Costly Errors:

Analyzing trends in cost estimate accuracy for New Starts projects

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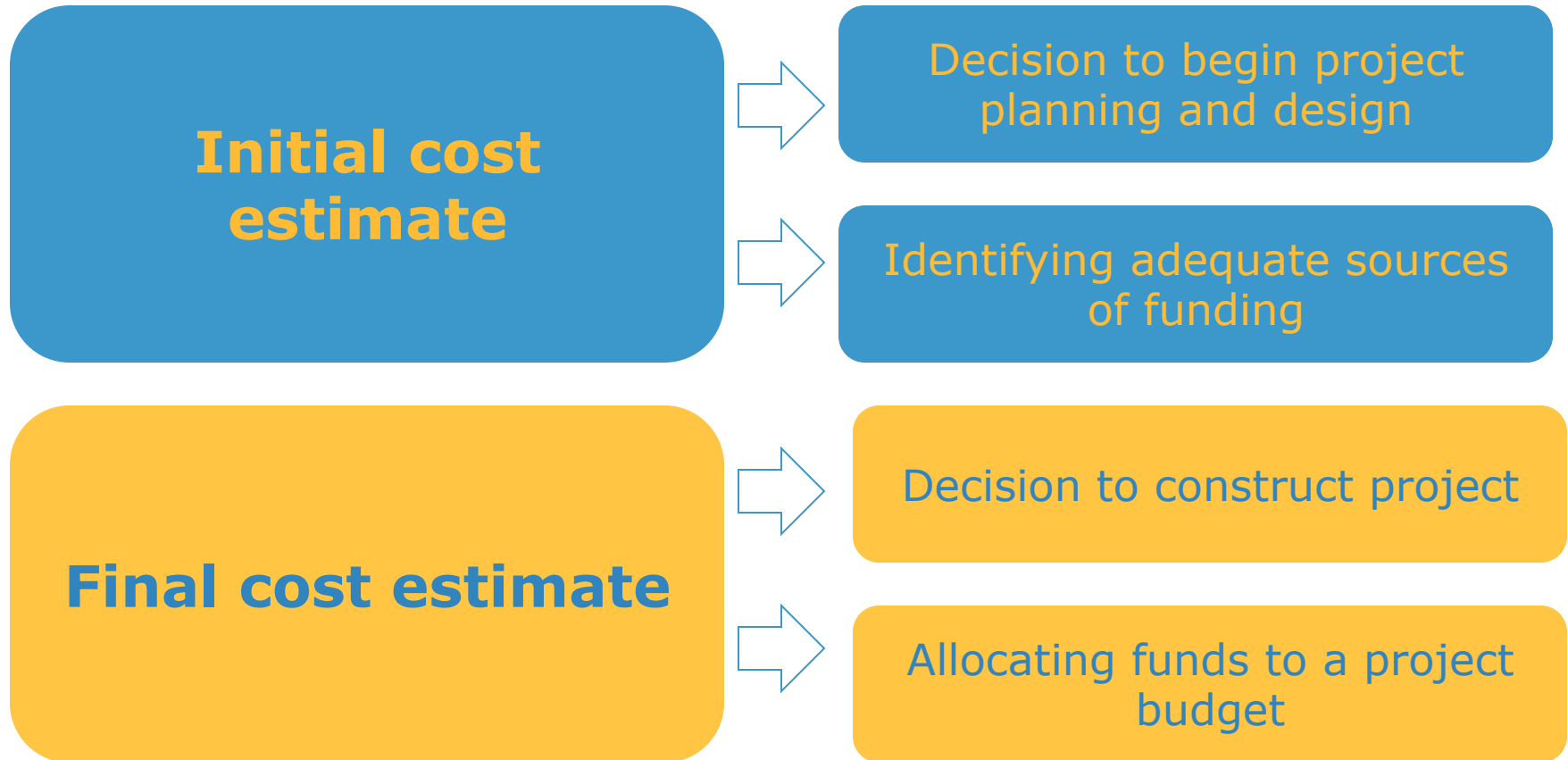
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What is the New Starts program?

