Relationship between biofuel production and future vehicle stocks under different oil price scenarios

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Introduction

Significant changes of U.S. agriculture due to biofuels:

- Land-use change (in the U.S. and elsewhere)
- Changes in trade patterns
- Price changes
- Greenhouse gas (GHG) emissions from changes in land-use

Future projections of vehicle composition and fuel economy

- Increase in plug-in hybrid and electric vehicles
- Corporate Average Fuel Economy (CAFE) standards
- Future of E85 and E15

Effects on commodity prices and land-use

Macroeconomic Conditions

Energy Information Administration (EIA) 2018 Annual Energy Outlook (AEO): 2017 to 2050

- Scenarios based on various macroeconomic conditions
- Projection of vehicle stock and fuel use at the federal level

Five scenarios (2017 $):

		Growth 2017 to 2050	
Scenario	Oil price	Oil price	GDP
Baseline	$114	2.4%	2.0%
Low Economic Growth	$108	2.2%	1.5%
High Economic Growth	$116	2.4%	2.6%
Low Oil Price	$52	0.0%	2.0%
High Oil Price	$230	4.6%	2.0%

Vehicle Sales Share

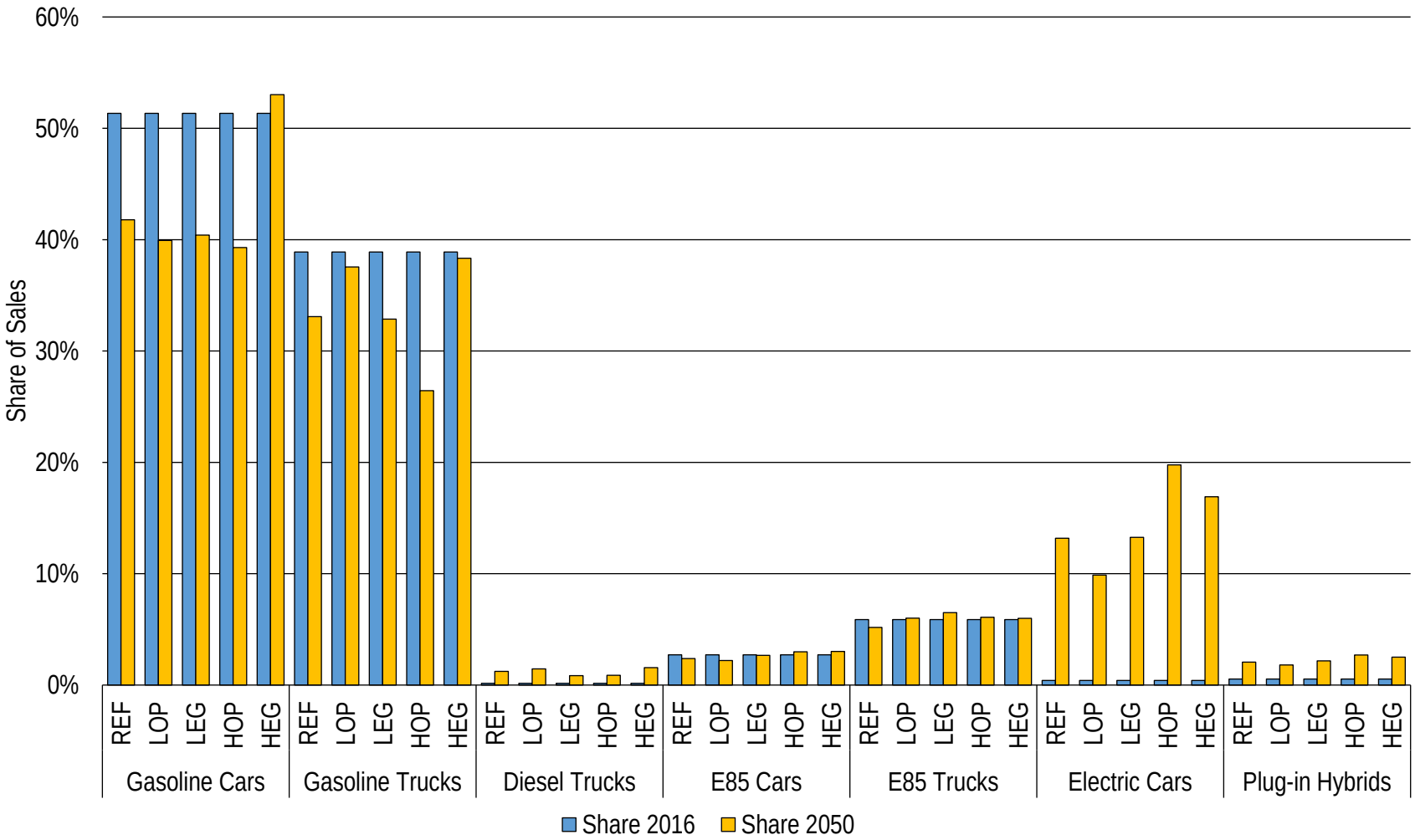


Figure: Gas, diesel, E85, electric, and plug-in hybrids (excl. other alternative fuels)

