PURDUE UNIVERSITY

PURDUE AGRICULTURE

BioEnergy

Fueling America Through Renewable Resources

Policy Options for Integrated Energy and Agricultural Markets

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Market Integration

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- 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.

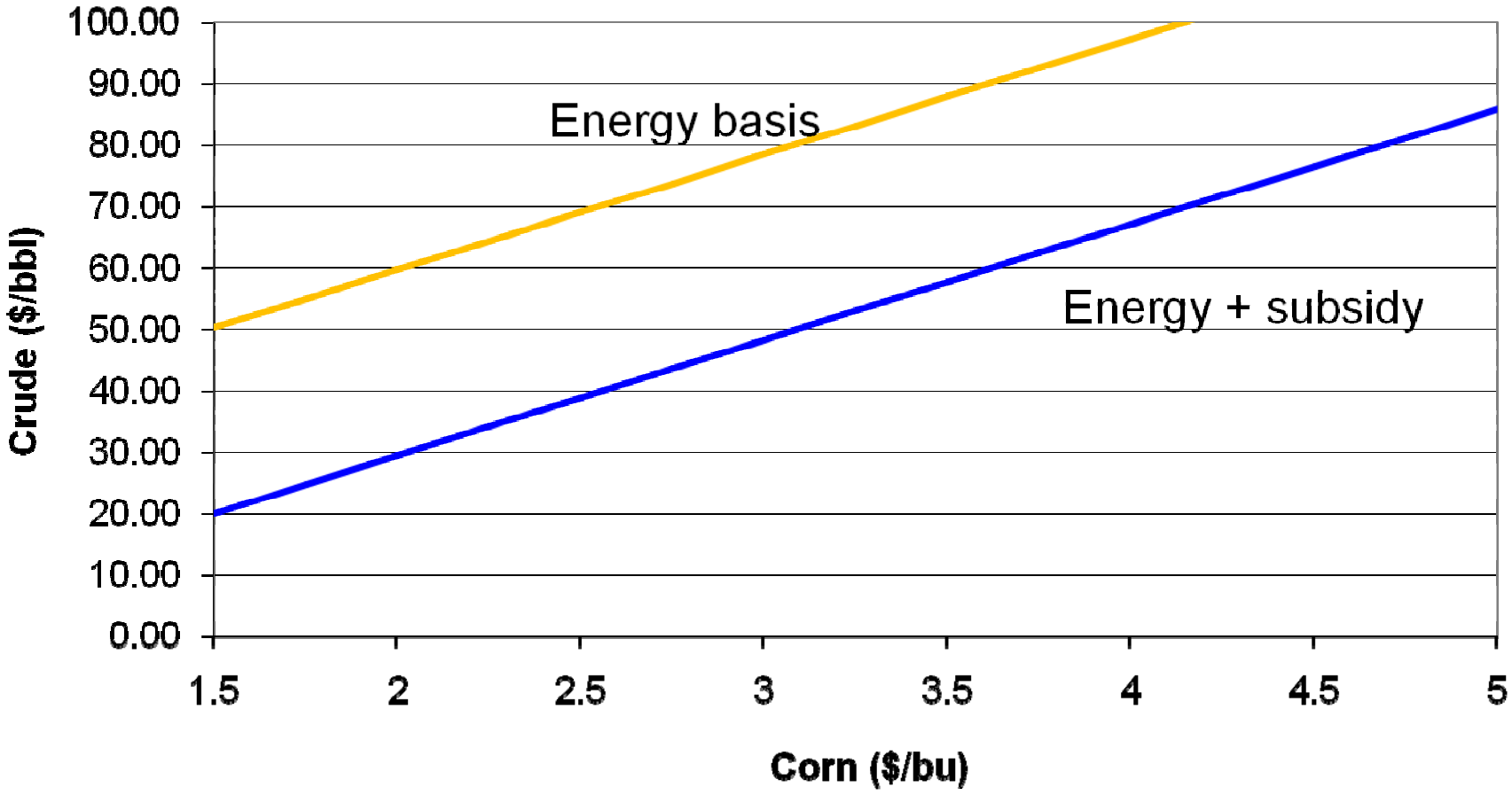
Agricultural and Energy Historic Price Correlations

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

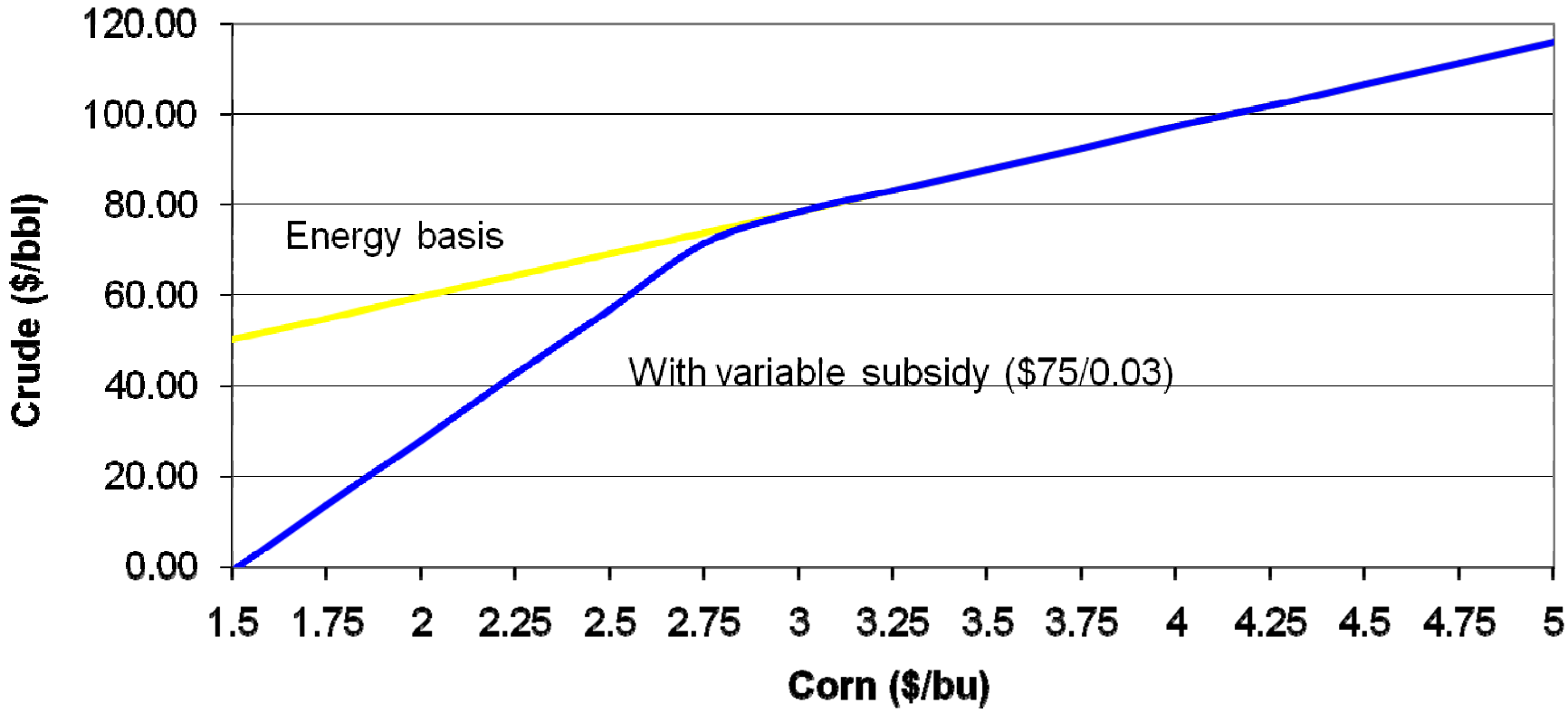
Breakeven Corn and Crude Prices with Ethanol Priced on Energy Bases with and without Federal Subsidy