- 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

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Data

Sources

- **1983-1988**
  - 10 projects
  - Pickrell 1989
- **1989-2002**
  - 19 projects
  - Spielberg et al. 2003
- **2003-2007**
  - 21 projects
  - Lewis-Workman et al. 2008
- **2008-2011**
  - 16 projects
  - Before and After Studies

Sample

- **62** initial cost estimates

- **58** final cost estimates

- **52** pairs of initial and final cost estimates

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(In)accuracy as error

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

P = Predicted value

A = Actual value

Underestimates are positive

Possible range from -200% to +200%

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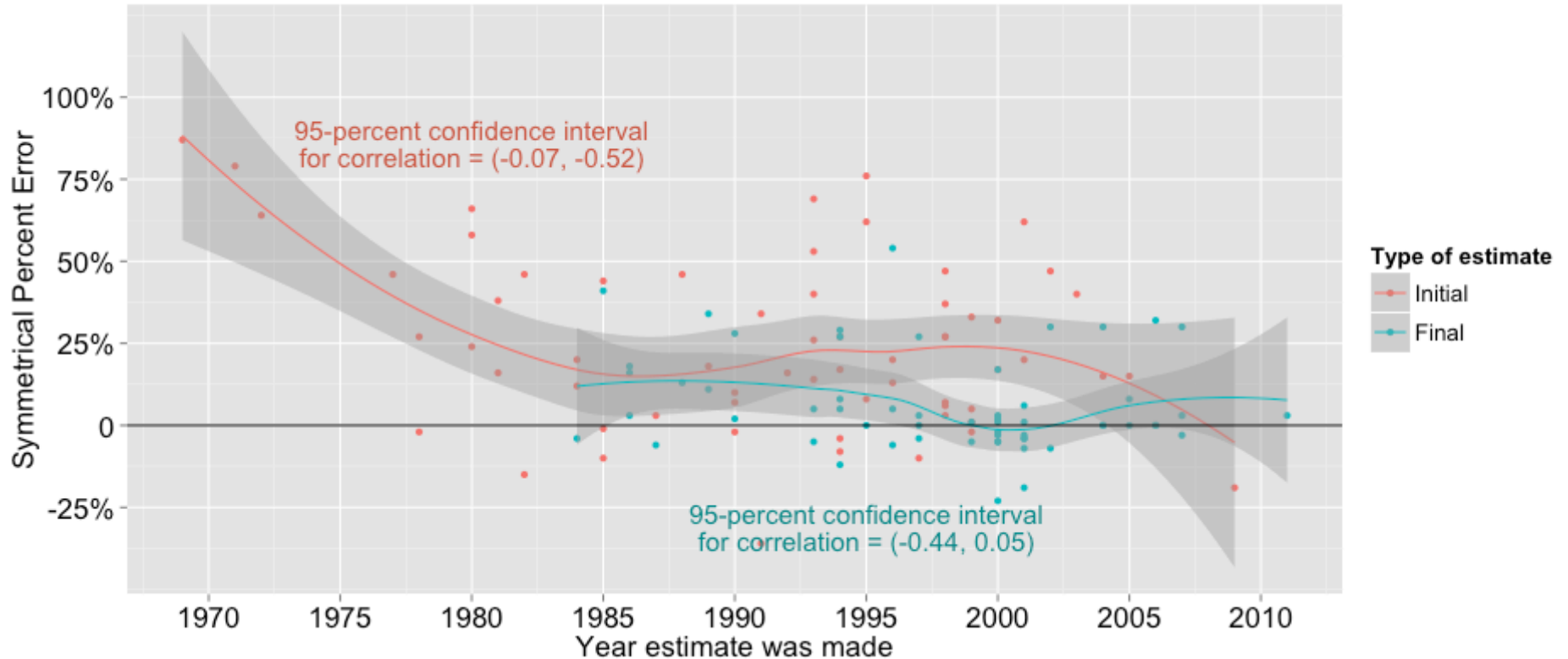INSTITUTE OF
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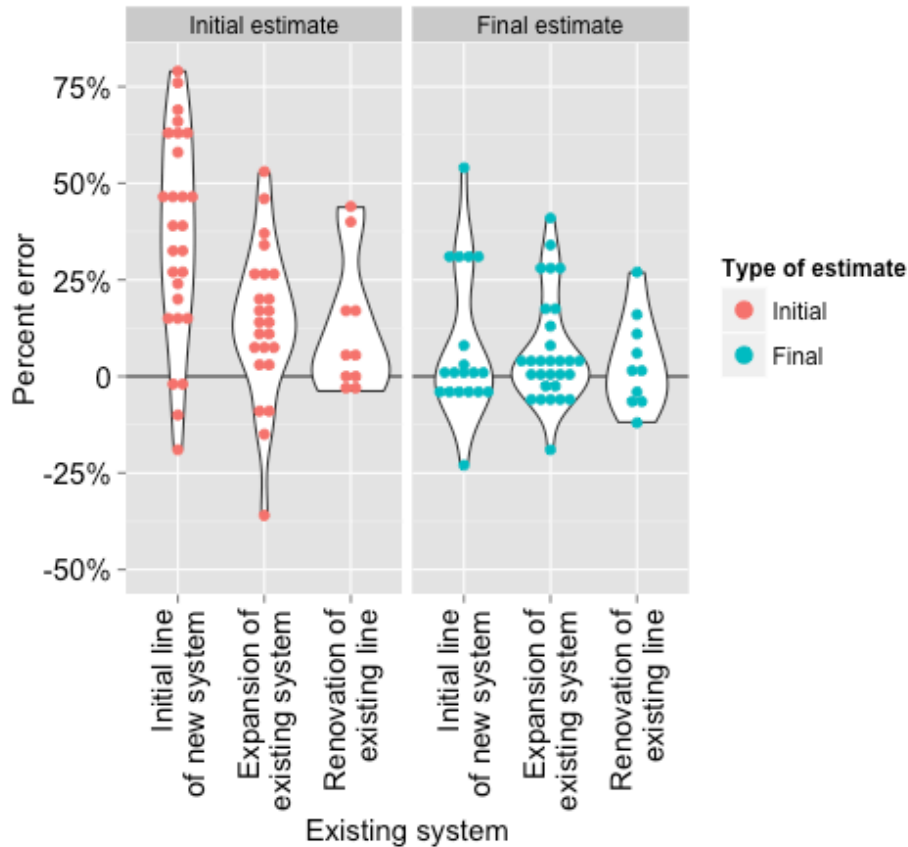# Improvements from initial to final cost estimates
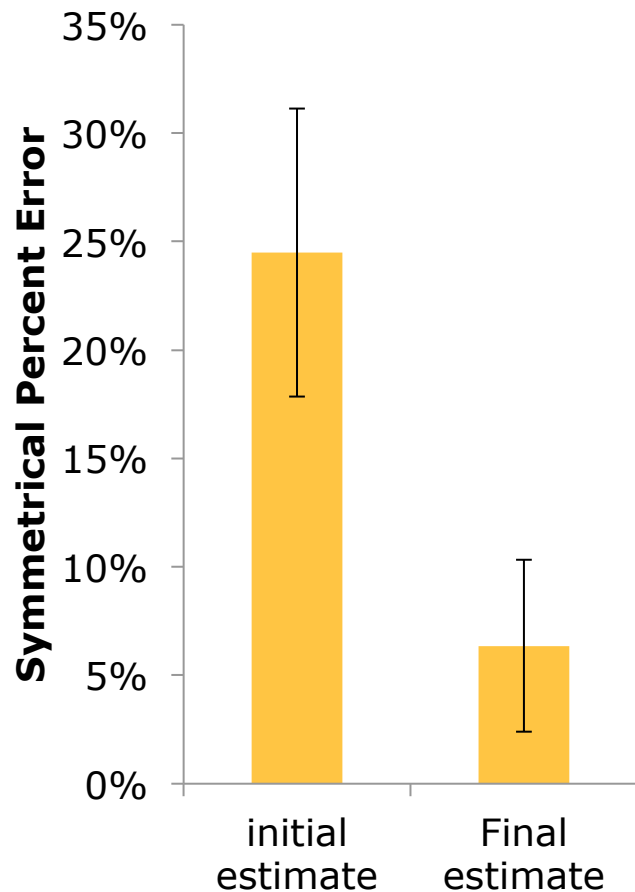
95% confidence intervals for improvement

