Assessing the impact of U.S. ethanol market shocks on global crude oil and U.S. gasoline: a structural VAR approach

By

Lihong Lu McPhail
Economic Research Service, USDA
Email: lihong.l.mcphail@gmail.com

Poster prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

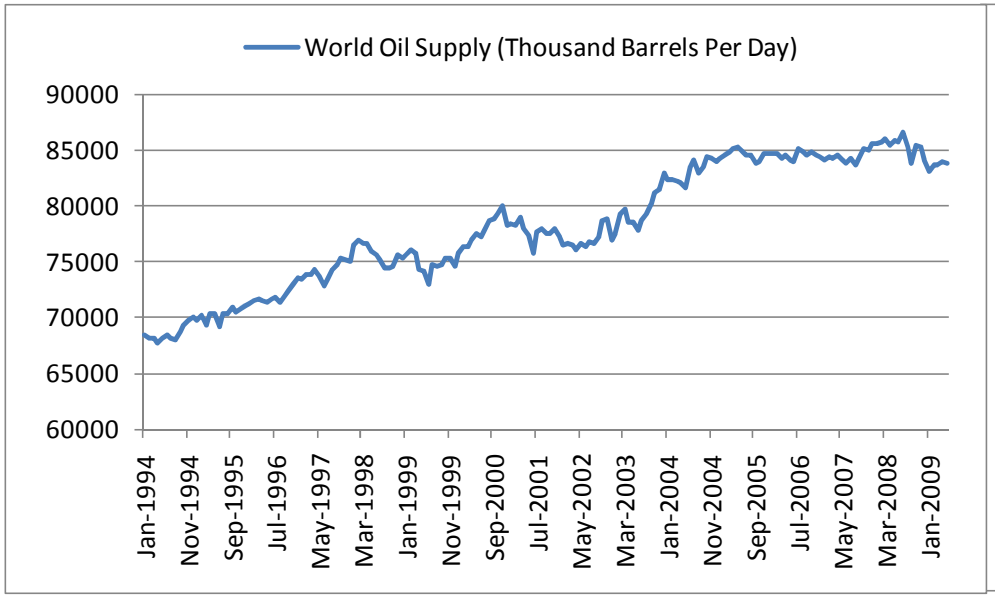
Question

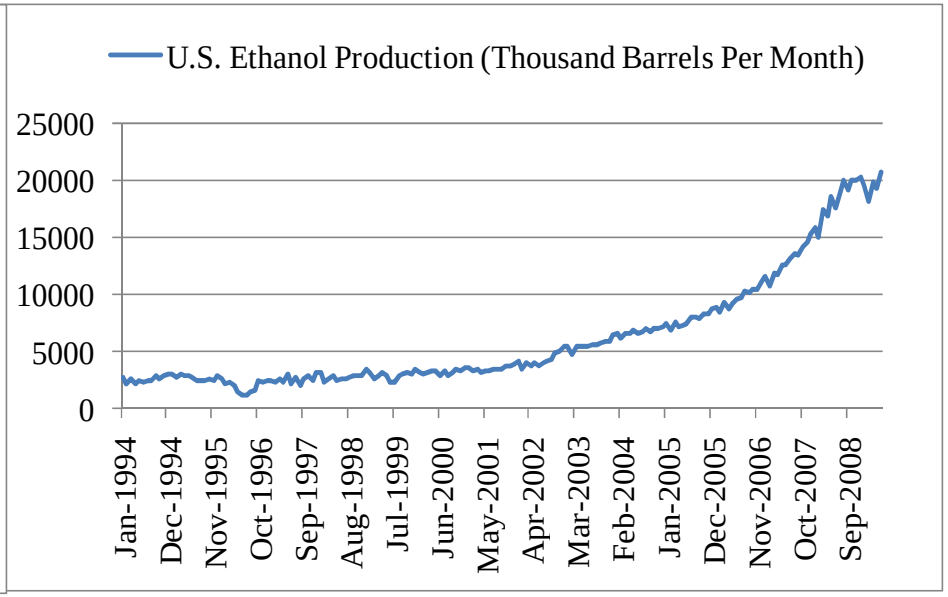
Does demand for alternative fuel such as ethanol partially explain the stagnation of global oil supply?