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 ($75)
  - Increase in the subsidy for each $1 crude falls below that price (0.03 cents/$)

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



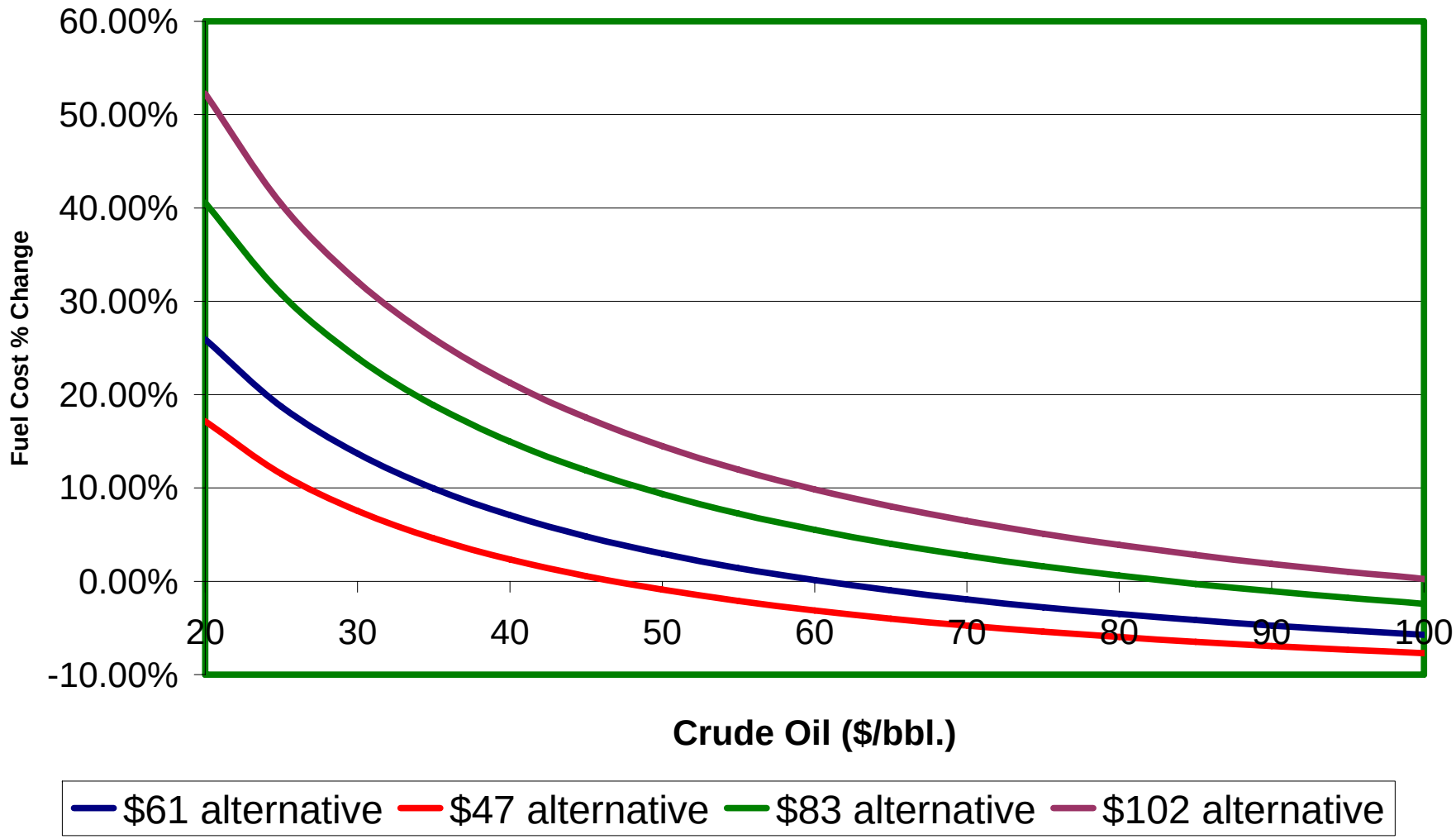
Renewable Fuel Standard

- The 2007 Energy Independence and Security Act contains a 36 bil. renewable fuel standard by 2022:
  - Current production is about 7 billion
  - Five fold increase in 15 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 credible 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
- If we wanted to capture the higher GHG impacts of cellulose ethanol, the standard would need to be partitioned with cellulose receiving a higher proportion

Fuel Cost Change from a Fuel Standard



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

- 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

Model Simulations

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- The model is simulated over a range of oil prices with no demand shock and a 10% demand shock (due to increases in incomes and population)
  - No demand shock assumes higher CAFE standard
  - 10% demand shock is DOE base case out to 2015 and essentially assumes that crude oil supply cannot keep up with rising gasoline demand as it has in the past

