Costly Errors:
Analyzing trends in cost estimate accuracy for New Starts projects

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What is the New Starts program?

- FTA’s primary grant program for capital investment in **fixed-guideway public transit projects**
  - Urban rail
    - Downtown people movers (monorail)
  - Light rail
  - Heavy rail/subway
  - Commuter rail
  - Bus rapid transit
Why does cost estimate accuracy matter?

Initial cost estimate
- Decision to begin project planning and design
- Identifying adequate sources of funding

Final cost estimate
- Decision to construct project
- Allocating funds to a project budget
Data

Sources

• **1983-1988**
  o 10 projects
  o Pickrell 1989

• **1989-2002**
  o 19 projects
  o Spielberg et al. 2003

• **2003-2007**
  o 21 projects
  o Lewis-Workman et al. 2008

• **2008-2011**
  o 16 projects
  o Before and After Studies

Sample

• **62** initial cost estimates

• **58** final cost estimates

• **52** pairs of initial and final cost estimates
(In)accuracy as error

Symmetrical Percent Error = \( \frac{(A - P)}{(1/2)(P + A)} \)

- \( P \) = Predicted value
- \( A \) = Actual value

Underestimates are positive

Possible range from -200% to +200%
Improvements from initial to final cost estimates

95% confidence intervals for improvement

- Difference in means (2-sample t-test): 10% to 26%
- Average improvement (paired t-test): 8% to 21%
Improvement in accuracy over time

95-percent confidence interval for correlation = (-0.07, -0.52)

95-percent confidence interval for correlation = (-0.44, 0.05)
Differences by project sequence

Initial cost estimates for initial lines have errors 8 – 40 percentage points higher than those for expansions and 5 – 46 percentage points higher than those for renovations (95 percent confidence).

Differences among final estimates are not significant.
Variation by prediction horizon

95-percent confidence interval for correlation = (0.13, 0.57)

95-percent confidence interval for correlation = (0.09, 0.55)
Variation by project size

95-percent confidence interval for correlation = (0.26, 0.65)

95-percent confidence interval for correlation = (0.10, 0.56)
Differences by project mode

Final cost estimates for heavy rail projects have errors 2 – 31 percentage points higher than those for light rail projects (95 percent confidence).

No other modal differences are significant.
Variation by federal funding share

95-percent confidence interval for correlation = (-0.47, > -0.01)

95-percent confidence interval for correlation = (-0.68, -0.31)
Model results

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Symmetric mean percent error of initial cost estimate</th>
<th>Symmetric mean percent error of final cost estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-squared:</td>
<td>0.532</td>
<td>0.479</td>
</tr>
<tr>
<td>Independent variables:</td>
<td>Coefficient estimate</td>
<td>p-value</td>
</tr>
<tr>
<td>Year of estimate</td>
<td>-0.01 to 0.01</td>
<td>0.582</td>
</tr>
<tr>
<td><strong>Existing system: Relative to initial line for new system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expansion of existing system</td>
<td>-0.18 to -0.05</td>
<td>0.001</td>
</tr>
<tr>
<td>Renovation of existing line</td>
<td>-0.14 to -0.02</td>
<td>0.024</td>
</tr>
<tr>
<td>Years to opening</td>
<td>-0.02 to 0.03</td>
<td>0.649</td>
</tr>
<tr>
<td>Actual cost (billions)</td>
<td>0.02 to 0.20</td>
<td>0.022</td>
</tr>
<tr>
<td><strong>Mode: Relative to light rail</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy rail</td>
<td>-0.04 to 0.12</td>
<td>0.339</td>
</tr>
<tr>
<td>Commuter rail</td>
<td>-0.07 to 0.06</td>
<td>0.943</td>
</tr>
<tr>
<td>Transitway</td>
<td>-0.01 to 0.12</td>
<td>0.101</td>
</tr>
<tr>
<td>People mover</td>
<td>-0.03 to 0.07</td>
<td>0.397</td>
</tr>
<tr>
<td>Bus rapid transit</td>
<td>-0.15 to -0.04</td>
<td>0.001</td>
</tr>
<tr>
<td>Federal share</td>
<td>-0.41 to 0.27</td>
<td>0.693</td>
</tr>
</tbody>
</table>

Gray text indicates that the coefficient is not significant at a 95-percent confidence level.
Conclusions

**Initial cost estimates**
- Less error associated with:
  - Expansion and renovation projects
  - Low-cost projects
  - Bus rapid transit

**Final cost estimates**
- Less variation (and less error) to begin with
- More error associated with heavy rail
- Less error associated with:
  - Commuter rail
  - Higher federal funding shares
What’s going on with federal funding shares?

Federal grants are made as fixed dollar amounts, based on intended share of total cost.

- Higher federal share
- Greater bias in cost estimation

- Project completed under budget
- Greater share of actual cost covered by federal grant
Thank you

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