Vehicle Sales, Stock, and Fuel Economy

Vehicles sales:

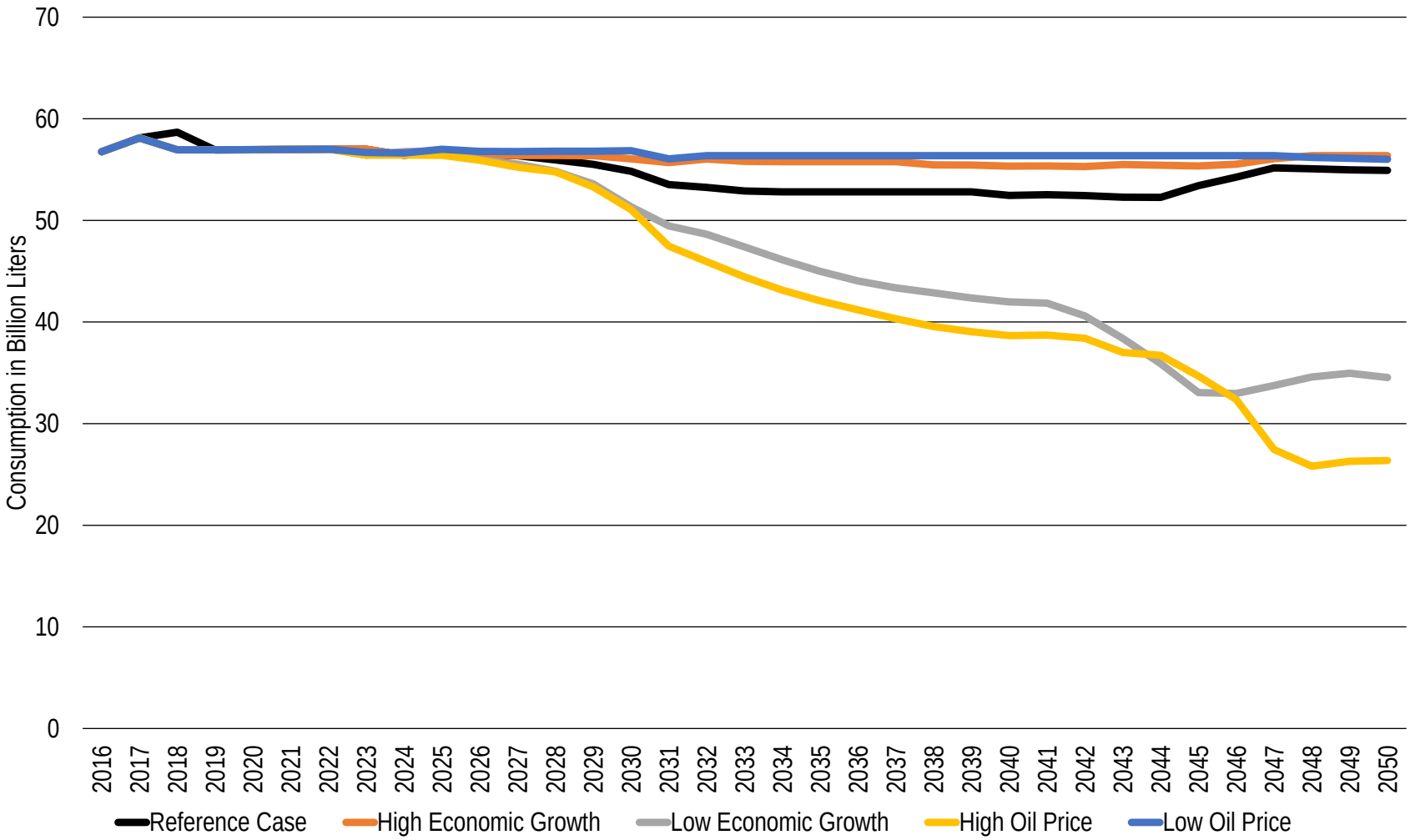
- Changes in vehicle sales translate into changes in the vehicle stock in the long-run
- Importance of survival rate to determine the time horizon in which new car sales translate into effects in the vehicle stock

Fuel efficiency

- Similar concept than in the case of vehicle sales (i.e., long-run effects)
- Previous research: Fuel efficiency is increasing more rapidly than vehicle miles traveled (driven by population growth)

Changes in vehicle stock and fuel efficiency affect gasoline, diesel, and ethanol consumption

Domestic Ethanol Production



Agricultural Sector

Demand side

- Population growth and income as the main predictors of food and feed demand

Supply side

- Growth in agricultural productivity
- Spatial differences in growth
- Constraints in land availability
- Influence of oil price on production costs for farmers

Preliminary results using a agricultural simulation model used previously for policies analyzing bioenergy crop production and afforestation.