Policy Simulations

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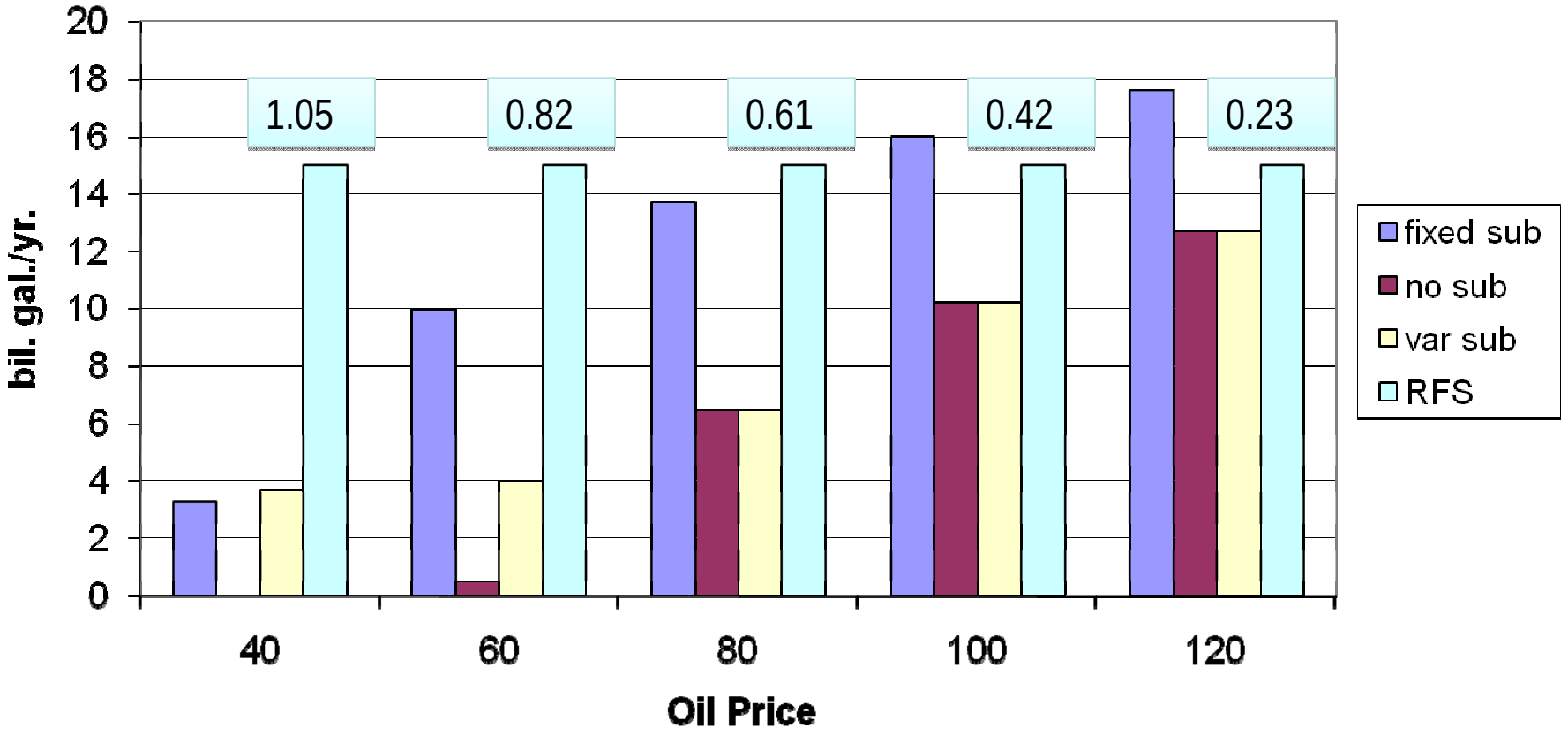
- For each demand scenario, we simulate the following policies:
  - Continuation of the 51 cent/gallon subsidy
  - No ethanol subsidy
  - A variable ethanol subsidy beginning at $70 oil and increasing $0.0175 for each dollar crude falls below $70
  - A renewable fuel standard of 15 billion gallons for corn, such as contained in the energy bill

