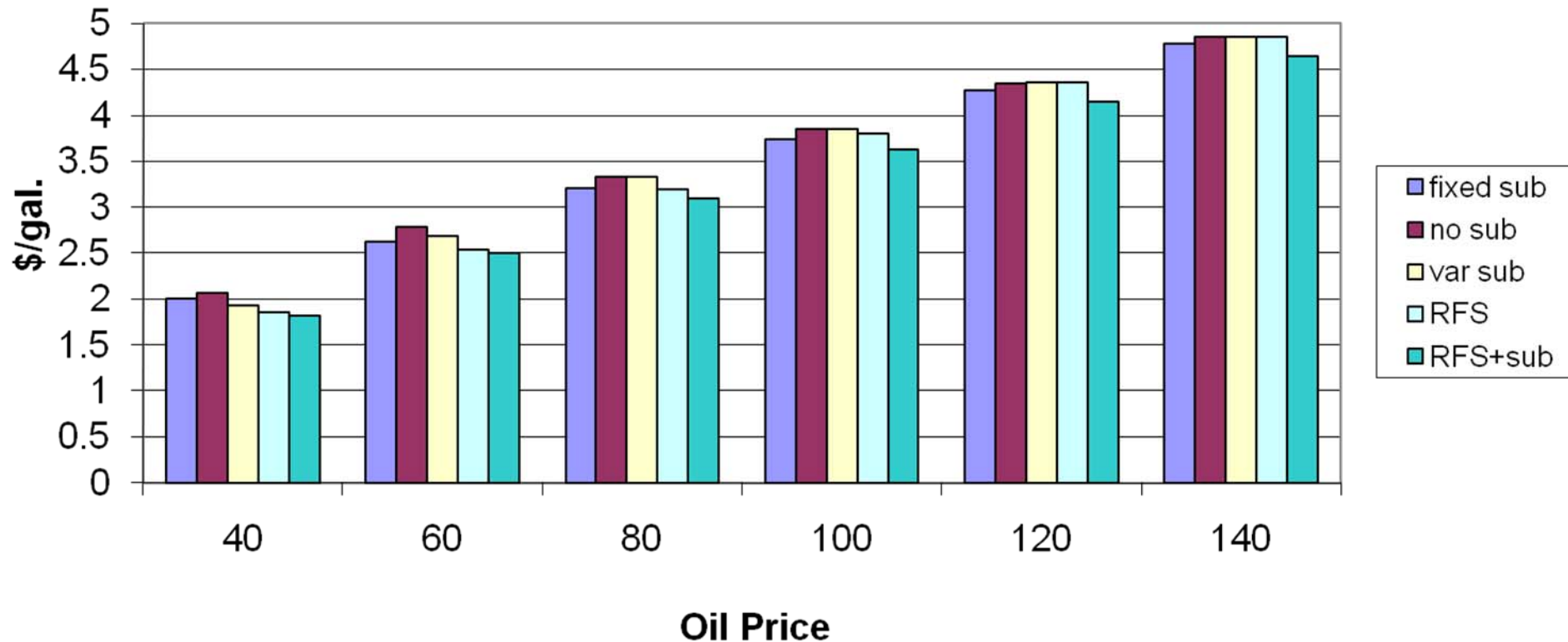


# Policy Costs



# Retail E10 Price

## 5% demand shock



# Sensitivity to 30% Corn Yield Increase

(compared with the base cases)

- Ethanol production up substantially
- Corn price down 15-39% depending on the case
- Corn production up 7-22% depending on the case
- Larger share of corn used for ethanol in all cases except RFS at lower oil prices
- Sensitivity results conform to expectations – yield increase means lower corn price, more corn produced, more profitable ethanol, and more ethanol production

# Other Ethanol Issues



- An issue that will face the industry very soon is the “blending wall.” That is the max ethanol that can be consumed at the E10 blending limit.
- Another important issue is the ethanol import tariff. Reducing or eliminating the import tariff would likely reduce pressure on corn prices and the level of domestic ethanol production if we are at the blending wall.



# Conclusions



- Results clearly illustrate the linkage between crude oil and corn prices and therefore with most agricultural commodities.
- There are substantial differences among the policies.
- At high oil prices, oil price trumps policy.
- At high oil prices, the RFS generally is not binding, but the subsidy still has an impact.
- When the mandate is binding, the subsidy serves to reduce the price of blended fuel.
- These model results are consistent with the firm level results illustrated earlier.
- The blending wall will be an important issue.

# Thanks very much!

*Questions and Comments*

For more information:

<http://www.ces.purdue.edu/bioenergy>

<http://www.agecon.purdue.edu/papers/>