Agricultural Production Model

Field crops covered:

- Corn, soybeans, and wheat

Constant elasticity demand function:

$$Q_j = \sum_{m=1}^{M} \left[\upsilon_{jm} \prod_{j=1}^{J} p_j^{\theta_{jm}} \right] + e$$

Agricultural returns in county i:

$$\pi_i^A(a_{ij}) = \max_{a_{ij}} \sum_{j=1}^{J} (p_j y_{ij} - \alpha_{ij}) a_{ij} - \sum_{j=1}^{J} \frac{\beta_{ij}}{2} a_{ij}^2$$

Data

Yield data from National Agricultural Statistics Service (NASS) from the U.S. Department of Agriculture (USDA)

- Linear county-level yield from 1998 to 2017
- Exogenously given yield and no change due to crop prices

Cost of production

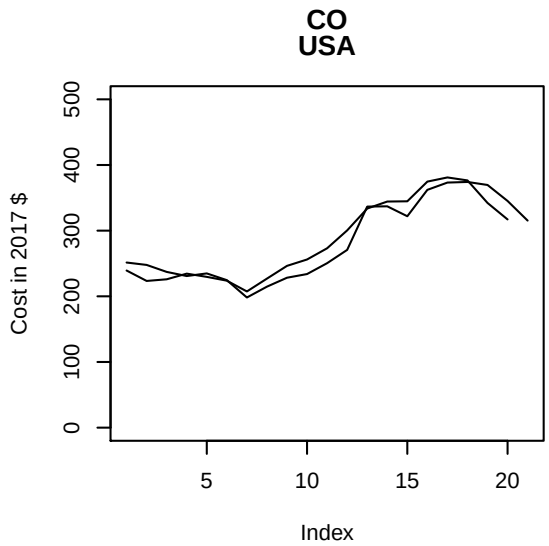
- USDA Cost and Return Data by region r
- Extraction of the operating cost

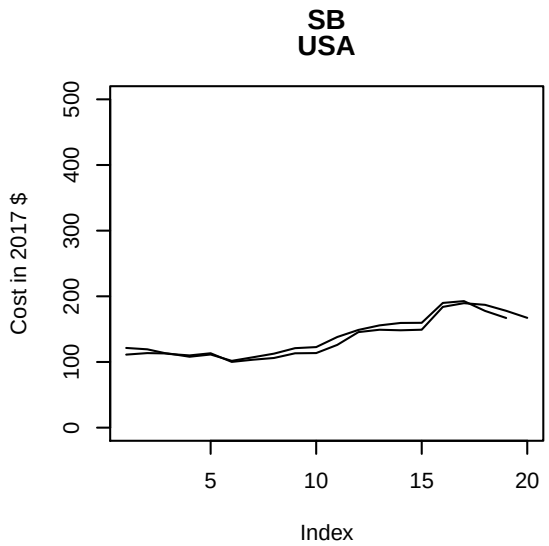
Functional form for regional cost of production:

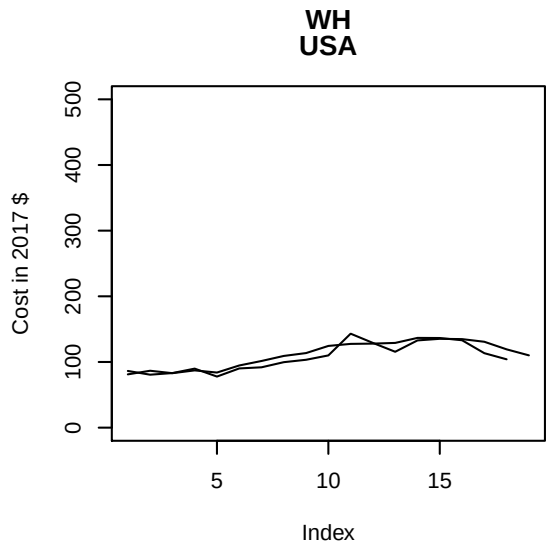
$$C_t = \gamma_1 + \gamma_2 \cdot C_{t-1} + \gamma_3 \cdot \ln(oil_t)$$

Cost of Production

Example: Corn, Soybeans, and Wheat for the U.S.