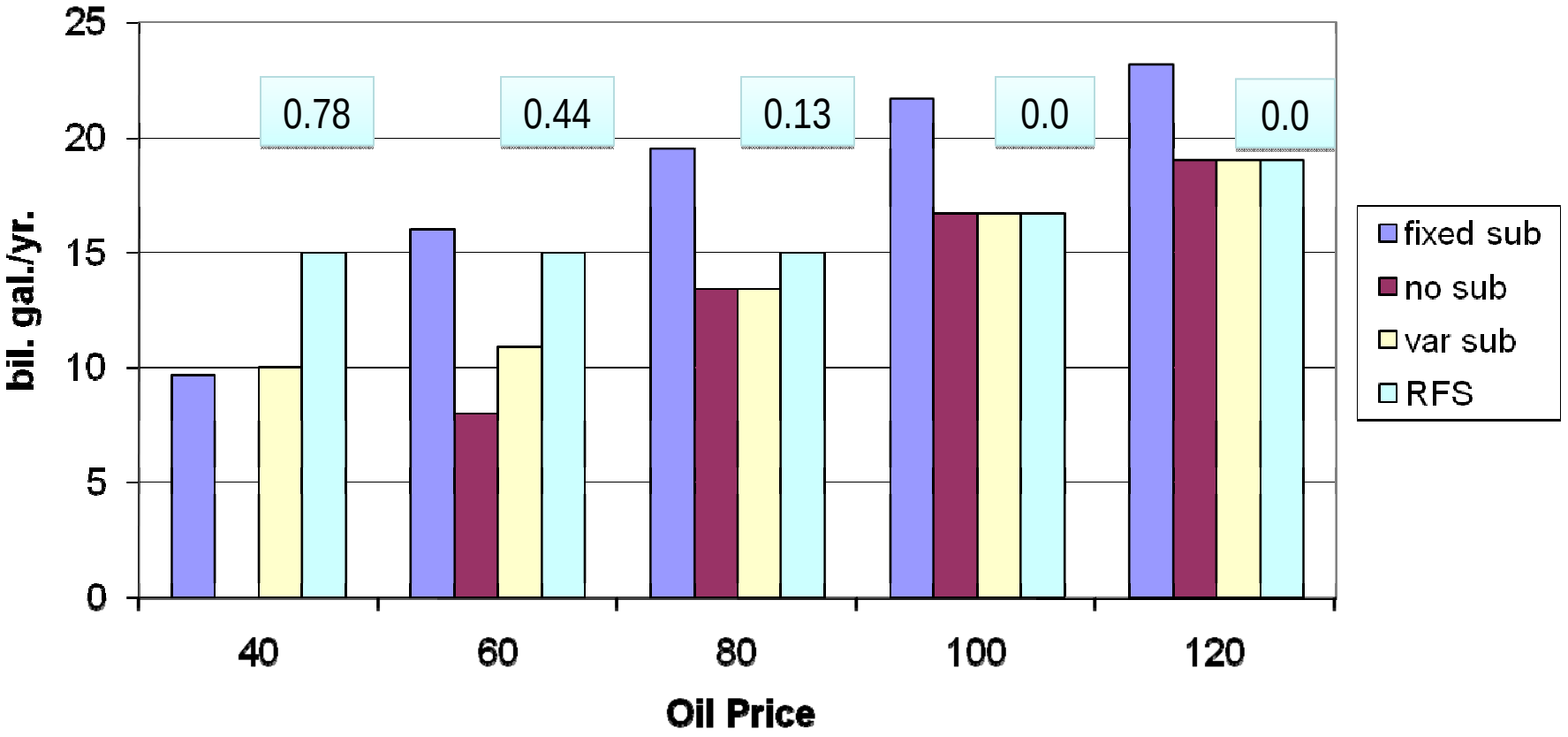
Ethanol Production

no demand shock



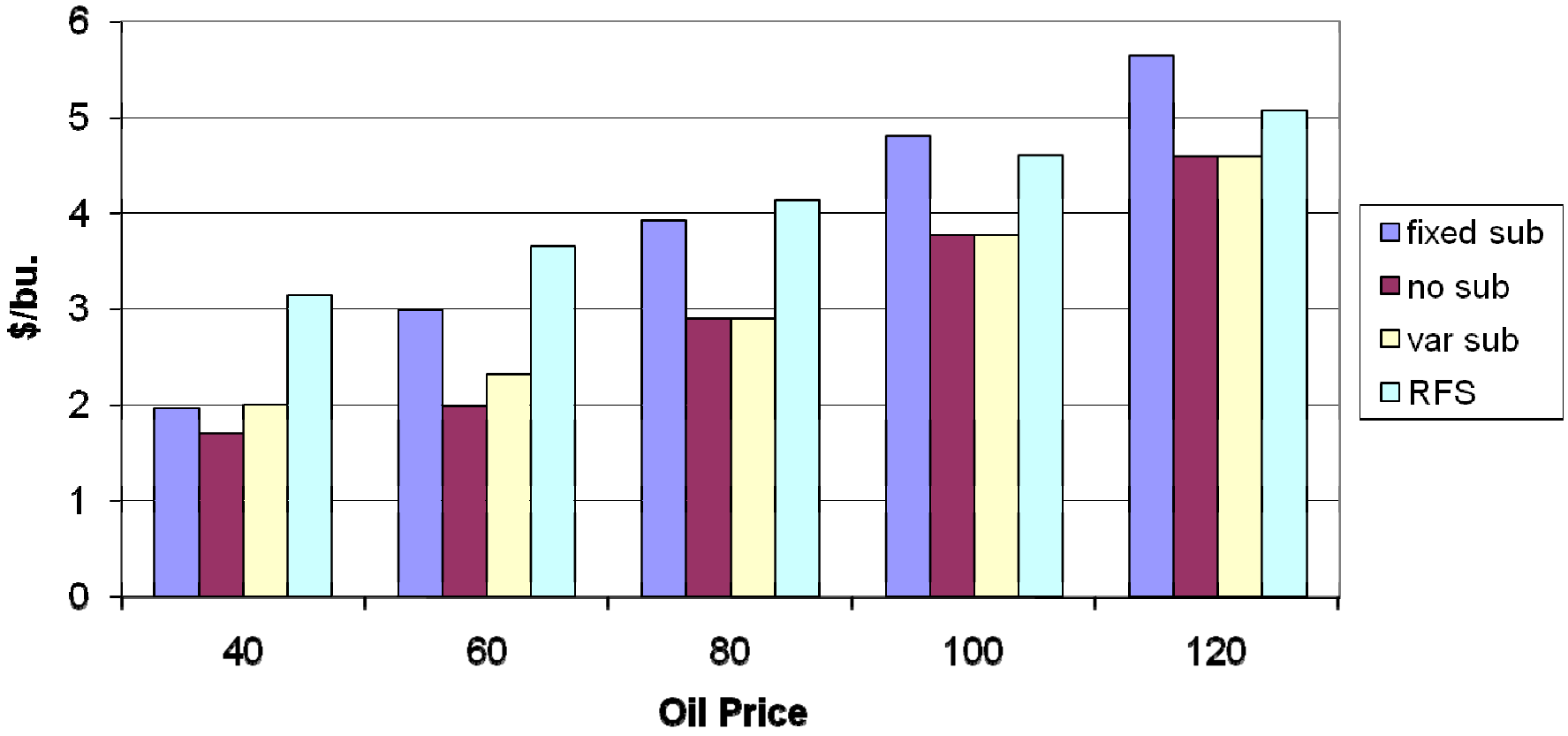
Ethanol Production

10% demand shock



