Spatial accessibility and equity analysis of Amazon parcel lockers facilities

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Motivation: e-commerce and equity

- During the COVID-19 lockdowns, home deliveries changed from being a desirable luxury or comfortable solution to a health-supporting and essential service for many COVID-19 at-risk populations.

- However, not all households are equal in terms of access to home deliveries.
Groups less likely to benefit from home deliveries:

- Low-income households
- Households with lower educational levels
- Small size and/or single member households
- Households with less access to electronic devices/internet
- Households that do not usually commute by auto or WFH
- Non-white households
Home-based accessibility (HBA)

Home deliveries have become a health-supporting and essential service for many at-risk populations.

Home-based accessibility (HBA): defined as the ease of accessing essential home deliveries of products such as groceries and medicines without leaving home.
References HBA and Equity/EJ


Business to Consumer Last Yard Delivery Types

ONTO THE PORCH
INTO A MAILBOX
INSIDE THE HOME OR CAR
INTO A STORAGE LOCKER

Least Secure ------------------------------------------------ Most Secure

OTHER FACTORS: time constrained households, cost, convenience, reliability.
Rapid growth of locker systems

- Amazon in partnership with convenience stores (7-eleven, Plaid Pantry), banks, hotels, universities, malls…

- Rapid expansion (in early 2021, 180 in Portland)

- Promise of more foot traffic and business

- Support expansion of 1-day deliveries while controlling costs

- Potential automation

- Cost and environmental benefits
Lockers nearby

1. **Amazon Hub Counter - Dave's liquor**
   - Distance: 1.7 mi
   - Address: 1601 East 4th Street, Long Beach, CA, 90802
   - Hours: Mon-Sun: 8am - 11:45pm
   - More information: [Show details]
   - Pick up here

2. **Amazon Hub Locker - Reference**
   - Distance: 0.8 mi
   - Address: 350 the Promenade N, at Ross Dress for Less, Long Beach, CA, 90802-2480
   - Hours: Mon, Tue, Wed, Thu, Sun: 9am - 10pm
   - Fri-Sat: 8am - 10pm
   - Directions: You will find the Locker inside the Store...
   - More information: [Hide details]
   - Pick up here

3. **Amazon Hub Counter - Your Hair N More**
   - Distance: 0.9 mi
   - Address: 408 E 3rd St, Long Beach, CA, 90802
   - Hours: Mon-Fri: 10am - 7pm
   - Sat: 10am - 3pm
   - Staff assistance at location
   - More information: [Hide details]
   - Pick up here

4. **Amazon Hub Locker - Ant**
   - Distance: 1 mi
   - Address: 601 Pine Ave, at Rite Aid, Long Beach, CA, 90802
   - Hours: Mon-Sun: 7am - 10pm
   - More information: [Show details]
   - Pick up here
Research questions

(a) How are lockers distributed with respect to accessibility measures such as population coverage and employment by mode of transportation? and

(b) What are the equity implications of the current distribution of lockers?
Lockers: traditional research approach
Locker Accessibility

Focus on PEOPLE

- Household income
- Per capita income
- Housing unit value

- Computer access
- Internet access
- Type of internet

- Age
- Race or origin
- Education attainment
- Employment status
- Etc.

- Population density
- Type of housing
- Commute mode
Methodology

• Google Places API
• US Census Bureau Zip Code Business Patterns for employment data
• US Census Bureau ACS for population and socio-demographic data
• Geographic tools and methods: spatial correlations, kernel density, clustering
## Accessibility by Mode

<table>
<thead>
<tr>
<th>Mode (Range)</th>
<th>Households</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HH (Thous.)</td>
<td>% of Total HH</td>
</tr>
<tr>
<td>Walk (0.25-0.5 Mi.)</td>
<td>81-232</td>
<td>12.6-36.1</td>
</tr>
<tr>
<td>Bike (1.5-3.0 Mi.)</td>
<td>546-605</td>
<td>84.9-94.0</td>
</tr>
<tr>
<td>Drive (3.0-5.0 Mi.)</td>
<td>605-624</td>
<td>94.0-97.0</td>
</tr>
</tbody>
</table>
Locker Distribution and Income Clusters
Locker Distribution and Trans. Built Env. Clusters
Locker Distribution and Internet clusters
Locker Distribution and Socio-Dem. Clusters
Population by race/ethnicity in the area studied

- **White ~ 77% (US 60%)**
- **Black ~ 3% (US 12%)**
- **Asian ~ 8% (US 6%)**
- **2+ ~ 7% (US 3%)**
- **Other ~ 5%**

**Hispanic ~ 12% (US 18%)**
It is possible to quantify differences by Cluster

- Lockers per square mile
- Lockers per person
- Lockers per household
Key findings

- Lockers tend to be in mixed-use areas and can be utilized by a large percentage of the population.
- The equity metrics indicate that the current distribution of lockers could be improved to reach traditionally underserved populations.
- Clustering is useful, but also mapping/spatial analysis because there are pockets with low accessibility within large clusters.
Market failure?

- Amazon is a private, profit-seeking entity, and the placement of lockers may not necessarily match the allocation of lockers based on equity or need considerations.

- The term market failure implies a situation when a minimum level of accessibility or mobility that should be available to all is not met by private/public providers.
Incentives to install lockers in certain areas?

- *Supplementary* common carrier (open) public parcel lockers in transit stations where they are needed the most to fill an equity or accessibility

- Incentives for businesses that can be granted at the local level (parking, etc.)
Key findings and questions

- Lockers have many environmental and economic advantages, should policymakers do more to encourage the expansion of this type of last mile solution? How?

- How to avoid market failures in low income communities that are currently underserved?
THANK YOU