Achieving the promise of the sharing economy: The case of peer-2-peer carsharing

Robert C. Hampshire
Research Assistant Professor
Transportation Research Institute
Industrial and Operations Engineering
University of Michigan
The real promise of the ‘sharing economy’ is what it could do for the poor
The promise of the sharing economy

- Economy equilibrium results of Fraiberger, S. P., & Sundararajan, A. (2015)* conclude that
  - Peer-to-peer rental marketplaces have a disproportionately positive effect on lower-income consumers across almost every measure.
  - Low income population is more likely to switch from owning to renting, provides a higher level of peer-to-peer marketplace demand, is more likely to contribute to marketplace supply,
  - Low income population enjoys significantly higher levels of surplus gains.

REAL TIME ECONOMICS

Why the Gig Economy May Not Put a Dent in Income Inequality

A new study complicates the idea that digital platforms can help close the inequality gap

By ERIC MORATH
May 3, 2016 11:22 am ET

http://blogs.wsj.com/economics/2016/05/03/why-the-gig-economy-may-not-put-a-dent-in-income-inequality/#:WT3oA37eY7c_SA
Data shows that participation is low for low income individuals.

* Anonymized sample of over 260,000 core Chase checking account customers who earned income on at least one of 30 platforms, see https://www.jpmorganchase.com/corporate/institute/institute-insights.htm#ope-most
This talk addresses possible ways to achieve the “real promise” of the sharing economy, particularly Peer-2-Peer carsharing.
Carsharing is an environmentally friendly, cost effective alternative to car ownership...

**Why car sharing Matters**

- **Reduced Emissions:** Carsharing reduces member vehicle miles traveled (VMT) by 67%

- **Less Congestion:** Each new share car removes 10.8 other vehicles from the road

- **Lower Costs:** 3% of US drivers (~5M people) would reduce their transportation costs by $150 per month or more.

...but, lack of convenient access to share cars inhibits large scale adoption of car sharing

• 10% of individuals aged 21+ in metropolitan areas of North America would become members if it were more convenient

• Real adoption rates for car sharing are lower than projected by customer research

Current NA Market

Primary Inhibitors

Potential NA Market

- Long (> ¼ mile) walks to cars
- Uncertain car availability

What is Peer-to-Peer CarSharing?

• Peer-to-Peer (P2P) carsharing allows car owners to convert their personal vehicles into shared cars which can be rented to other drivers on a short-term basis.

• This model leverages the fact that most privately owned vehicles sit idle over 90% of the day.
### Whip Car

<table>
<thead>
<tr>
<th>Car Model</th>
<th>Distance</th>
<th>Avg Response Time</th>
<th>Rating</th>
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<th>Weekly Rate</th>
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<tr>
<td>Smart Roadster Bluewave</td>
<td>2 - 3 miles</td>
<td>&lt; 1 hour</td>
<td>(10)</td>
<td>£39.00</td>
<td>£8 199 597</td>
<td>£13 205</td>
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<td>&lt; 1 hour</td>
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<td>Mini Cooper D</td>
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<td>Toyota Corolla T3 Vvti</td>
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<td></td>
<td>£50.00</td>
<td>£15 185 555</td>
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<tr>
<td>Ford Mondeo St Tdci</td>
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<td>£40.00</td>
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<td>Fiat 500 C Lounge</td>
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<td>£7 155 465</td>
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</table>
Rent a Smart Roadster Bluewave

Rent this car from £8.00 an hour!

£8.00 per hour
£39.00 per day
£199.00 per week
£697.00 per month

Car suitability (10)
Punctuality (10)
Car cleanliness (10)

Location: London, SW11
Transmission: Automatic
Fuel type: Petrol
Colour: Silver
Body: Convertible
Age: 7 years old
Seating capacity:
Mileage:
Engine CC: 608cc
CO2: 124g/km

About me and my car
My SMART ROADSTER BLUEWAVE is really clean and well taken care of. It is huge fun for a weekend spin. The air-con is not working, but the sunroof is. I have a TOMTOM if needed.

Pick up details
You can pick up my SMART ROADSTER BLUEWAVE near my house. I park it in the road.

Hire a car in London, SW11
WhipCar will automatically insure this car for your booking. We also provide breakdown cover and send you alerts when it is time to pick up and drop off this car. Find out more

Pick up date * Drop off date *
From... To...

Book

Availability for FunSmart's Smart Roadster Bluewave

March

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</table>
Lower costs put cars near more customers, improving convenience & availability

**Traditional Model**

Each vehicle requires 25 members within ¼ mile to breakeven

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**P2P Model**

Each vehicle requires 10 members within ¼ mile to breakeven

P2P model allows for 3 times as many vehicles in any given market

How do we achieve the promise of the sharing economy?