- Daniel Yergin of CERA w*rote in Washington Post on July 31st, 2005*

"Between 2004 and 2010, capacity to produce oil (not actual production) could grow by 16 million barrels a day— from 85 million barrels per day to 101 million barrels a day—a 20 percent increase. "

- Couple this expanding abundance of crude oil with the world's increasing demand for transportation fuels from 2005 to 2008 and one would expect to see an increase in crude oil supply. However, crude oil supply was stagnant from 2005 to 2008.





Source: Energy Information Administration (EIA)

Goals and approach

- To examine the responses of prices and quantities of global crude oil and U.S. gasoline markets to policy-led ethanol production
- By constructing a structural VAR model of global oil market, U.S. gasoline market, and U.S. ethanol market

Structural VAR

$$A_0 x_t = \alpha + \sum_{i=1}^{p} A_i x_{t-i} + \varepsilon_t$$

$$x_t = \begin{pmatrix} \Delta prodo_t \\ rea_t \\ rpo_t \\ rpg_t \\ \Delta consg_t \\ rpe_t \\ \Delta prode_t \end{pmatrix}$$

- Growth rate of global oil production
- Real global economic activity
- Real crude oil price
- Real U.S. gasoline price
- Growth rate of U.S. gasoline consumption
- Real U.S. ethanol price
- Level change in U.S. ethanol production

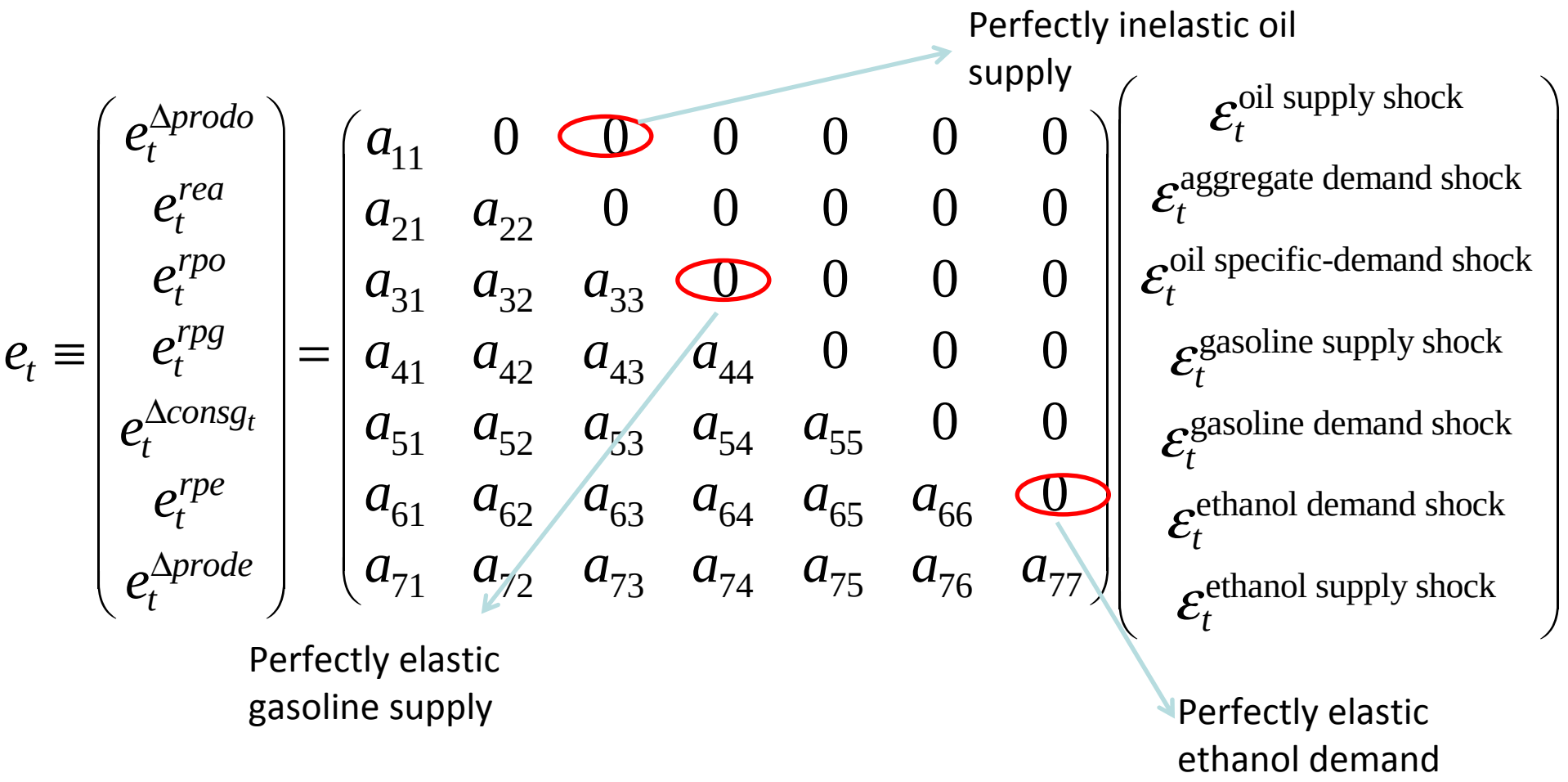
What are the shocks?

