The Impacts of Transportation Noise in Urban Areas
A Literature Review

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Introduction

Review of transportation noise literature

• 2002 to present
• Investigate & compare methods used
• Investigate types of data used (i.e. primary, secondary, proxy)
• Compare various transportation modes (Rail, Road, Aircraft)

Goals

• Outline research gaps
• Identify research areas for Southern California
• Analyze health and economic impacts from noise along I-710 and Alameda Corridor
Background

Early transportation noise studies

• Mostly Revealed Preference (RP) approach
  • Hedonic pricing models (Rosen 1974)
  • Heavily aggregated
  • Proxy variables
  • Limited datasets

Later studies

• Emergence of Stated Preference (SP)
• Incorporation of additional relevant datasets
  • Demographic
  • Accessibility
• Improved primary noise datasets
  • Directive 2002/49/EC (“END”) noise maps
Study Method Developments

Spatial data incorporation
  • Geographical Information Systems (GIS) (Bateman et al. 2002)
  • Geographically Weighted Regression (GWR) (Fotheringham et al. 2002)

SP noise studies
  • Contingent Valuation (CV) most prevalent

Quantification measures
  • RP: Noise Depreciation Index (NDI)
  • SP: Willingness-to-pay (WTP)
Bowes and Ihanfeldt (2001) *Atlanta*
• Extensive demographic and accessibility analysis to isolate negative externalities near MARTA

Van Praag and Baarsma (2005) *Amsterdam*
• Hybrid HP/SP airport noise study
• Noise perception found to be demographic-dependent

Arsenio *et al.* (2006) *Lisbon*
• SP study indicated non-linear response to traffic noise levels
• Higher sensitivity at higher noise levels

Salvi (2007) *Zurich*
• HP model with GIS-specified weighting matrices
• Extensive location- and time-specific airport noise data

Pan (2012) *Houston*
• Multilevel regression HP model
• Separate regressions for property versus zonal
Study Areas & Highlights

Europe

• Extensive noise map data

Source: defra.gov.uk
Study Areas & Highlights

Asia
  • Developed vs. Developing areas
    • Hong Kong, Beijing, Taiwan, Seoul, Dubai

Africa
  • Port Harcourt, Nigeria
    • Higher noise sensitivity based on income level