• Addressing the following operational challenges to P2P carsharing
  – Perceptions of Peer-2-Peer carsharing
  – Improved reputation/trust systems
  – Addressing spatial-temporal mismatch of supply and demand
Perceptions of Peer-2-Peer carsharing

Shaheen and Bansal (2015) conducted a survey in San Francisco. They found that

- Only 40% respondents who did not have access to a vehicle were aware of P2P carsharing
- 84% of respondents were aware of classic carsharing
- 47% of respondents were aware of P2P carsharing.
Perceptions of Peer-2-Peer carsharing

• Shaheen and Bansal (2015) also found the following barriers to participation.
  – Liability
  – Aversion to interacting with strangers
  – Trust
Reputation/trust systems

• According to the Pew foundation*:
  – It found that whites are more trusting than blacks or Hispanics.
  – People with higher family incomes are more trusting than those with lower family incomes.
  – The married are more trusting than the unmarried.

## Who’s More Trusting?

Social trust index, by demographics

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<thead>
<tr>
<th>Category</th>
<th>High</th>
<th>Mid</th>
<th>Low</th>
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<tr>
<td>All adults</td>
<td>35</td>
<td>22</td>
<td>38</td>
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<tr>
<td>White</td>
<td>41</td>
<td>23</td>
<td>32</td>
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<tr>
<td>Black</td>
<td>20</td>
<td>14</td>
<td>61</td>
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<tr>
<td>Hispanic</td>
<td>12</td>
<td>24</td>
<td>53</td>
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<tr>
<td>18-29</td>
<td>23</td>
<td>23</td>
<td>49</td>
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<tr>
<td>30-49</td>
<td>34</td>
<td>23</td>
<td>41</td>
</tr>
<tr>
<td>50-64</td>
<td>42</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td>65+</td>
<td>41</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Married</td>
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<td>33</td>
</tr>
<tr>
<td>Not married</td>
<td>29</td>
<td>20</td>
<td>44</td>
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<tr>
<th>Family Income</th>
<th>High</th>
<th>Mid</th>
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<tr>
<td>$100K+</td>
<td>46</td>
<td>23</td>
<td>30</td>
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<tr>
<td>$50K - $99K</td>
<td>41</td>
<td>24</td>
<td>34</td>
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<td>$30K - $49K</td>
<td>31</td>
<td>24</td>
<td>40</td>
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<tr>
<td>Under $30K</td>
<td>26</td>
<td>19</td>
<td>48</td>
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<table>
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<tr>
<th>Location</th>
<th>High</th>
<th>Mid</th>
<th>Low</th>
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</thead>
<tbody>
<tr>
<td>Rural area</td>
<td>43</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>Suburb near a large city</td>
<td>39</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td>Small city or town</td>
<td>35</td>
<td>20</td>
<td>39</td>
</tr>
<tr>
<td>Large city</td>
<td>23</td>
<td>24</td>
<td>46</td>
</tr>
</tbody>
</table>

Notes: Social trust is a three-item index; respondents are split into three groups: those with high, moderate and low levels of social trust. Whites include only non-Hispanic whites. Blacks include only non-Hispanic blacks. Hispanics are of any race. Don’t know
This suggests that trust and income may directly impact participation.

• However, the economic models assume that the matching probability distribution is independent of the income distribution.

Furthermore, there is evidence of discrimination in P2P capital platform markets.

- In AirBnB, African-Americans are roughly 16% less likely to be accepted than White guests.
- The result is independent of the race of the host*

Group reputation systems as a mechanism to increase trust.

- Our previous research shows that Group reputation systems increases the participation of “high risk” individuals in Peer-2-Peer Lending.

Results from Peer-2-Peer Lending site Prosper.com

- Groups that provide high quality structural signals *(group size, rating, select)* secure loans with lower interest rate.

- Groups that provide high quality behavioral signals *(endorsements, coaching, financing)* signals will secure loans with lower interest rates.

- Low quality individual signals benefit more from group behavioral signals.
Spatial mismatch impacts the participation in Peer-to-Peer carsharing

- **Spatial mismatch** is the mismatch between where low-income households reside and suitable job opportunities.

- It is a result of residential segregation, economic restructuring and the suburbanization of employment.


P2P Car sharing: Market Analysis

- Estimate Supply of Parked Cars
- Estimate P2P Carsharing Demand
- Matching Supply and Demand

Supply of Parked Cars

• The number of cars parked due to employment is estimated using data from the 2008 Longitudinal Employment Dynamics (LED) program of the U.S. Census.