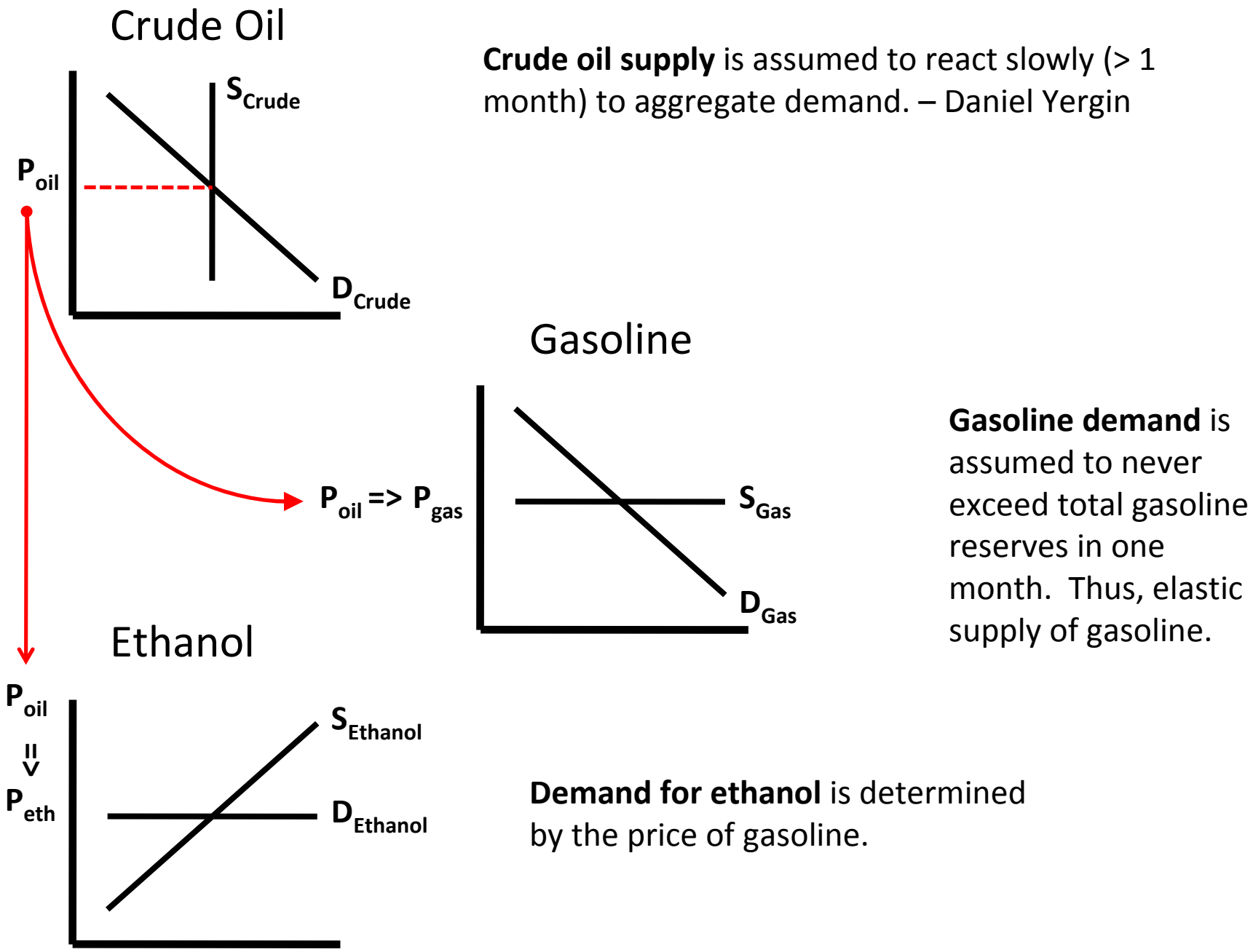
$$\varepsilon_t = \begin{pmatrix} \varepsilon_t^{\text{oil supply shock}} \\ \varepsilon_t^{\text{aggregate demand shock}} \\ \varepsilon_t^{\text{oil specific-demand shock}} \\ \varepsilon_t^{\text{gasoline supply shock}} \\ \varepsilon_t^{\text{gasoline demand shock}} \\ \varepsilon_t^{\text{ethanol demand shock}} \\ \varepsilon_t^{\text{ethanol supply shock}} \end{pmatrix}$$

