Mode choice in urban courier deliveries

Pan-American Advanced Studies Institute on Sustainable Urban Freight Systems (PASI-SUFS)
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Johannes Gruber
DLR – Institute of Transport Research, Berlin
Some alternative titles and outlook

• Titles
  • "Mode choice in urban courier deliveries" → PASI title
  • "Potentials of electric cargo bikes for last-mile deliveries" → Project results
  • "Acceptance of urban freight innovations" → More project results
  • "..." → PhD thesis

• Outlook
  • Personal and institutional background
  • The courier market in Germany
  • Locations of demand for courier trips
  • Project background and empirical foundation
  • Results: ex-ante vs. ex-post
  • Discussion and further steps
Personal and institutional background

• Degree in human geography (LMU University Munich, Germany)
• Since 2011: research assistant at DLR-Institute of Transport Research, Berlin
  • DLR: public research institution with 8000 employees and 16 sites, active in aeronautics, space, transport (~ 10% of employees) and energy business areas
  • Institute of Transport Research (led by Prof. Barbara Lenz): about 50 researchers of various disciplines
• Project manager of a research project analyzing the potentials of electric cargo bikes for urban courier logistics deliveries (funded by the Federal Ministry for the Environment)
• "Transition phase" towards dissertation
The courier market in Germany

• Courier is a segment of the CEP market: courier, express, parcel/postal
  • Deliveries – CEP: 2.45 billion → courier 0.24 billion (10%)
  • Turnover – CEP: 17.8 billion € → courier: 3.9 billion € (22%)
  • Employees – CEP: 254,000 → courier: 19,000 car, 5,000 bike messengers

• Some usual characteristics of courier companies:
  • Many regionally operating companies
  • Acting as intermediary between B2B customers and self-employed messengers
  • Dispatching of assignments via "open radio" or smartphone
  • Messengers use their own vehicles
  • Provision-based remuneration
  • Pricing depending on vehicle ordered and shipment distance
## Berlin: example for pricing of courier shipments

<table>
<thead>
<tr>
<th>Pricing = vehicle ordered</th>
<th>Goods' size (max. cm³)</th>
<th>Goods' weight (max. kg)</th>
<th>Fixed costs (incl 1st km)</th>
<th>Variable costs (per km)</th>
<th>Market share (t1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>50 x 30</td>
<td>5</td>
<td>5.50 €</td>
<td>0.95 €</td>
<td>54%</td>
</tr>
<tr>
<td>Cargo Bike</td>
<td>50 x 30 x 30</td>
<td>25</td>
<td>6.00 €</td>
<td>0.95 €</td>
<td>6%</td>
</tr>
<tr>
<td>Car</td>
<td>100 x 70 x 50</td>
<td>100</td>
<td>6.50 €</td>
<td>1.00 €</td>
<td>29%</td>
</tr>
<tr>
<td>Small van</td>
<td>150 x 100 x 100</td>
<td>250</td>
<td>10.00 €</td>
<td>1.00 €</td>
<td>7%</td>
</tr>
<tr>
<td>Large van</td>
<td>320 x 180 x 150</td>
<td>1000</td>
<td>15.00 €</td>
<td>1.10 €</td>
<td>4%</td>
</tr>
</tbody>
</table>

Pricing model extracted from [www.messenger.de](http://www.messenger.de)
Berlin: Extensive size, densely populated center

**Inner City Low Emission Zone**
- 1 million inhabitants
- 88 km²
- 11,200 people / km²

**Total Municipality:**
- 3.5 million inhabitants
- 892 km²
- → 3,800 people / km²
PM emissions
Density of courier pickups
The courier market – density of pickups (Berlin city center)
OD-relations of courier shipments (Berlin city center)

Shipments per week:
- Bike messengers
- Car messengers

1 km
Project "I substitute a car": How sustainable is implementing electric cargo bikes for courier deliveries?

- Used vehicle: *iBullitt Pedelec* (x40)
  - 250 Watts engine
  - Payload: ~ 100 kg
  - Cargo box volume: ~ 200 l

- Additional vehicle: *CargoCruiser* (x1)

8 German cities, 8 courier companies
Empirical foundation

- Database: 3 million (=3 years) of courier shipment records of 8 courier companies:
  - Type of shipment: point-to-point vs. milk run
  - OD and shipment distance
  - Time stamps
  - Priced vehicle and used vehicle
  - Messenger ID
  - partly: type/size of good, customer's business sector, delivery windows
- Quantitative surveys targeting all ~600 messengers associated with these 8 courier companies:
  - t0-survey (2012), 191 responses, 2 groups: bicycle and car messengers
  - t1-survey (2014), 171 responses, 3 groups: bicycle, iBullitt and car messengers
  - panel data from 63 respondents
- Qualitative interviews with CEOs, dispatchers and messengers
Short trips and light goods: downshift in type of vehicle seems possible.

<10km: 72% of trips

Bike messengers (n=79,903)
Car messengers (n=52,810)

Shipment Distance [km]

non-transportable
transportable 89%
Car substitution potential

Share of trips below 10km & transportable goods

Substitutable deliveries 42%

Substitutable mileage 19%
21 months of using the electric cargo bikes – It was successful ...

