The Flow of Services from Owned Vehicles in Consumer Expenditure Interview Surveys

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March 18, 2022
Consumption Measure of Motor Vehicles

- Measuring living standards for households
- Frequent and expensive long-lived goods
- Consumption vs. spending
  - zero spending ≠ zero consumption
Key Concept:
Depreciation of Motor Vehicles

- An effort towards a full user cost approach
  1) Value of service received during the reference period
  2) Smooth out consumption
  3) Measures at consumer unit level
Service Flow From Owned Vehicles

\[ S_{it} = \sum_{j=1}^{J} \left( (r_t + \delta_{a(j)}) \cdot (1 - \delta_{a(j)})^{y_j} \cdot P_{jo} \right) \]

where

- \( S_{it} \): service flow from all vehicles at time \( t \) of CU \( i \)
- \( r_t \): inflation adjusted annual yield on long-term security at time \( t \)
- \( \delta_{a(j)} \): age specific depreciation rate
- \( P_{jo} \): purchase price for vehicle \( j \)
- \( y_j \): owned years since purchasing
- \( J \): number of vehicles owned by CU \( i \)
CE Interview Survey, 1996Q1-2019Q4

- Over 1 million motor vehicles
  - Include cars, SUVs, trucks (85%)
  - Exclude boats, kayaks, aircrafts, RVs, other unknowns, etc. (15%)
- 40% purchased as new vs. 60% purchased as used
- 23% price reported (11% news cars, 12% used cars)
### CE Variables Description

<table>
<thead>
<tr>
<th>CE Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMID, NEWID</td>
<td>Consumer unit ID</td>
</tr>
<tr>
<td>SEQNO</td>
<td>Sequence number</td>
</tr>
<tr>
<td>ALCNO</td>
<td>Allocation number</td>
</tr>
<tr>
<td>QINTRVYR, QINTRVMO</td>
<td>Interview year, Month</td>
</tr>
<tr>
<td>VEHICYR</td>
<td>Vehicle model year</td>
</tr>
<tr>
<td>VEHPURYR, VEHPURMO</td>
<td>Purchase year and month</td>
</tr>
<tr>
<td>NETPURX</td>
<td>Net purchase price after discount, trade-in, or rebate including destination fee</td>
</tr>
<tr>
<td>TRADEX</td>
<td>Amount of trade-in allowance</td>
</tr>
<tr>
<td>MKMDLY</td>
<td>Vehicle Make and Model code (4 digit #)</td>
</tr>
<tr>
<td>MKMODEL</td>
<td>Vehicle Make and Model</td>
</tr>
<tr>
<td>MKMDESC</td>
<td>Vehicle make and model description</td>
</tr>
<tr>
<td>VEHNEWU</td>
<td>Was it new or used when acquired?</td>
</tr>
<tr>
<td>FINLWT21</td>
<td>Calibration final weight for the full sample</td>
</tr>
</tbody>
</table>
Regression Model

Regression model

$$\log (P_{jt}) = \theta_0 + \theta_a * age_t + make + model + year + u_{jt}$$

- Constant geometric depreciation include vehicles of all ages
- Non-parametric depreciation include only new vehicles and vehicles of specific ages from 1 through 20.
Construction of Subsamples for Depreciation Estimation

- Purchase prices are reported and >$300 in 1983 dollars
- Variables *make, model, modelyear* are all available

<table>
<thead>
<tr>
<th>Purchase condition and age</th>
<th>Composition of estimation sample</th>
<th># of obs</th>
<th>Percent share of full sample (obs=1071468)</th>
</tr>
</thead>
<tbody>
<tr>
<td>used car</td>
<td>used cars of all ages</td>
<td>147290</td>
<td>13.75%</td>
</tr>
<tr>
<td>new car</td>
<td>new cars (age=0) and used cars of all ages</td>
<td>212619</td>
<td>19.84%</td>
</tr>
<tr>
<td>new car &amp; age 1</td>
<td>new cars (age=0) and used cars of age 1</td>
<td>118828</td>
<td>11.09%</td>
</tr>
<tr>
<td>new car &amp; age 2</td>
<td>new cars (age=0) and used cars of age 2</td>
<td>118516</td>
<td>11.06%</td>
</tr>
<tr>
<td>new car &amp; age 3</td>
<td>new cars (age=0) and used cars of age 3</td>
<td>118001</td>
<td>11.01%</td>
</tr>
<tr>
<td>new car &amp; age 4</td>
<td>new cars (age=0) and used cars of age 4</td>
<td>111531</td>
<td>10.41%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>new car &amp; age 20</td>
<td>new car (age=0) and used car of age 20 &amp; over</td>
<td>99444</td>
<td>9.28%</td>
</tr>
</tbody>
</table>
Annual Depreciation Rates ($\delta_a$)

- **Age specific depreciation rate**
  \[ \delta_a = 1 - \exp(\theta_a) \]

- **Current market value**
  \[ CMV_{jt} = P_{j0} \times (1 - \delta_a)^y \]

- **Service flow received during the reference period**
  \[ S_{jt} = (r_t + \delta_a) \times CMV_{jt} \]
Depreciation Rate ($\delta_a$)

Notes: The new vehicle depreciation rate by age (solid line) shows how much vehicles' market value have decreased over the past year as a percentage of their purchase prices. The average depreciation rates of new and used vehicles are average value change across all ages.
Motor Vehicle Consumption vs. Spending
Quarterly Average of All Consumer Units

- Nonparametric depreciation
- Constant geometric depreciation
- Net spending on motor purchases
Consumption and Spending at Consumer Unit Level

2019Q4
Consumption and Spending at Consumer Unit Level

2019Q4 (>$0)
Consumption and Spending at Consumer Unit Level

Consumption = 888 + 0.05*Spending

2019Q4
Conclusion

- Depreciation based approach
  - Correlated with spending measure
  - Reliable and smoothed estimates at CU level

- Next step: adding in other expenditures
  - Maintenance & repairs
  - Operating expense
  - Gas & fluids
  - Vehicle insurance
Appendix

Coefficient of simple regression: NADA price = CE predicted price (no intercept)

<table>
<thead>
<tr>
<th></th>
<th>Non-parametric depreciation</th>
<th>Constant geometric depreciation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Average</td>
<td>0.93</td>
<td>0.89</td>
</tr>
</tbody>
</table>

- Ratio of CE predicted price to NADA value for given make/model/age
- Non-parametric prices more similar to NADA prices than constant geometric prices
Contact Information

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