Examples of causes of different shocks:

- Iraq war 2003
- Emergence of industrial economy in Asia
- Oil demand increase before Iraq war 2003
- Refinery shutdown caused by hurricane
- Urbanization
- A change in policy, such as RFS
- Feedstock price increase caused by weather

Identifying assumptions





Crude oil supply is assumed to react slowly (> 1 month) to aggregate demand. – Daniel Yergin

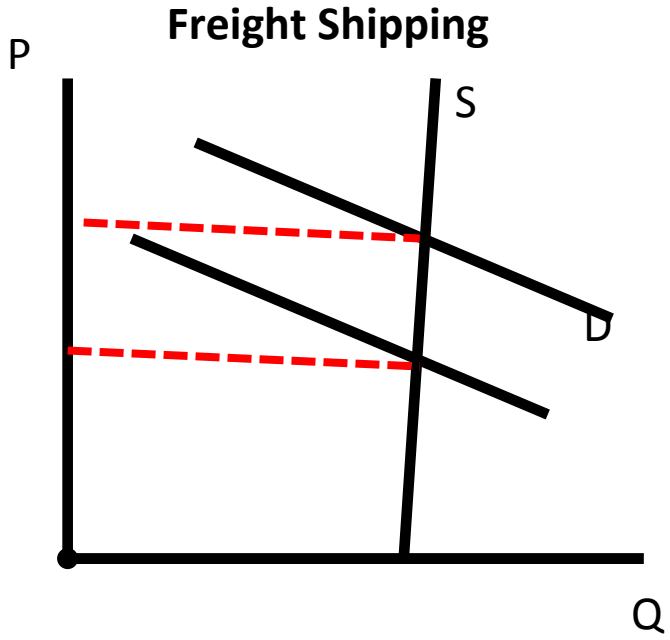
Gasoline demand is assumed to never exceed total gasoline reserves in one month. Thus, elastic supply of gasoline.

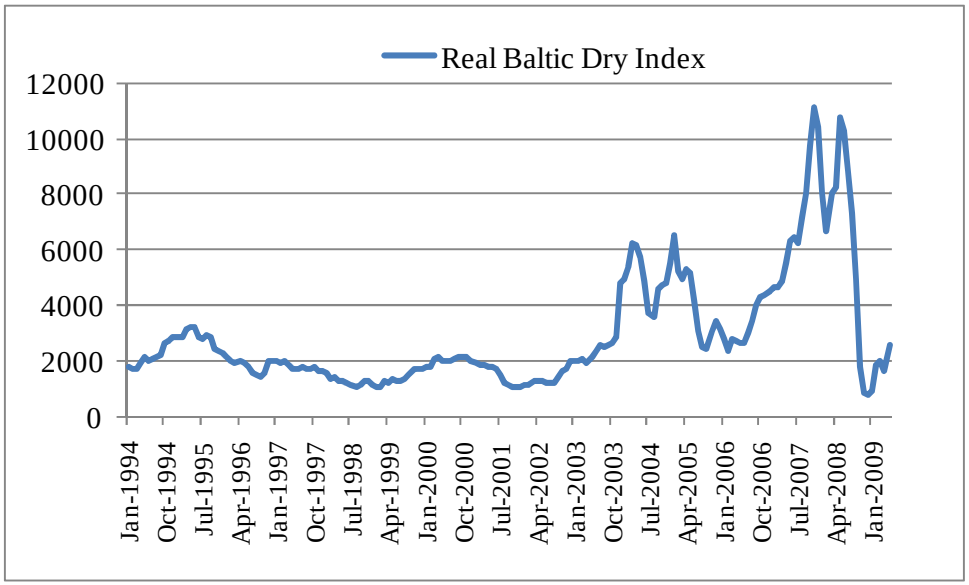
Demand for ethanol is determined by the price of gasoline.

