Modeling the impact of fuel economy standards on global oil markets

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USAEE/IAEE North American Conference
November 5, 2012

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Fuel economy (or per-mile tailpipe CO₂ emissions) regulations are in place in many countries.
Framing Questions: How to think about the combined global impact of fuel economy standards?

• **Considerations:**
  – How will higher passenger vehicle efficiency affect **fuel use and prices**?
  – By how much will **vehicle cost** change due to efficiency improvements? How will **consumer vehicle demand** react?
  – Considering both direct and indirect effects of policy, what is the energy, CO₂ emissions and economic impact?
    • Rebound and leakage effects.
    • Effects of policy cost on broader economy.

• **This study:**
  – Uses a carefully calibrated CGE model with a disaggregated passenger vehicle sector to investigate energy, emissions, price, and sensitivities to mobility demand assumptions.
MIT EPPA model is used to simulate the impact of fuel economy standards

The MIT Emissions Prediction and Policy Analysis Model

New passenger vehicle sector
Detailed physical accounting

(1) Travel demand
(2) Fuel efficiency
(3) Alt. Technology

Passenger Vehicles

Primary Factors

Private Households

Income

Expenditures

Producers

Goods and Services

EPPA-HTRN

- Multi-sector, multi-regional computable general equilibrium model
- Technologies compete based on cost
- Prices are determined inside the model
- Can apply policies, e.g. cap-and-trade, fuel tax

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Current Policies Scenario:
Global Vehicle Fuel Efficiency Targets

- Fuel economy policy implemented in the CGE framework as a constraint:

\[ FES_t \leq A_t \left( \frac{Q_{f,t_0}}{Q_{VKT,t_0}} \right) \]

- After 2025, constraint is held constant through 2050

New vehicle fuel economy in year $t$
Global demand for refined oil use in passenger vehicles continues to increase through 2050 with policy

- Model results: Current FES policies would reduce global refined oil use by around 16% in 2050 relative to baseline—much of the reduction comes from the developed countries (lower red lines).
Current fuel economy policies result in downward pressure on global refined oil prices.
Current fuel economy standards reduce passenger vehicle refined oil use most in the advanced industrialized countries.

(reduction shown in percent for each regional group)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Developed</th>
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<tbody>
<tr>
<td>2010</td>
<td></td>
<td>&lt;1%</td>
<td>2%</td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td>14%</td>
<td>28%</td>
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<tr>
<td>2050</td>
<td></td>
<td>30%</td>
<td>10%</td>
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</table>

Billion gallons gasoline equivalent
China and India contribute a growing share of total passenger vehicle refined oil use.

Fuel economy policy is applied in this simulation. Includes passenger vehicle fuel use only.
FE standards are not very effective at reducing global CO₂ emissions – only 4% reduction under current policy
Impact on one non-target sector: Refined oil use by road vehicles not classified as passenger vehicles

Driven by two offsetting effects:

- Lower fuel prices
- Policy impact on economic activity
How important is vehicle demand growth uncertainty to future refined oil demand projections?

Vehicle Demand Growth Projections for China

![Graph showing projected vehicle demand growth for China with different projections from various studies.]

In Kishimoto et al., 2012

**Figure 3.** Projected growth of total vehicles in use (stock) through 2050 by various studies. “Wang (JK)” and “(all)” refer to the projections from Wang et al. (2011) using the Japan/Korea and all-countries panels, respectively. The Argonne National Laboratory (ANL) Low-, Medium- and High-growth projections are from Wang et al. (2006); others from (Dargay et al., 2007; A.T. Kearney, 2011; Barclays Capital, 2011; International Energy Agency, 2011).
Uncertainty in China’s fuel demand makes difference to global total (both high and low scenarios assume current policy)

Two scenarios for China passenger vehicle demand:
448 million vehicles vs. 530 million vehicles in 2050*

* Scenario development described in Kishimoto et al., 2012.
In the case of climate policy, it is often said that the U.S. should not act unless China does. Whether or not you agree, the same logic can be applied to fuel economy standards.
Conclusions

• **Current passenger vehicle fuel economy standards will have limited impact on energy security and global climate.**
  – Current announced fuel economy standards reduces global passenger vehicle fuel use by 16% in 2050.
  – Global CO₂ emissions are reduced by 4% in 2050.

• **Indirect effects.**
  – Example of non-passenger road vehicles – fuel use increases in some regions, decreases in others.
  – Related to the impact of the passenger vehicle fuel economy standard on fuel prices & economic activity.

• **Demand uncertainty and relative magnitude of reductions.**
  – Uncertainty in China’s 2050 fuel demand about as large as fuel use displaced by U.S. fuel economy standards continued through 2050.

• **National fuel economy policy should consider global context.**
Thank you!

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United States: Comparing estimated impact of the Fuel Economy Standards (2011 – 2025) from the EPPA model with White House estimates

Not shown:
Economy-wide consumption loss in 2025 is around 5%.

EPPA results in red.
(Includes general equilibrium effects.)

- Save around 11 billion barrels of refined oil.
- Eliminate around 4.9 billion metric tons CO₂.
- Save $1.7 TRILLION at the pump over the life of the program.
- Eliminate 6 billion metric tons of carbon dioxide pollution.
- A family that purchases a new vehicle in 2026 will save $8,200 in fuel costs when compared with a similar vehicle in 2010.

Depends on gasoline price: U.S. $1.3 – 1.4 trillion