Scenarios

Baseline

- Current ethanol production levels
- Reduction by 3% (2050) in the AEO Reference Case

Scenarios: Reduction in domestic ethanol production

- Low Economic Growth: 39%
- High Oil Price: 54%

Reduction driven by oil prices, economic growth, changes in the vehicle stock, and fuel efficiency.

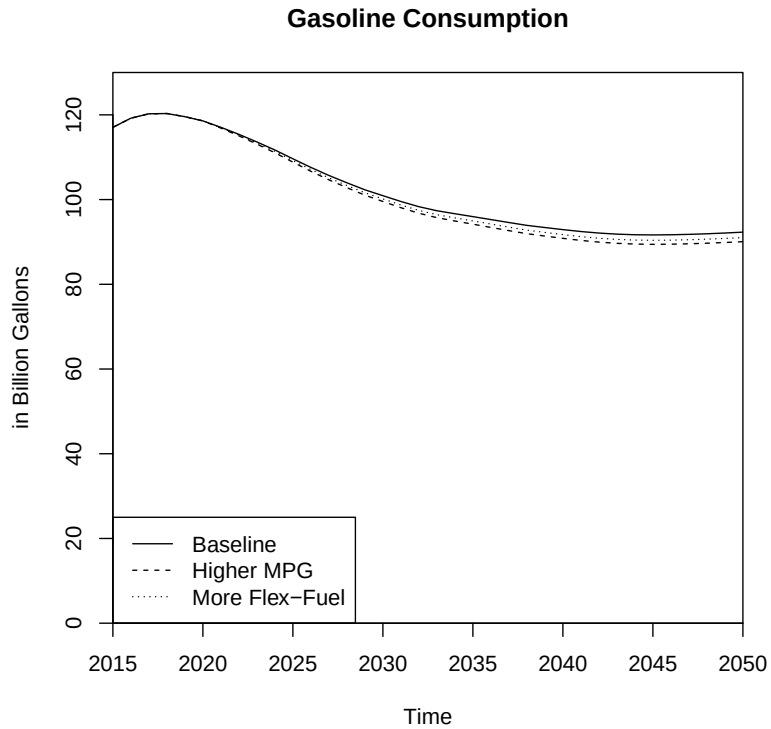
Results

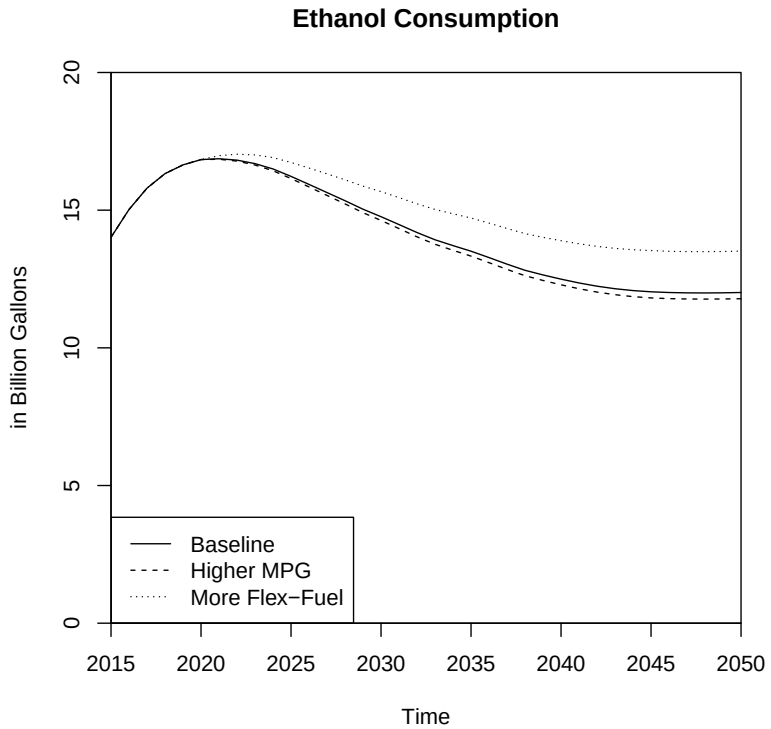
	Corn	Soybeans	Wheat
Change in prices compared to baseline			
Low Economic Growth	-11.30%	-5.88%	-4.46%
High Oil Price	-15.47%	-7.88%	-5.89%
Change in production compared to baseline			
Low Economic Growth	-13.22%	3.03%	1.58%
High Oil Price	-18.23%	4.13%	2.05%

Alternative Scenarios

Effects of policies:

- Increase in fuel efficiency standards by 1 mile per gallon by 2050
- Increase in flex-fuel vehicles sold





Conclusion

Long-run changes ahead for U.S. agriculture

- Changes in vehicle composition
- Changes in fuel economy

Reduced demand for ethanol

- Changes in the export quantity of ethanol
- Policy changes in the U.S.