Data: the global economic activity index

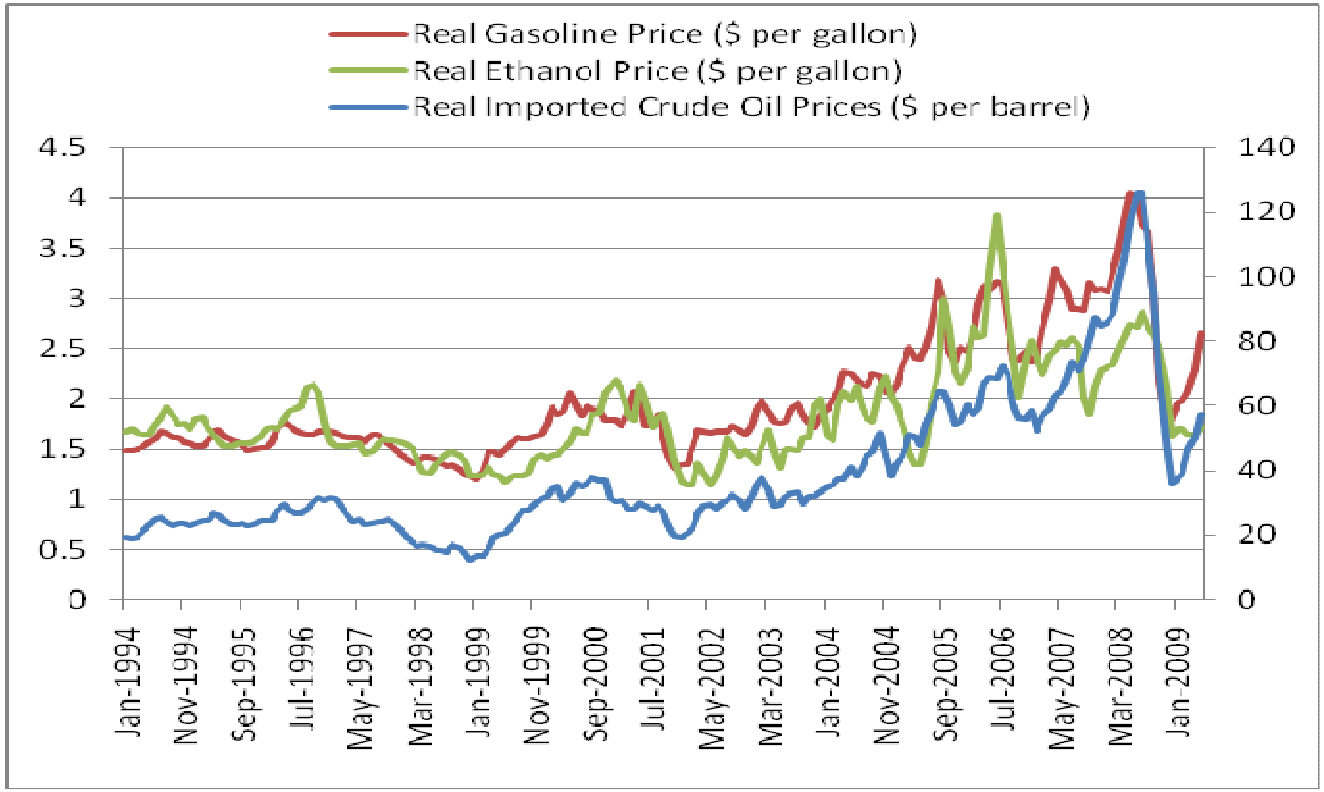
- Killian shows that oil supply shock alone do not explain the bulk of oil price fluctuations
- Killian proposes to the use of freight rates, such as Baltic dry Index, to capture shifts in the demand for industrial commodities driven by the global business cycle.

