Valuing Domestic Transport Infrastructure: A View from the Route Choice of Exporters

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Abstract

A key input to quantitative evaluations of transport infrastructure projects is their impact on transport costs. This paper proposes a new method of estimating this impact relying on the widely accessible customs data, by using the route choice of exporters. We combine our method with a spatial equilibrium model to study the aggregate effects of the massive expressway construction in China between 1999 and 2010. We find that the construction brings 5.1% welfare gains, implying a net return to investment of 150%. Our analysis also produces some intermediate output of independent interest, for example, a time-varying IV for city-sector export.

Introduction

Goal: evaluate welfare effects of domestic transport infrastructure improvements, e.g.,

Key step: estimate how transport networks map to city-to-city trade costs

Existing methods: freight rates: infer from price gaps of goods; infer from shipment flows

Challenges: lack of shipment flow data over time in many countries

Our approach

- Exploit over-time variations from exogenous expressway expansion
- Estimate using changes in exporting firm’s port choice from easily accessible customs data
- Combine a routing and spatial equilibrium model to estimate parameter and conduct counterfactual investigation

Data and Reduced-form Evidence

\[ \ln(\epsilon_t^{d, RoW}) = \beta_t + \beta_{t}^{d} + \beta_{t}^{d} + \gamma \cdot \text{dist}_{t}^{d} + \epsilon_{t}^{d} \]

- \( \epsilon_t^{d, RoW} \): Value of export from city \( d \) via port \( d \) in year \( t \) (1999, 2010); from Chinese customs data
- \( \text{dist}_{t}^{d} \): Regular route-length equivalent length of the shortest route; maps from Baum-Snow et al. (2016)

Estimated results

<table>
<thead>
<tr>
<th>Effective Length</th>
<th>By Road Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{dist}_{t}^{d} )</td>
<td>-0.384*** 0.174***</td>
</tr>
<tr>
<td>( \text{dist}_{t}^{d} ) on express</td>
<td>-0.888***</td>
</tr>
<tr>
<td>( \text{dist}_{t}^{d} ) on regular</td>
<td>-0.174***</td>
</tr>
</tbody>
</table>

City-port FE no yes yes

Notes: All columns control for origin-time and dest.-time fixed effects. Standard errors are clustered at city-port level.

Takeaways

- Using cross-section variations alone (i.e., no city-port FE) overstates the elasticity by 100%
- The distance elasticity for expressway is lower

Highlights

- Use over-time variations in express network and export routing choice to estimate route cost elasticity
- Combine routing and spatial equilibrium model to estimate structural parameters and evaluate welfare
- 100 km on expressway and regular roads increases trade cost by 3.4% and 4.2%, respectively
- Expressway expansion in China during 1999-2010 brings 5.1% welfare gains and a net return of 150%

The Spatial Equilibrium Model

Setup

- 323 prefectures+RoW, 25 sectors (2-digit)
- Mobile workers with Cobb-Douglas preference
- Intermediate goods production: combine labor and sectoral final goods with Cobb-Douglas
- Final good production: combine sectoral intermediate inputs across regions a la Armington
- Preferences differ in sectoral productivity and amenity, calibrated to match regional specialization and population distribution

Key parameters estimated

<table>
<thead>
<tr>
<th>Parameters Descriptions</th>
<th>Value</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta )</td>
<td>Routing elasticity</td>
<td>11.5</td>
</tr>
<tr>
<td>( \kappa_H )</td>
<td>Expressway route cost</td>
<td>0.034</td>
</tr>
<tr>
<td>( \kappa_L )</td>
<td>Regular route cost</td>
<td>0.042</td>
</tr>
</tbody>
</table>

- Elasticity of substitution of routing is high
- Expressway offers about 20% cost saving

Results - Evaluate Mega Projects

14 projects that incur 60% of total cost

<table>
<thead>
<tr>
<th>ID</th>
<th>Welfare Gain</th>
<th>Net return to % Change in</th>
<th>% Change in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>investment</td>
<td>dom. trade</td>
<td>Export</td>
</tr>
<tr>
<td>G1</td>
<td>0.40</td>
<td>507.69%</td>
<td>1.16</td>
</tr>
<tr>
<td>G2</td>
<td>0.49</td>
<td>354.16%</td>
<td>1.65</td>
</tr>
<tr>
<td>G10</td>
<td>0.02</td>
<td>-60.95%</td>
<td>0.09</td>
</tr>
<tr>
<td>G30</td>
<td>0.39</td>
<td>129.32%</td>
<td>1.34</td>
</tr>
<tr>
<td>Total</td>
<td>1.47</td>
<td>88.76%</td>
<td>4.48</td>
</tr>
</tbody>
</table>

- Substantial heterogeneity in impacts on welfare, domestic/int’l trade, and investment return

Additional Results

- Ignoring regional specialization, int’l trade, or intermediate good trade understates welfare gains and could turn investment return to negative
- Model-implied shipment flows and export align well with data. Model-produced domestic trade and export growth useful in other research
- Derive a 2nd-order sufficient statistic formula for welfare evaluation that takes into account nonlinearity due to the routing block

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Export Expansion: Expansion in China, 1999 (blue)-2010 (orange)