Does Diesel Price Matter?
Estimate the Elasticities of Trucking Decisions With Respect to Fuel Prices

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Introduction

Research Question

Does diesel price affect truckers’ decisions?

- Vehicle miles traveled (VMT)
- Fuel economy (MPG)
- Load-specific fuel consumption (LSFC)

1. Light single-unit truck: straight truck; not pulling a trailer, GVWR class 3-6
2. Heavy single-unit truck: straight truck; GVWR class 7 or 8
3. Tractor trailer: truck tractor; pulling one or more trailers

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Light Single-unit Truck

"'99-'04 Ford F-350 (class 3)" by Bull-Doser - Own work. Licensed under Public Domain via Commons
Heavy Single-unit Truck

“2015 HINO 268 Box Truck (class 7)” from CommercialTruckTrader.com
Tractor Trailer

Semi-trailer tractor with sleeper behind the cab and oversize load on lowboy trailer by User Gbleem on en.wikipedia
Elasticity of VMT
What are the estimates in existing studies?

Reviews (Goodwin et al., 2004; Graham & Glaister, 2003; Dahl, 2012)

Using aggregate data (national level)
- Canada: from -0.42 to -0.78 (Barla et al., 2014)
- U.K.: from -0.11 to -0.30 (Ramli & Graham, 2014)

Using disaggregate data
- inelastic (Greene, 1984)

Fuel tax discussion: from -0.31 to -0.47 (Parry, 2008)
Vehicle Use and Inventory Survey (VIUS)

- Truck-level micro data
- Survey year: 1982 - 2002 (every 5 years)
- Acquired after 1973
- Model year after 1973
- Powered by diesel fuel
- Motor carrier, for-hire transportation
Trip Distribution

- **Light Single-unit**
  - In state: 90.28%
  - Out of state: 9.72%

- **Heavy Single-unit**
  - In state: 88.17%
  - Out of state: 11.83%

- **Tractor Trailer**
  - In state: 46.94%
  - Out of state: 53.06%
Diesel Price

- State-level distillate fuel oil price (U.S. Energy Information Administration)
- Include federal and state diesel fuel tax
- Adjustments
Diesel Price in Pennsylvania (1973-2002)

Diesel price in Pennsylvania from 1973 to 2002; in 2002 USD
Diesel Price in 2002

Diesel price in 2002 across states (in 2002 USD)
Empirical Identification

\[
\ln\left(\frac{VMT_i}{MPG_i/LSFC_i}\right) = \alpha_0 + \alpha_1 \ln(P_i^C) \\
+ \varphi_1 HS_i \times \ln(P_i^C) + \varphi_2 TT_i \times \ln(P_i^C) \\
+ \text{TRUCK}_i \cdot \delta + \text{BUSINESS}_i \cdot \mu + \tau + \gamma + \varepsilon_i
\]

- \textbf{TRUCK}_i: engine model year, average vehicle weight, odometer reading, total length, total number of axles, number of cylinders, make, body/trailer type, cab type and engine displacement
- \textbf{BUSINESS}_i: fleet size, main payload cargo
- \tau, \gamma: year and location fixed effects
Two Concerns

Endogeneity of fuel price

- Instrumental variable estimation
  (IV: average price in the non-neighboring states)

Measurement error

- Aggregate at the level of year, region, make, body/trailer type and axle configuration.
Regions

Source: U.S. Energy Information Administration Form EIA-878
## Elasticities of VMT