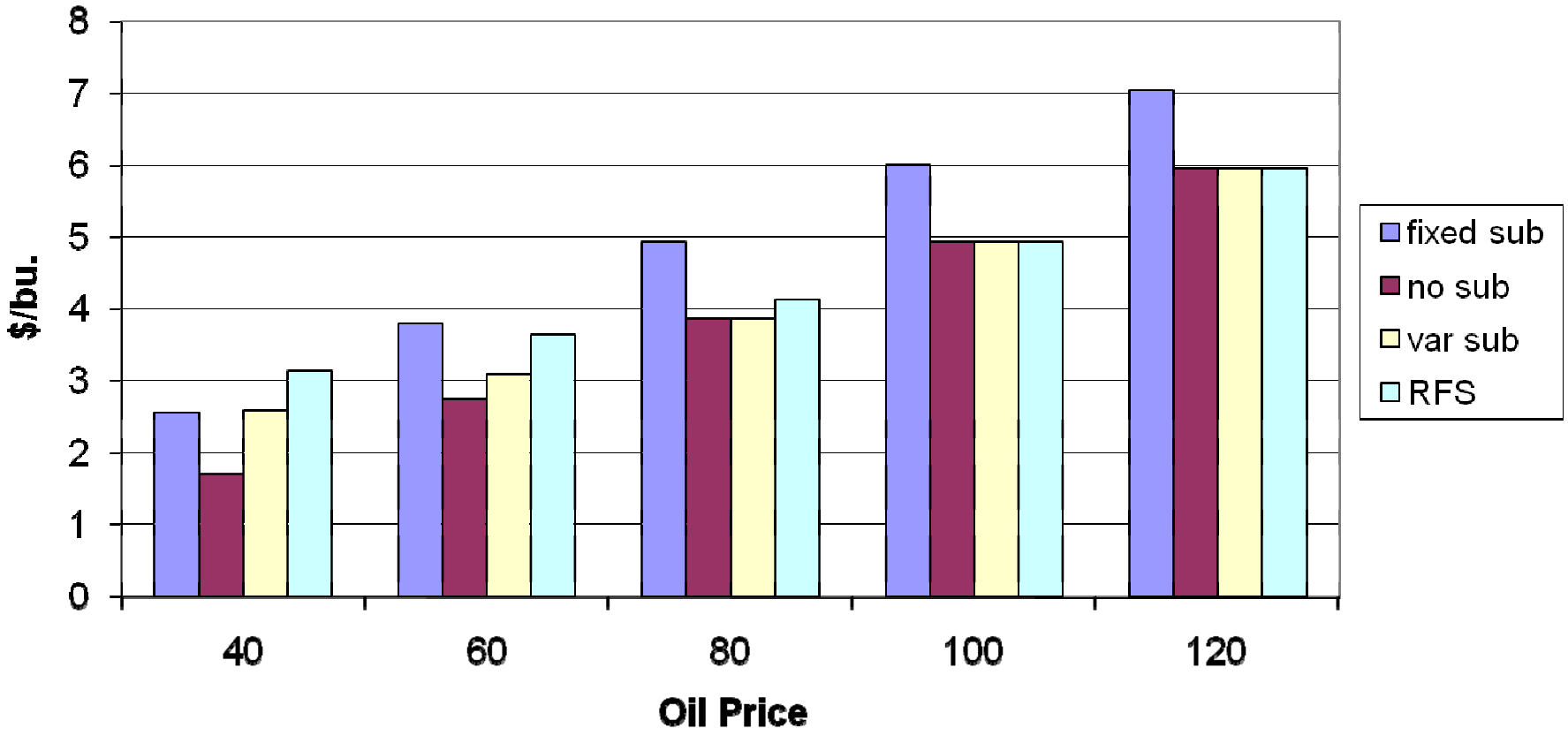
Corn Price

no demand shock



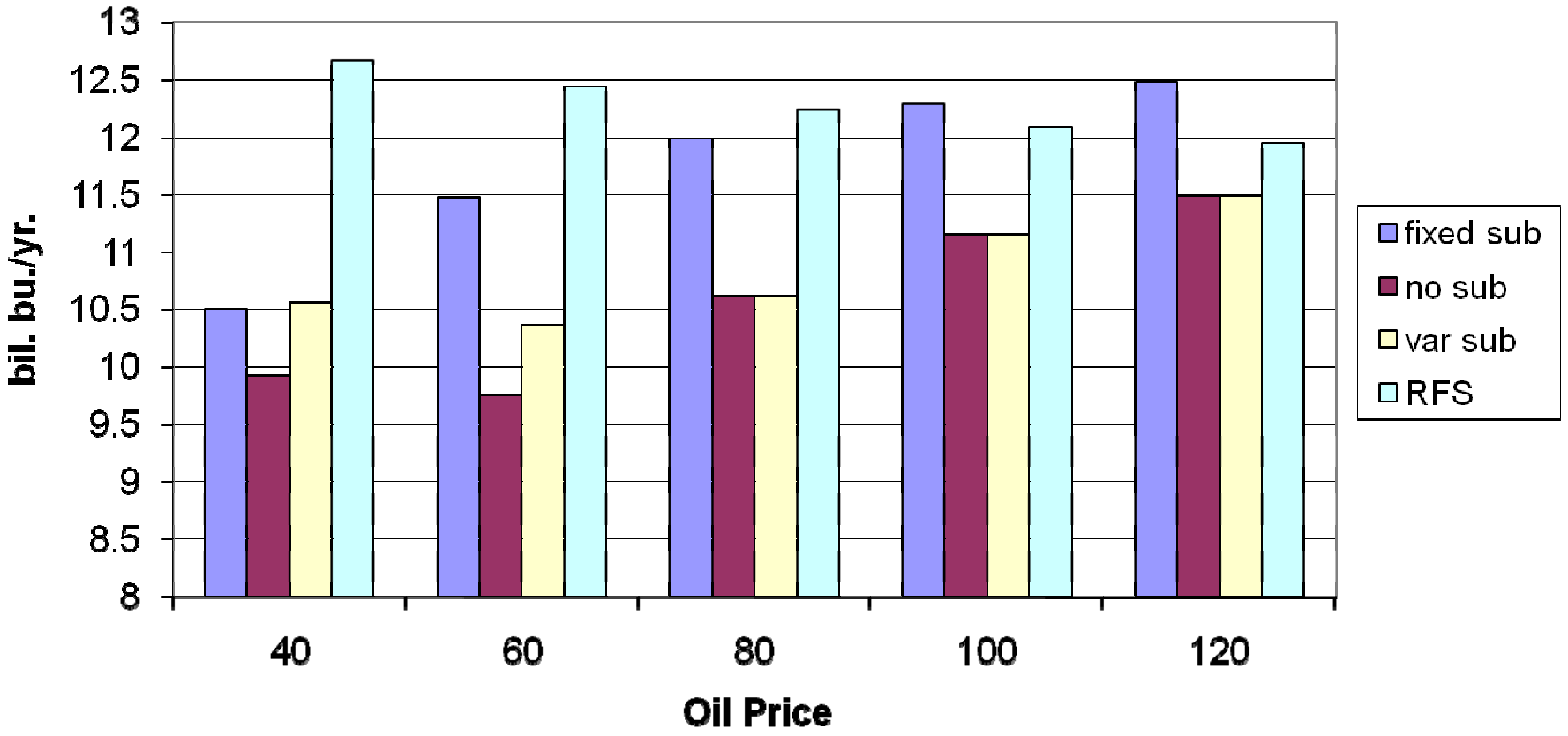
Corn Price

10% demand shock