• The number of cars parked due to residences is estimated using data from the 2000 U.S. Census.

• First, the parked cars of unemployed people may be estimated from the census and the current unemployment rate.

• Second, the rate of homebased nonwork trips over the day may be estimated from the National Household Transportation Survey (NHTS).
• AAA estimates that the cost of depreciation for a vehicle driven 10,000 to 15,000 miles per year at $0.17 to $0.22 per mile.

• Rental payments are based on usage charges of $5.50 per hour and $0.35 per mile.

<table>
<thead>
<tr>
<th>Setup Time (Hours)</th>
<th>$ 10,000</th>
<th>$ 30,000</th>
<th>$ 50,000</th>
<th>$ 70,000</th>
<th>$ 90,000</th>
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<td>0.25</td>
<td>$5,420</td>
<td>$4,748</td>
<td>$4,076</td>
<td>$3,404</td>
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<td>0.5</td>
<td>$5,084</td>
<td>$3,740</td>
<td>$2,395</td>
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<td>($292)</td>
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<td>0.75</td>
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<td>$2,731</td>
<td>$715</td>
<td>($1,300)</td>
<td>($3,317)</td>
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<tr>
<td>1</td>
<td>$4,412</td>
<td>$1,723</td>
<td>($964)</td>
<td>($3,653)</td>
<td>($6,341)</td>
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P2P Car Sharing Demand

Demographics of traditional Car-Sharing users:

1) The percentage of the population within each area that lives in an urban area;
2) The percentage of the population within each area aged 25-40;
3) The percentage of households (family and non-family) within each area with two or fewer people;

4) The percentage of workers over 16 that do not use a car, van, or truck to get to work.
Matching Supply and Demand

• We compute the minimum number of P2P cars needed in each target area to accommodate the demand generated by the target renters in that area.

• Using the Erlang C formula from queueing theory. We find the number of cars needed to deliver an acceptable car availability rate.

\[
\gamma(C, \rho) = \frac{\left(\frac{(C\rho)^C}{C!}\right) \cdot \left(\frac{1}{1-\rho}\right)}{\sum_{k=0}^{C} \frac{(C\rho)^k}{k!} + \left(\frac{(C\rho)^C}{C!}\right) \cdot \left(\frac{1}{1-\rho}\right)},
\]

where \( C \) is the number of P2P cars, and \( \rho \) is defined as the product of demand rate and the average trip length.

Pittsburgh Case Study

• We find that there are up to 14,460 potential members living in viable markets.

• The spatial distribution of parked cars available in terms of full-time car equivalents (FTCE) is computed for each census block group.

• Each FTCE represents 24 car hours.
Pittsburgh Case Study: Viable Census Block Groups
Pittsburgh Case Study:
Required market penetration
• We find that there are up to 14,460 potential members living in viable markets.

• The spatial distribution of parked cars available in terms of full-time car equivalents (FTCE) is computed for each census block group.

• Each FTCE represents 24 car hours.
Pittsburgh Case Study: Viable Census Block Groups
Areas with high poverty rates need a higher owner participation rate to be viable.

Areas with extremely low poverty do not have enough demand.

*http://www.richblockspoorblocks.com/*
Achieving the promise of the sharing economy?

- We propose addressing operational challenges to increase access to P2P carsharing.
  - Perceptions of Peer-2-Peer car sharing
  - Improved reputation/trust systems
  - Addressing spatial-temporal mismatch of supply and demand
Thank you to the organizers and participants!
Mobility Analytics

Smart Parking
- ParkPGH
- SFpark

Bike Sharing

Ride Sharing

Car Sharing
- GO-OP
- zipcar
# P2P Car Sharing Demand

<table>
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<tr>
<th>Density (Persons/Acre)</th>
<th>Penetration Rate Needed (50 members)</th>
<th>Penetration Rate Needed (25 members)</th>
<th>Penetration Rate Needed (20 members)</th>
<th>Penetration Rate Needed (15 members)</th>
<th>Penetration Rate Needed (10 members)</th>
<th>Penetration Rate Needed (5 members)</th>
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<tr>
<td>10</td>
<td>4.00%</td>
<td>1.99%</td>
<td>1.59%</td>
<td>1.19%</td>
<td>0.80%</td>
<td>0.40%</td>
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<td>15</td>
<td>2.7%</td>
<td>1.33%</td>
<td>1.06%</td>
<td>0.80%</td>
<td>0.53%</td>
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<td>30</td>
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<td>0.53%</td>
<td>0.40%</td>
<td>0.26%</td>
<td>0.13%</td>
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**TABLE 1** Penetration rates required to achieve 50, 25, 20, 25, 10, or 5 members per vehicle