<table>
<thead>
<tr>
<th></th>
<th>Baseline OLS (1)</th>
<th>OLS IV Estimation (2)</th>
<th>IV Estimation (3)</th>
<th>IV Estimation (4)</th>
<th>Aggregate &amp; IV (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light single-unit</td>
<td>-0.716**</td>
<td>-0.563**</td>
<td>-1.279***</td>
<td>-0.706**</td>
<td>-1.907**</td>
</tr>
<tr>
<td></td>
<td>(0.231)</td>
<td>(0.245)</td>
<td>(0.330)</td>
<td>(0.337)</td>
<td>(0.898)</td>
</tr>
<tr>
<td>Heavy single-unit</td>
<td>-0.064</td>
<td>0.091</td>
<td>-0.424</td>
<td>0.129</td>
<td>-0.634</td>
</tr>
<tr>
<td></td>
<td>(0.131)</td>
<td>(0.146)</td>
<td>(0.295)</td>
<td>(0.414)</td>
<td>(0.919)</td>
</tr>
<tr>
<td>Tractor trailer</td>
<td>0.254**</td>
<td>0.420**</td>
<td>0.048</td>
<td>0.586</td>
<td>-0.225</td>
</tr>
<tr>
<td></td>
<td>(0.094)</td>
<td>(0.142)</td>
<td>(0.292)</td>
<td>(0.434)</td>
<td>(0.843)</td>
</tr>
<tr>
<td>Truck characteristics?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Business characteristics?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State/region fixed effects?</td>
<td>Region</td>
<td>State</td>
<td>Region</td>
<td>State</td>
<td>Region</td>
</tr>
<tr>
<td>Survey year fixed effects?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No. of observations</td>
<td>37,132</td>
<td>37,132</td>
<td>37,132</td>
<td>37,132</td>
<td>7,056</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.491</td>
<td>0.493</td>
<td>0.490</td>
<td>0.493</td>
<td>0.569</td>
</tr>
</tbody>
</table>

* : $p < 0.1$; ** : $p < 0.05$; *** : $p < 0.01$. All standard errors are clustered at the region level.

Column (5): Data are aggregated at the level of year, region, make, body/trailer type and axle configuration.
## Elasticities of MPG

<table>
<thead>
<tr>
<th></th>
<th>Baseline OLS</th>
<th>IV Estimation</th>
<th>Aggregate &amp; IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Light single-unit</td>
<td>0.014</td>
<td>0.021</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td>(0.107)</td>
<td>(0.076)</td>
<td>(0.083)</td>
</tr>
<tr>
<td>Heavy single-unit</td>
<td>0.140</td>
<td>0.150**</td>
<td>0.073</td>
</tr>
<tr>
<td></td>
<td>(0.115)</td>
<td>(0.075)</td>
<td>(0.057)</td>
</tr>
<tr>
<td>Tractor trailer</td>
<td>0.097</td>
<td>0.112**</td>
<td><strong>0.125</strong>*</td>
</tr>
<tr>
<td></td>
<td>(0.071)</td>
<td>(0.053)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>Business characteristics?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State/region fixed effects?</td>
<td>Region</td>
<td>State</td>
<td>Region</td>
</tr>
<tr>
<td>Survey year fixed effects?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No. of observations</td>
<td>37,132</td>
<td>37,132</td>
<td>37,132</td>
</tr>
<tr>
<td>R^2</td>
<td>0.298</td>
<td>0.300</td>
<td>0.298</td>
</tr>
</tbody>
</table>

* : p < 0.1; ** : p < 0.05; *** : p < 0.01. All standard errors are clustered at the region level.

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## Elasticities of LSFC

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<th>Aggregate &amp; IV (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light single-unit</td>
<td>0.308**</td>
<td>0.497**</td>
<td>-0.644</td>
<td>0.058</td>
<td>-1.891*</td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td>(0.155)</td>
<td>(0.515)</td>
<td>(0.570)</td>
<td>(1.023)</td>
</tr>
<tr>
<td>Heavy single-unit</td>
<td>-0.085</td>
<td>0.086</td>
<td>-1.054**</td>
<td>-0.372</td>
<td>-1.932**</td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td>(0.118)</td>
<td>(0.480)</td>
<td>(0.549)</td>
<td>(0.856)</td>
</tr>
<tr>
<td>Tractor trailer</td>
<td>-0.114</td>
<td>0.092</td>
<td>-1.121**</td>
<td>-0.422</td>
<td>-1.964**</td>
</tr>
<tr>
<td></td>
<td>(0.061)</td>
<td>(0.081)</td>
<td>(0.508)</td>
<td>(0.503)</td>
<td>(0.866)</td>
</tr>
<tr>
<td>Truck characteristics?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Business characteristics?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Region</td>
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<td>Region</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>No. of observations</td>
<td>36,429</td>
<td>36,429</td>
<td>36,429</td>
<td>36,429</td>
<td>6,919</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.389</td>
<td>0.394</td>
<td>0.383</td>
<td>0.393</td>
<td>0.524</td>
</tr>
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Policy Implications

Will diesel fuel tax be an effective policy instrument to...

- encourage truckers to drive less?
- incentivize truckers to buy more fuel efficient vehicles?
- improve shipping efficiency?

Alternative policy:

- Fuel efficiency standards (24% reduction from 2018 to 2027)
Thank You!