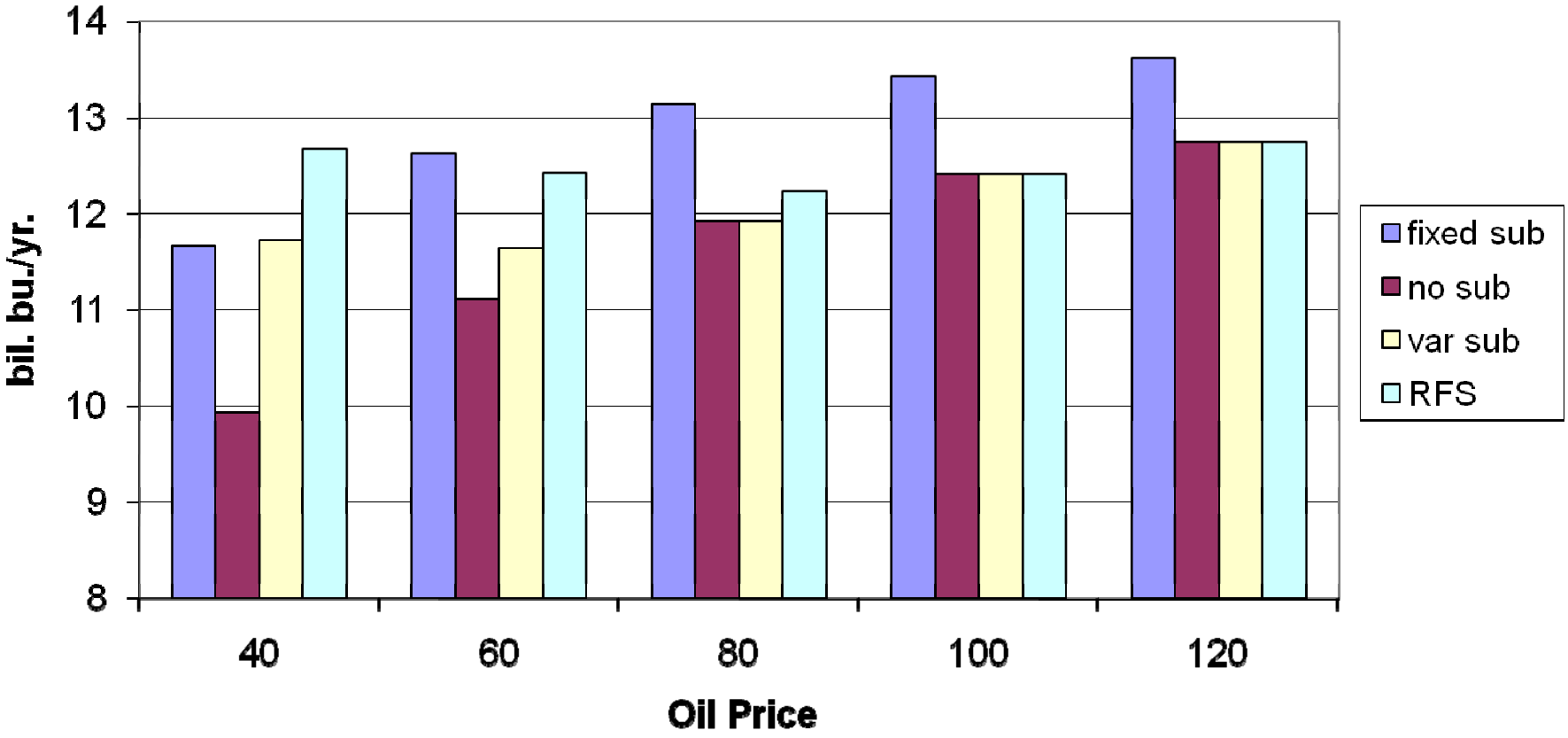
Corn Production

no demand shock



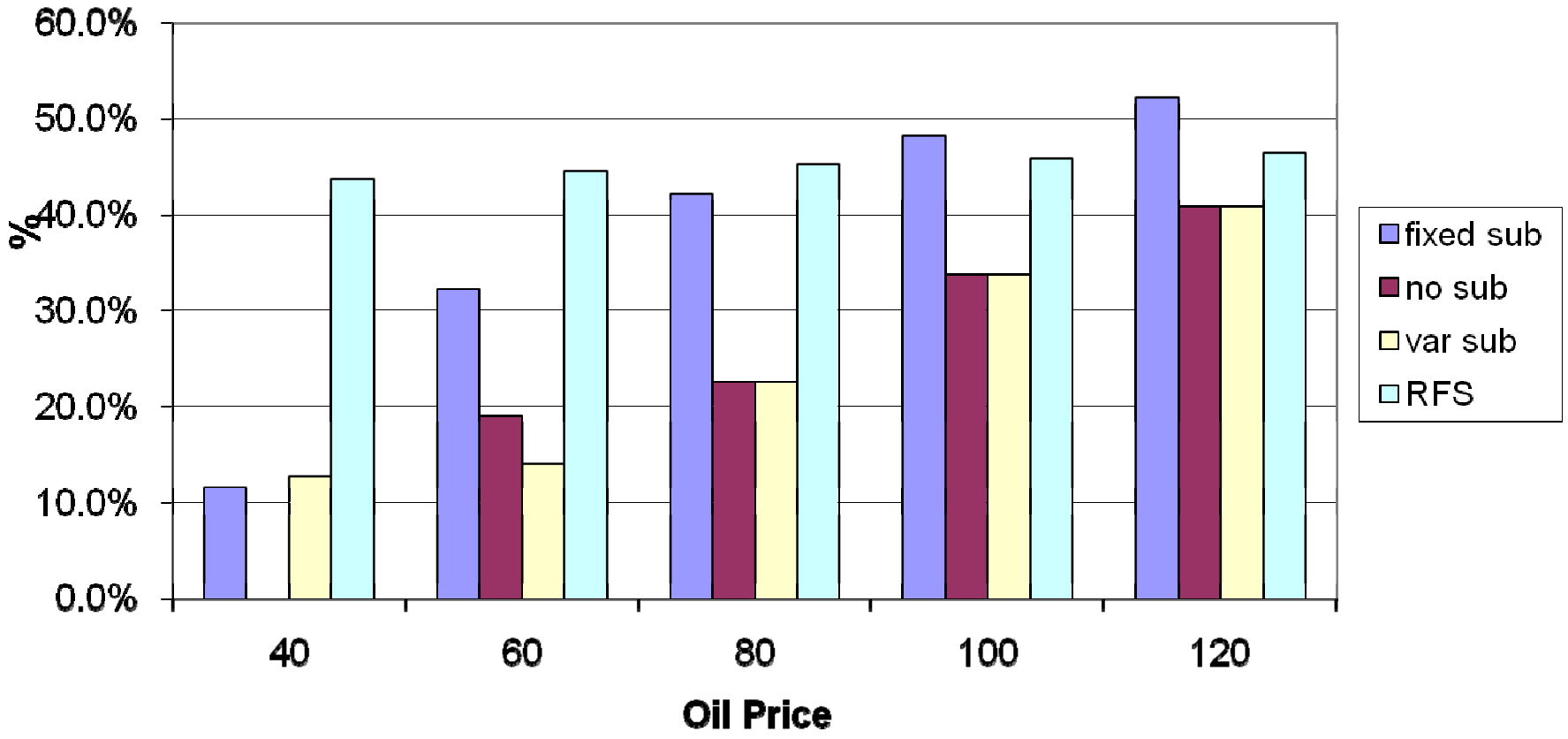
Corn Production

10% demand shock



Fraction of Corn for Ethanol

