Vehicle Ownership and Income Growth, Worldwide: 1960-2030

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Vehicle Ownership and Income Growth, Worldwide: 1960-2030

- Use historical data 1960-2002 for 45 countries (75% of world’s population) to model the relationship between vehicle ownership and per-capita income, and make projections 2002-2030.

- Relationship between vehicle ownership and per-capita income is highly non-linear.

- We use an S-shaped Gompertz function to model this relationship.
Growth in Vehicle Ownership and Per-Capita Income: Germany, Japan, South Korea, USA
Growth in Vehicle Ownership and Per-Capita Income: Brazil, China, India, South Korea

Vehicles per 1000 people 1960-2002

per-capita income, 1960-2002 (Real $ PPP, thousands)
Modeling Vehicle Ownership as a function of Per-Capita Income: An illustrative S-shaped Gompertz function

- Vehicle ownership grows slowly at lowest income levels
- about twice as rapidly as income in $3000-$10000 range
- about as fast as income in range of $12000-$18000
- quite slowly at highest income levels, as saturation is approached.
Vehicle model

Gompertz function relates long-run vehicles per capita, $V^*$, to per capita income, $GDP$

$$V_{i,t}^* = \gamma_{i,t} e^{\alpha e^{\beta_i GDP_{i,t}}}$$

Dynamics: Partial Adjustment Mechanism

$$V_{i,t} = V_{i,t-1} + \theta (V_{i,t}^* - V_{i,t-1})$$

Saturation level ($\gamma$)

depends on population density ($D$) and urbanization ($U$)

$$\gamma_{i,t} = \bar{\gamma} + \lambda D_{i,t}^a + \varphi U_{i,t}^a$$

$D$ and $U$ adjusted so that USA defines maximum saturation
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<tbody>
<tr>
<td>United States</td>
<td>32</td>
<td>57</td>
<td>2.1%</td>
<td>812</td>
<td>849</td>
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<td>234</td>
<td>314</td>
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<td>Germany</td>
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<td>1.7%</td>
<td>586</td>
<td>705</td>
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<td>21</td>
<td>84</td>
<td>5.1%</td>
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<td>China</td>
<td>4</td>
<td>16</td>
<td>4.8%</td>
<td>16</td>
<td>269</td>
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<td>7</td>
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<td>29</td>
<td>166</td>
<td>6.5%</td>
<td>6</td>
<td>46</td>
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<tr>
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<td>OECD Total</td>
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<td>617</td>
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<td>195</td>
<td>1172</td>
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<td>Total World</td>
<td>7</td>
<td>14</td>
<td>1.7%</td>
<td>130</td>
<td>254</td>
<td>1.6%</td>
<td>812</td>
<td>2080</td>
<td>3.4%</td>
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Income Elasticity of Vehicle Ownership and Level of Per-capita Income: 

Historical, 1970-2002

long-run income elasticity of vehicle ownership

average per-capita income, 
(thousands), 1970-2002

ratio of vehicles growth to income growth, 1970-2002
Income Elasticity of Vehicle Ownership and Level of Per-capita Income: Projected, 2002-2030

The graph shows the ratio of vehicles growth to income growth, 2002-2030, against the average per-capita income (in thousands), 2002-2030. The long-run income elasticity of vehicle ownership is indicated by the curve on the graph.
Growth in Vehicle Ownership and Per-Capita Income, Historical: 1960-2002
Growth in Vehicle Ownership and Per-Capita Income, Projected: 2002-2030

annual growth rate 2002-2030: Vehicles per 1000 people

equally fast
twice as fast
Ratio of Growth Rate of Vehicle Ownership to Growth Rate of Per-Capita Income, Historical and Projected

Ratio of growth rates: vehicle ownership to per-capita income, 2002-2030

Ratio of growth rates: vehicle ownership to per-capita income, 1970-2002
Vehicle Ownership and Per-Capita Income: 8 countries
Countries’ Estimated Vehicle Ownership Saturation Levels and Income Levels at which Vehicle Ownership = 200

per-capita GDP at which vehicle ownership = 200 in long run

vehicle ownership saturation level

0 2 4 6 8 10 12 14
History 1960-2002 and Projections 2002-2030:
Total Vehicles
Regional Shares of the Absolute Increase in GDP and Total Vehicles, 2002-2030

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<tr>
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<td>Egypt</td>
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<tr>
<td>World</td>
<td>0.94</td>
<td>0.61</td>
<td>0.57</td>
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</table>

If these vehicles are oil driven, this would mean a growth of demand by 2.5% annually

0.9% OECD and 5.2% in the rest of the world