North America
  • Minimal freight rail studies
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Location</th>
<th>Study Type</th>
<th>Method</th>
<th>Key Variables</th>
<th>Data Info</th>
<th>Main Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baranzini &amp; Ramirez</td>
<td>Geneva, Switzerland</td>
<td>Aircraft &amp; Hedonic model</td>
<td>OLS</td>
<td>Property, accessibility (via GIS); Governmental NO2 and noise data</td>
<td>13,064 apartment observations (10,394 private rental, 2,640 public rental)</td>
<td>Aircraft -1.04% Aggregate -0.7%</td>
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<tr>
<td>Kawamura (2005)</td>
<td>Chicago, Illinois</td>
<td>Road; Hedonic model</td>
<td>OLS &amp; Spatial lag</td>
<td>Property characteristics; traffic volume; block data</td>
<td>130 observations</td>
<td>-0.50% effect on price</td>
</tr>
<tr>
<td>Nguyen, et al. (2013)</td>
<td>Beijing, China</td>
<td>Aircraft, Hedonic model</td>
<td>OLS</td>
<td>Property characteristics, distance to noise source</td>
<td>1996-2006 housing sale data, # of observations not specified</td>
<td>-0.30 to -1.28% effect on price</td>
</tr>
<tr>
<td>Andersson, et al. (2009)</td>
<td>Lern, Sweden</td>
<td>Rail; Hedonic model</td>
<td>OLS &amp; Spatial lag</td>
<td>Property, demographic, accessibility characteristics</td>
<td>2007 housing sale data, 1,550 single family home observations</td>
<td>-0.70% effect on price</td>
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<tr>
<td>Andersson, et al. (2010)</td>
<td>Tainan, Taiwan</td>
<td>HSR; Hedonic model</td>
<td>OLS</td>
<td>Property, demographic, accessibility characteristics</td>
<td></td>
<td>(Min)</td>
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<tr>
<td>Chung &amp; Kim (2013)</td>
<td>Seoul, Korea</td>
<td>Rail; Hedonic model</td>
<td>OLS</td>
<td>Property, demographic, accessibility characteristics, Noise, air &amp; environmental data; Proprietary noise level formula</td>
<td>923 single family home observations</td>
<td>-0.53% effect on price</td>
</tr>
<tr>
<td>Pan (2012)</td>
<td>Houston, Texas</td>
<td>Rail; Hedonic model</td>
<td>OLS &amp; Multilevel regression</td>
<td>Property, demographic, accessibility characteristics; Distance to noise source</td>
<td>2007 housing sale data, 36,622 observations</td>
<td>Negative effect @ &lt;1/4 mile proximity, positive effect &gt;1/4 mile</td>
</tr>
<tr>
<td>Dokkers &amp; van der Sranen (2009)</td>
<td>Amsterdam, Netherlands</td>
<td>Aircraft, Rail, Road; Hedonic model</td>
<td>OLS &amp; Spatial lag</td>
<td>Property, demographic, accessibility characteristics; Distance to noise source</td>
<td>1999-2003 NVM housing sale data, &gt;66,000 observations</td>
<td>Aircraft -0.77%; Railway -0.67%; Road -0.16%</td>
</tr>
<tr>
<td>Day, et al. (2007)</td>
<td>Birmingham, U.K.</td>
<td>Aircraft, Rail, Road; Hedonic model</td>
<td>OLS with Spatial smoothing</td>
<td>Property, demographic, accessibility characteristics; Government noise maps</td>
<td>1997 housing sale data, 10,848 observations</td>
<td>Aircraft -0.03% to -1.6%; Rail -0.67%; Road -0.18% to -0.35%</td>
</tr>
<tr>
<td>Rich &amp; Nielsen (2003)</td>
<td>Copenhagen, Denmark</td>
<td>Road; Hedonic model</td>
<td>OLS</td>
<td>Government noise data, Property characteristics, Accessibility characteristics</td>
<td>845 houses, 906 apartments</td>
<td>*=0.54% price effect for houses, -0.21% for apartments</td>
</tr>
<tr>
<td>Galilea &amp; Ortizar (2005)</td>
<td>Santiago, Chile</td>
<td>Road; Stated preference</td>
<td>Multinomia l &amp; Mixed logit</td>
<td>Property and demographic characteristics, accessibility</td>
<td>150 respondents</td>
<td>ML model performed best, noise effects not linear</td>
</tr>
<tr>
<td>Arsenio, et al. (2006)</td>
<td>Lisbon, Portugal</td>
<td>Road; Stated preference &amp; measured noise</td>
<td>OLS, Binary &amp; Mixed logit</td>
<td>Measured noise data, Perceived noise levels, Property characteristics, Demographic characteristics</td>
<td>1999 apartment residents, 412 respondents</td>
<td>Non-linear effect from noise levels, WTP increased with noise level</td>
</tr>
<tr>
<td>Björner (2004)</td>
<td>Copenhagen, Denmark</td>
<td>Traffic noise, Stated preference</td>
<td>Ordered probit</td>
<td>Environmental and noise questionnaire, Demographic characteristics, High traffic respondents overemphasized</td>
<td>1,149 observations</td>
<td>Non-linear effect from noise levels, WTP increased with noise level</td>
</tr>
<tr>
<td>Van Praag &amp; Baarsma (2005)</td>
<td>Amsterdam, Netherlands</td>
<td>Airport noise; Stated preference</td>
<td>Ordered probit</td>
<td>Environmental, demographic, noise characteristics questionnaire</td>
<td>1,400 observations, well-being questions used ordered 1-10 scale</td>
<td>Non-linear effect from noise levels, WTP increased with noise level</td>
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</tbody>
</table>
Typical Study Observations

- Road annoyance relatively constant day or night
- Rail more annoying than road <200m
- Annoyance increases with overall noise level

<table>
<thead>
<tr>
<th></th>
<th>Typical NDI</th>
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</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td>0.6% to 0.8%</td>
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<tr>
<td>Road</td>
<td>0.08 to 2.2%</td>
</tr>
<tr>
<td>Rail</td>
<td>0.6% to 0.7%</td>
</tr>
</tbody>
</table>
Other Literature Review Areas

Health effects

• Loss of sleep
• Cardiovascular disease
• Stress-related illness
• Economic health burden (Eriksson et al. 2012)

Noise data collection methods

• Types of microphones/arrays
• Microphone orientation/location
• Consumer data gathering
• Various mode characteristics

Survey collection

• Avoid strategic answers (Ohrstrom et al. 2005)
• Respondent comprehension (Saelensminde 2005)
Research Gaps

- Minimal noise research conducted in Southern California area
- Many studies continue to use distance as proxy
- Lack of differentiation between modes
- Day and night differentiation
- Spatial heterogeneity issues
- Incorporation of combined RP and SP models
Proposed Research

Southern California area

• Focus on freight transportation effects
• Collect primary noise data
• Collect survey data
• Combine RP & SP models
• Spatial hedonic pricing models/GIS/GWR
• Estimate health and economic impacts
Questions?

Comments and suggestions are welcome and appreciated!


Bateman, I.J., 2002


Pan, Qisheng, 2013. The impacts of an urban light rail system on residential property values: a case study of the Houston METRORail transit line. Transportation Planning and Technology, 36:2, 145-169


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