no demand shock



Fraction of Corn for Ethanol

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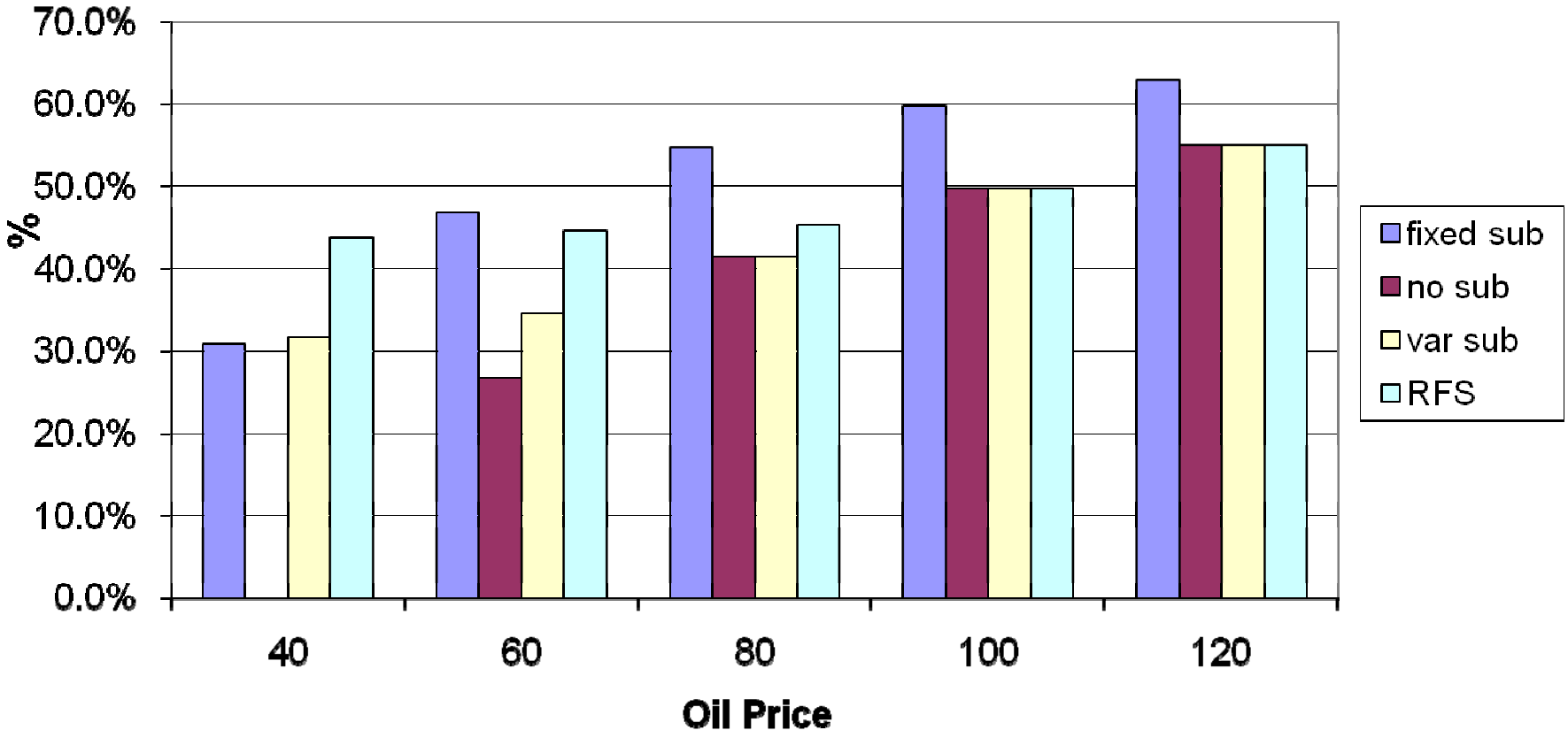