<table>
<thead>
<tr>
<th># iBullitts</th>
<th>Shipments by iBullitt</th>
<th>% of all shipments</th>
<th>iBullitt net traveled km</th>
<th>% of all net traveled km</th>
<th>Mean shipment length</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>37</td>
<td>125.900</td>
<td>8%</td>
<td>485.000</td>
<td>4%</td>
</tr>
<tr>
<td>Berlin</td>
<td>17</td>
<td>46.500</td>
<td>10%</td>
<td>202.000</td>
<td>4%</td>
</tr>
<tr>
<td>Hamburg</td>
<td>4</td>
<td>23.900</td>
<td>6%</td>
<td>75.000</td>
<td>2%</td>
</tr>
<tr>
<td>München</td>
<td>4</td>
<td>21.800</td>
<td>12%</td>
<td>83.000</td>
<td>7%</td>
</tr>
<tr>
<td>Düsseldorf</td>
<td>4</td>
<td>8.300</td>
<td>7%</td>
<td>31.000</td>
<td>7%</td>
</tr>
<tr>
<td>Bremen</td>
<td>3</td>
<td>12.600</td>
<td>9%</td>
<td>38.000</td>
<td>4%</td>
</tr>
<tr>
<td>Nürnberg</td>
<td>3</td>
<td>3.400</td>
<td>3%</td>
<td>13.000</td>
<td>2%</td>
</tr>
<tr>
<td>Leipzig</td>
<td>1</td>
<td>3.100</td>
<td>3%</td>
<td>14.000</td>
<td>1%</td>
</tr>
<tr>
<td>Potsdam</td>
<td>1</td>
<td>6.300</td>
<td>35%</td>
<td>29.000</td>
<td>8%</td>
</tr>
</tbody>
</table>
... but was it sustainable?
Change in modal split of net km traveled in 2 cities

Bremen
- Bicycle: 28%
- iBullitt: 12%
- Car: 55%
- Small van: 4%
- Large van: 7%

Berlin
- Bicycle: 34%
- icBullitt: 11%
- Car: 33%
- Small van: 1%
- Large van: 11%

$t0$ (before implementation): 5/2011 – 6/2012
$t1$ (after implementation): 7/2012 – 3/2014
## Messengers' background, job organization, attitudes

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Type of vehicle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bicycle</td>
</tr>
<tr>
<td>n (t1 survey 2014)</td>
<td>48</td>
</tr>
<tr>
<td>Age Ø</td>
<td>39 years</td>
</tr>
<tr>
<td>Gender: male</td>
<td>90%</td>
</tr>
<tr>
<td>Education: high (Abitur)</td>
<td>74%</td>
</tr>
<tr>
<td>Income</td>
<td>Below 500 €</td>
</tr>
<tr>
<td></td>
<td>2500 € and more</td>
</tr>
<tr>
<td>Job organization</td>
<td>Working as messenger only</td>
</tr>
<tr>
<td></td>
<td>Working hours per week Ø</td>
</tr>
<tr>
<td></td>
<td>Using only one type of vehicle</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Using electric cargo bikes in my city makes sense.&quot;</td>
<td>t0</td>
</tr>
<tr>
<td>&quot;Electric cargo bikes will generally be successful in courier services.&quot;</td>
<td>48%</td>
</tr>
<tr>
<td>&quot;There is plenty of information available on electric cargo bikes and their use.&quot;</td>
<td>36%</td>
</tr>
</tbody>
</table>

n=63
Berlin: vehicle ordered vs. vehicle used

<table>
<thead>
<tr>
<th>Vehicle ordered</th>
<th>Market share (t1)</th>
<th>Change (t0 → t1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>54%</td>
<td>-1%</td>
</tr>
<tr>
<td>Cargo Bike</td>
<td>6%</td>
<td>+43%</td>
</tr>
<tr>
<td>Car</td>
<td>29%</td>
<td>+3%</td>
</tr>
<tr>
<td>Small van</td>
<td>7%</td>
<td>+45%</td>
</tr>
<tr>
<td>Large van</td>
<td>4%</td>
<td>+27%</td>
</tr>
</tbody>
</table>

*total: + 5%*

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**Vehicle used**

- **Bicycle**: 54% (t1), -1% (t0→t1)
- **Cargo Bike**: 6% (t1), +43% (t0→t1)
- **Car**: 29% (t1), +3% (t0→t1)
- **Small van**: 7% (t1), +45% (t0→t1)
- **Large van**: 4% (t1), +27% (t0→t1)

*total: + 5%*
Project results

- Considerable demand for courier services in urban core areas
- Several modes are in direct competition
- Large potential for electric cargo bikes to substitute urban small-scale car trips
- Assessment of sustainability: mixed results
  - Economically successful for companies and majority of messengers
  - Environmentally: Substitution of bicycle trips in some cities (from macro-perspective) vs. positive effects in some areas
  - Socially: Almost only bicycle messengers were willing to change to electric cargo bikes
- Structures are shifting, yet gradually
Possible further steps

- Revealed preference analysis – with an "open radio" as assignment market, messengers have several options to choose from
- Possible spheres of influence for mode choice in urban courier deliveries:
  - trip characteristics
  - company's operations: order acceptance, pricing, dispatching
  - customer
  - degree of messenger competition
  - individual messenger's background and skills (e.g. bundling of shipments)
  - seasonality, weekday, time of day
  - weather conditions
  - congestion status
- Things to check:
  - Is this a relevant segment of urban freight?
  - Is the available data representative?
  - "So what"?
Thank you for your attention - and your questions!

Johannes Gruber

German Aerospace Center (DLR)
Institute of Transport Research
Rutherfordstr. 2
12489 Berlin-Adlershof
Germany
johannes.gruber@dlr.de