Economic Effects of Connected & Automated Vehicles

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Overview

• Examination of **U.S. macroeconomic effects** of connected & self-driving vehicles
• Focuses on:
  – A) Individual **Industries**
  – B) **Economy-Wide** Effects
• Integrates already-published literature & new analysis into comprehensive report
Most Affected Industries

- Ordered *from most directly affected* to more tangentially affected markets...
  - **Automotive**
  - **Electronics & Software Technology**
  - **Freight Transport**
  - **Personal Transport**
  - **Auto Repair**
  - **Medical**
  - **Insurance**
  - **Law**
  - **Construction/Infrastructure**
  - **Land Development**
  - **Digital Media**
  - **Police**
  - **Oil & Gas**
Automotive Industry

• 10% Increase in vehicle miles traveled (VMT) → more cars sold
  – Accessibility for children, elderly, disabled
  – Decreased cost per mile traveled

• Shared autonomous vehicles (SAVs) → fewer cars sold

• 7.5 percent increase in vehicles sold → $42 billion
Freight Impacts

• **Automated** freight transport with **convoys**
• **Fewer jobs** for drivers, industry saves wage $-
• Current shortage of drivers, could **increase capacity**
• Industry gains **$100-500 billion** per year (McKinsey 2013)
Personal Travel

• Shared autonomous vehicle (SAV) fleets emerge...
  – Hurting taxis, trains, planes, public transit systems
  – Helping tech companies & TNCs (like Uber & Lyft)
Collision–related Effects

• Fewer crashes
  – Volume of auto repairs may fall, but cost per repair will probably rise (due to complex technology).
  – Medical care needs for crash victims will fall.
    • Resources can be used for other patients
Collision–related (2)

• Crash liability
  – Insurance companies issue larger policies for OEMs, & lower personal premiums.
  – Lawyers specializing in personal injury lose business (up to $3.2 billion/yr).
**Infrastructure & Land Development**

- **Parking demand** falls
  - Freeing land for development & repurposing of garage space

- **Investment in technology infrastructure**
  - Vehicle-to-Infrastructure (V2I) communication

- **Movement** to & from city center
  - “Easier travel” → some people & businesses outward?
  - Better SAV services → shift central?
  - **7.4%** expect to move **centrally**, **11.1% outward** (Bansal & Kockelman 2016)
**Police (Traffic Violations)**

- Fewer traffic violations thanks to “obedient” AVs
  - Traffic tickets bring in $7.5-15$ billion annually
  - Police can be re-assigned to tackle other crimes.
  - Smaller, “speed-trap towns” may lose solid share of public revenues.
Economy-Wide Effects

• **Time** Savings
  – Decreased *congestion*
  – Decreased *collisions*
  – Usable time during commute
  – Increased *productivity*

• **Fuel** Consumption
  – Increased *efficiency* of driving
  – BUT possible increase in *VMT*
Economy-Wide Effects (2)

Economy-wide gains could add up to $1.2 trillion annually (7% of U.S. GDP)

– $488 billion/yr from collision costs
– $448 billion/yr from increase in productivity/value of travel time (VOTT)
# Impact by U.S. Industry

<table>
<thead>
<tr>
<th>Industry-Specific Effects</th>
<th>Industry Revenue ($B/yr)</th>
<th>Industry Impact ($B/yr)</th>
<th>% Change in Industry</th>
<th>$ per Capita per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insurance</td>
<td>$180</td>
<td>- $108</td>
<td>- 60%</td>
<td>$339</td>
</tr>
<tr>
<td>Freight Transportation</td>
<td>$604</td>
<td>+ $100</td>
<td>+ 17%</td>
<td>$313</td>
</tr>
<tr>
<td>Land Development</td>
<td>$931</td>
<td>+ $45</td>
<td>+ 5%</td>
<td>$142</td>
</tr>
<tr>
<td>Automotive</td>
<td>$570</td>
<td>+ $42</td>
<td>+ 7%</td>
<td>$132</td>
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<tr>
<td>Personal Transportation</td>
<td>$86</td>
<td>- $27</td>
<td>- 31%</td>
<td>$83</td>
</tr>
<tr>
<td>Electronics &amp; Software Technology</td>
<td>$203</td>
<td>+ $26</td>
<td>+ 13%</td>
<td>$83</td>
</tr>
<tr>
<td>Auto Repair</td>
<td>$58</td>
<td>- $15</td>
<td>- 26%</td>
<td>$47</td>
</tr>
<tr>
<td>Digital Media</td>
<td>$42</td>
<td>+ $14</td>
<td>+ 33%</td>
<td>$44</td>
</tr>
<tr>
<td>Oil and Gas</td>
<td>$284</td>
<td>+ $14</td>
<td>+ 5%</td>
<td>$44</td>
</tr>
<tr>
<td>Medical</td>
<td>$1,067</td>
<td>- $12</td>
<td>- 1%</td>
<td>$36</td>
</tr>
<tr>
<td>Construction/Infrastructure</td>
<td>$169</td>
<td>- $8</td>
<td>- 4%</td>
<td>$24</td>
</tr>
<tr>
<td>Traffic Police</td>
<td>$10</td>
<td>- $5</td>
<td>- 50%</td>
<td>$16</td>
</tr>
<tr>
<td>Law</td>
<td>$277</td>
<td>- $3</td>
<td>- 1%</td>
<td>$10</td>
</tr>
<tr>
<td><strong>Industry-Specific Total</strong></td>
<td><strong>$4.48 Trillion/yr</strong></td>
<td><strong>$418 B/yr.</strong></td>
<td><strong>9%</strong></td>
<td><strong>$1,312 /person/yr</strong></td>
</tr>
</tbody>
</table>
# U.S. Economy-Wide & Total Effects

<table>
<thead>
<tr>
<th>Economy-Wide Effects (+ Industry &amp; Total Effects)</th>
<th>Economic Impact ($billion/year)</th>
<th>$ per Capita per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>$448 B/yr.</td>
<td>$1,404/person/year</td>
</tr>
<tr>
<td>Collisions</td>
<td>$488</td>
<td>$1,530</td>
</tr>
<tr>
<td>Economy-Wide Total</td>
<td>$936</td>
<td>$2,934</td>
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<tr>
<td>Industry-Specific Total</td>
<td>$418</td>
<td>$1,312</td>
</tr>
<tr>
<td>Collision Value Overlap</td>
<td>- $138</td>
<td>- $432</td>
</tr>
<tr>
<td><strong>Overall (Industries + Economy-Wide - Overlap) Total</strong></td>
<td><strong>$1.217 TRILLION/yr</strong></td>
<td><strong>$3,814/person/yr</strong></td>
</tr>
</tbody>
</table>
Congestion Pricing with Connected Vehicles
Congestion Pricing (CP)

- **Incentivize** route choices to improve efficiency

- High *congestion* $\rightarrow$ higher *price* on roadway

- Communication/computing *technology* can enable effective implementation of CP
Policies

• **VMT** fees
  – Charged for miles traveled from GPS data
  – California & Oregon pilots

• Credit-based congestion pricing (**CBCP**)
  – Tolled for marginal cost of congestion
Technologies

• **DSRC** (5.9 GHz)
  – Short-term, limited locations

• **Cellular**
  – Long-term, widespread

• **Video**
  – Less promising
Thank you for your kind attention!
Questions & Suggestions?

20+ CAV papers at www.caee.utexas.edu prof/kockelman