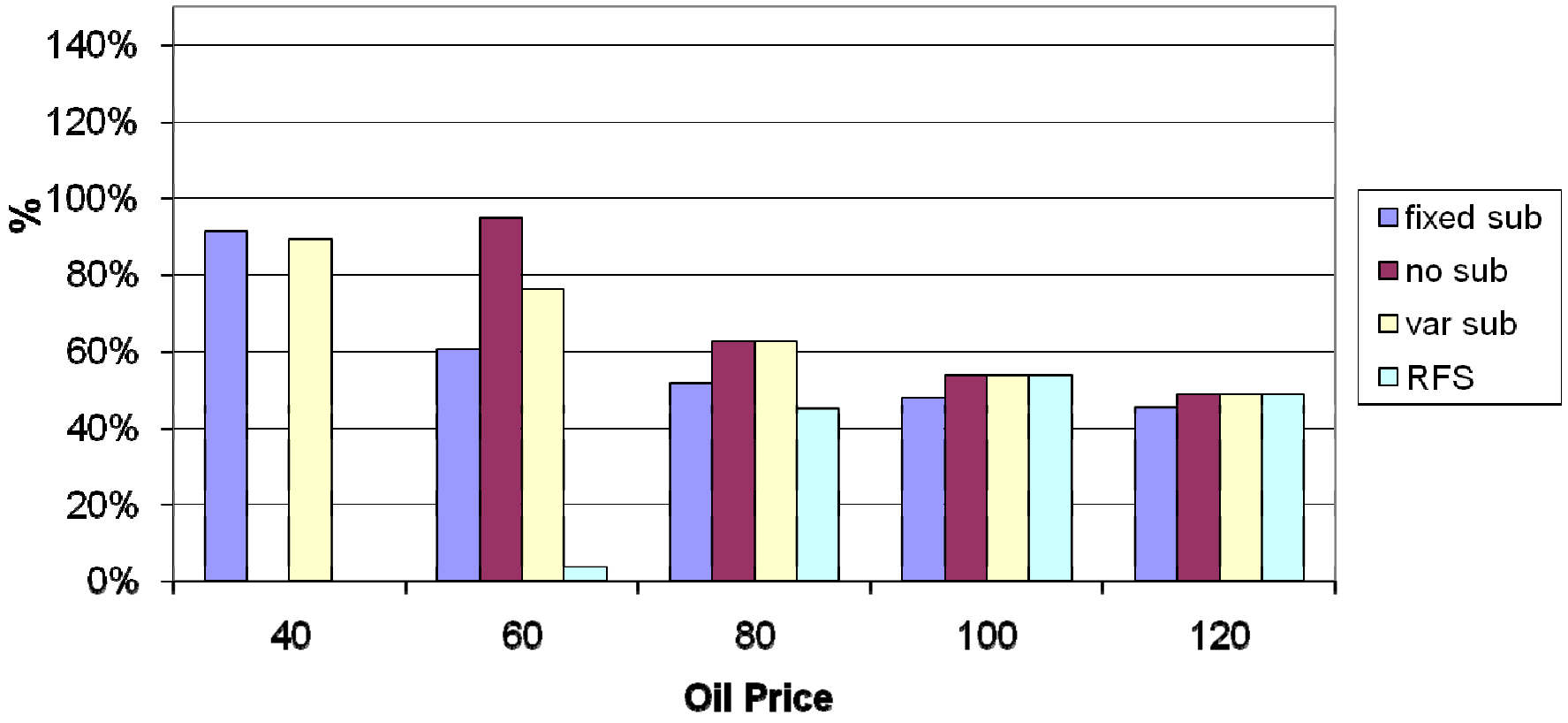
Sensitivity to 30% Corn Yield Increase

(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

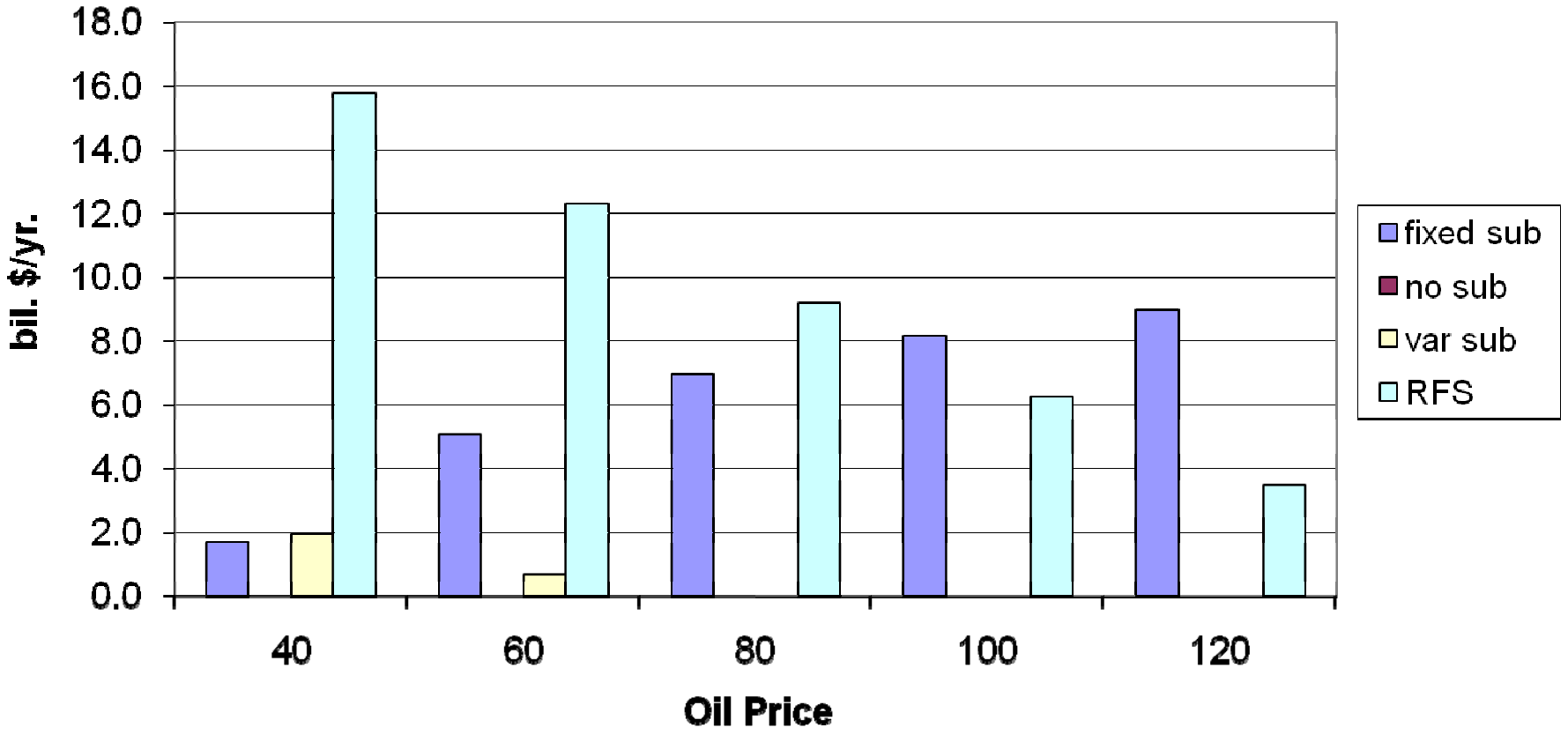
% Change in Ethanol Production with 30% Corn Yield Increase

10% demand shock



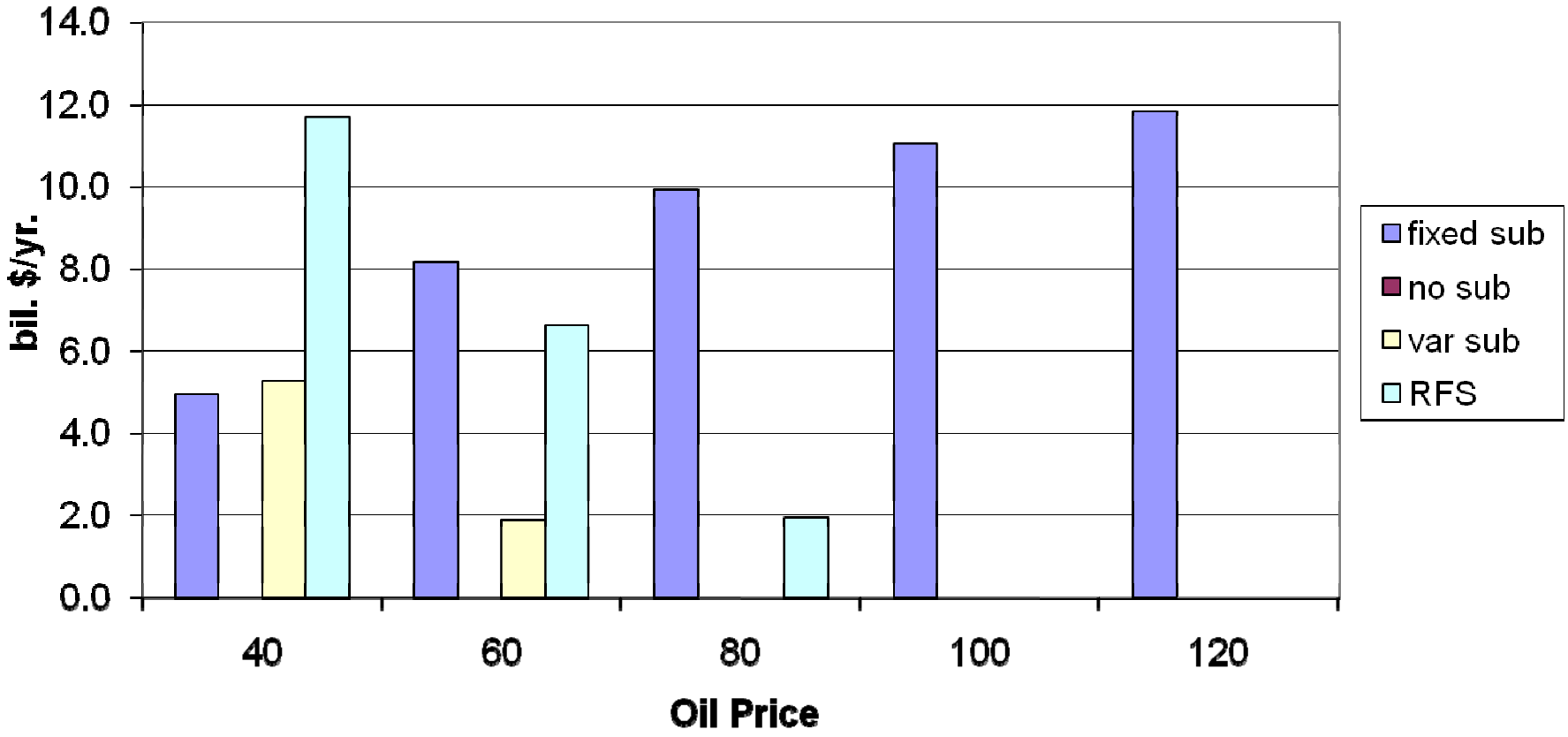
Policy Costs

no demand shock



Policy Costs

10% demand shock



Conclusions

- Model results clearly illustrate the linkage between crude oil prices and corn prices and therefore with most agricultural commodities
- There are **substantial differences among the policy alternatives** evaluated.
  - Fixed subsidy cost is on the government budget.
  - RFS cost is paid directly by consumers.
  - Variable subsidy cost is very low.
- These model results are consistent with the firm level results illustrated earlier

Thanks very much!

Questions and Comments

For more information:

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

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