WHY?





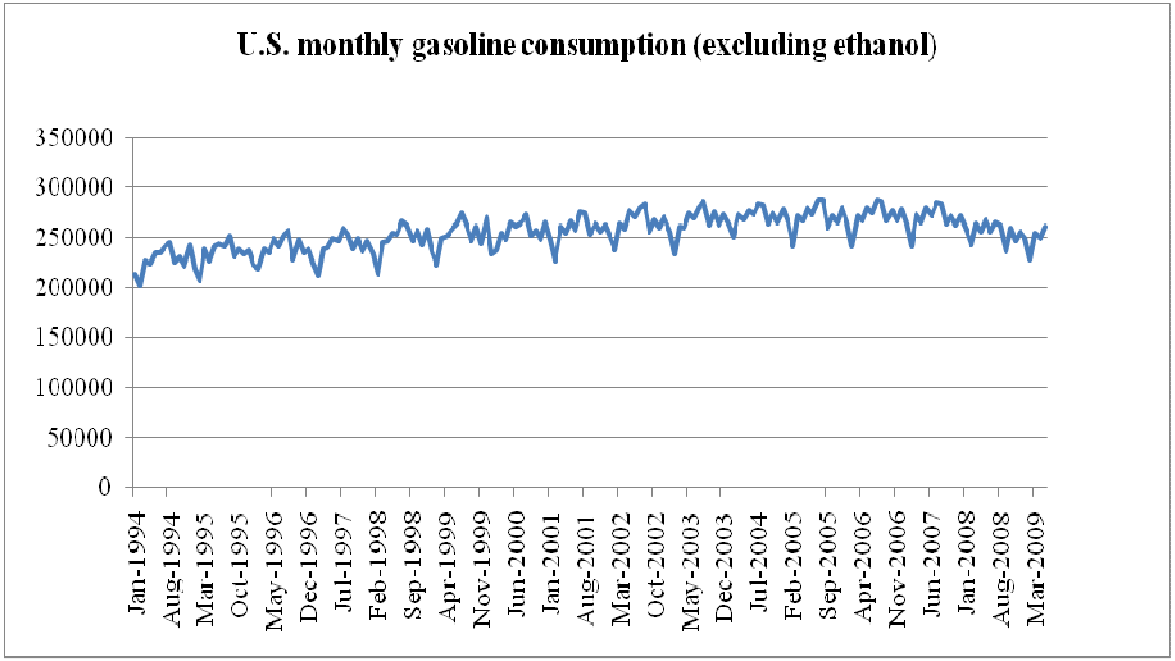
Data: prices



Source for norminal ethanol prices: http://www.neo.ne.gov/statshtml/66.html

Source for gasoline and crude oil prices: EIA

Data: US gasoline consumption



Source: Energy Information Administration

Seasonal variation is removed and then the data are transformed to the growth rate of U.S. gasoline consumption

Findings

- The growth rate of global oil production does respond to an ethanol demand shock with statistical significance, but not a supply shock.
  - Ethanol demand is mainly driven by policy. A change in ethanol demand is a change in policy. Ethanol supply shock is caused by an unanticipated change in feedstock prices, largely driven by weather conditions. This suggests that oil producers respond more to the largest government voting for support for alternative fuel than the passing weather.
  - Ethanol could affect crude oil market, not because it is currently a competitor as it accounts for less than 1% flowing into the crude oil market; but because when US government votes on the value of renewable energy; that will affect the future of fossil fuel.

Findings

- We do not find a statistically significant impact of shocks to ethanol markets on crude oil prices.

- Ethanol demand and supply increases cause statistically significant drops in real gasoline prices, but do not affect the growth rate of gasoline consumption.

References

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Acknowledgement

Thanks to Joseph McPhail, Dr. Bruce Babcock, Dr. James Bushnell, Dr. Sergio Lence, Dr. David Hennessy, and Dr. Peter Orazem for their expert feedback.