- Difference in means (2-sample t-test): **10% to 26%**

- Average improvement (paired t-test): **8% to 21%**

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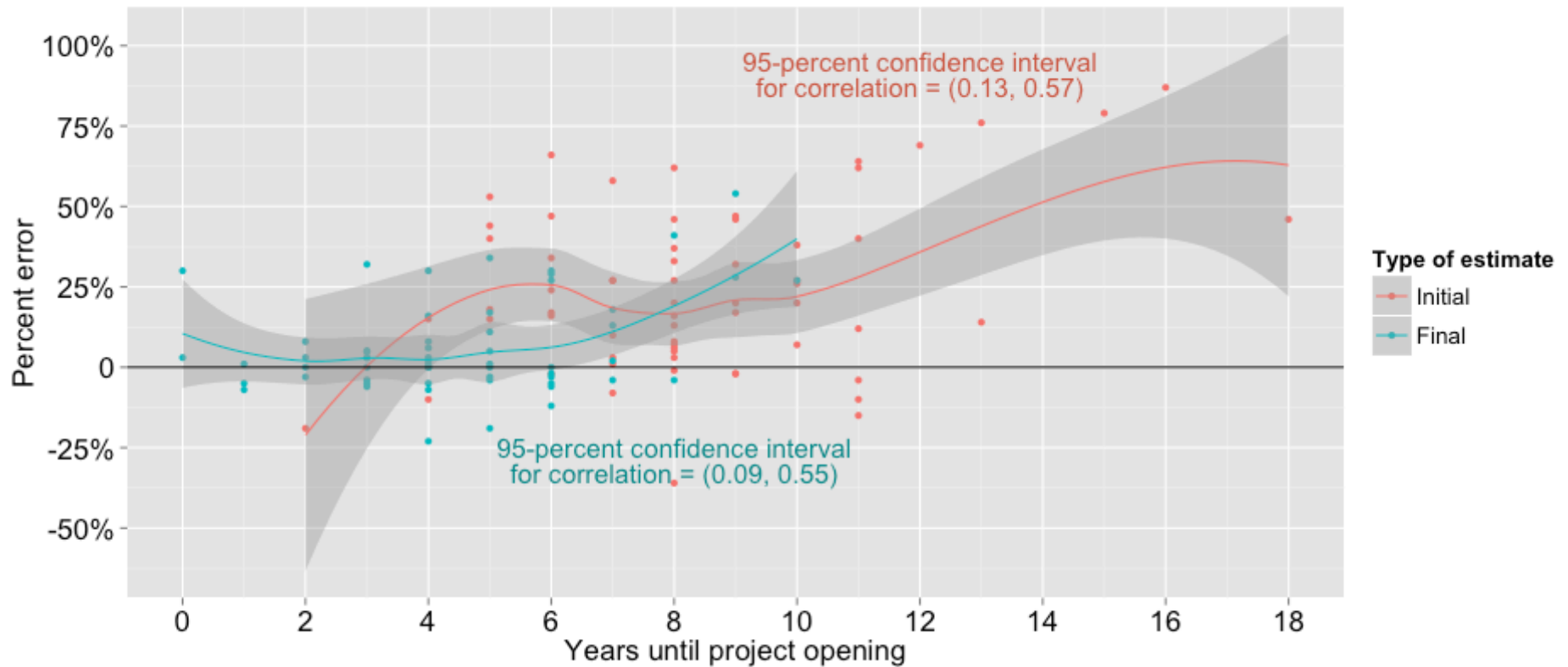
Improvement in accuracy over time
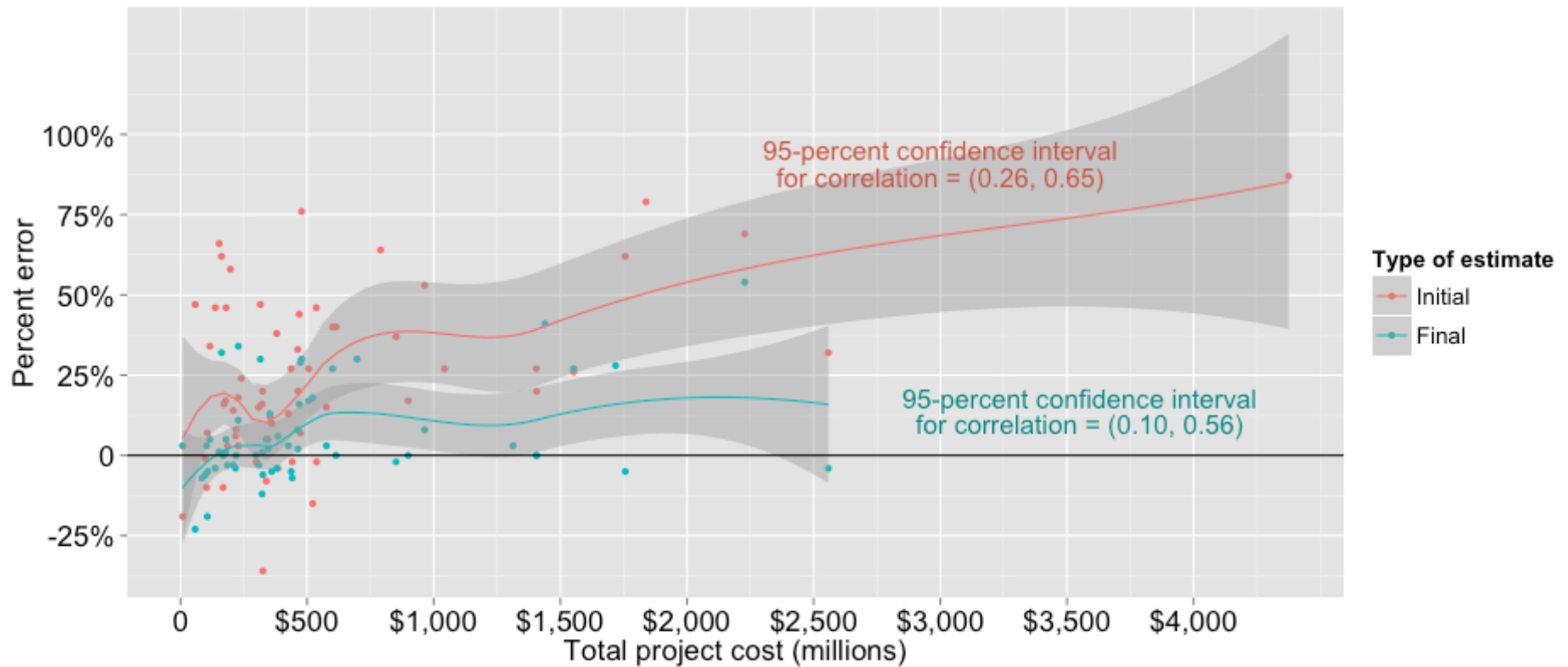
Differences by project sequence

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

Variation by project size

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

95-percent confidence interval for correlation = (0.10, 0.56)

Type of estimate
Initial
Final

Percent error

Total project cost (millions)

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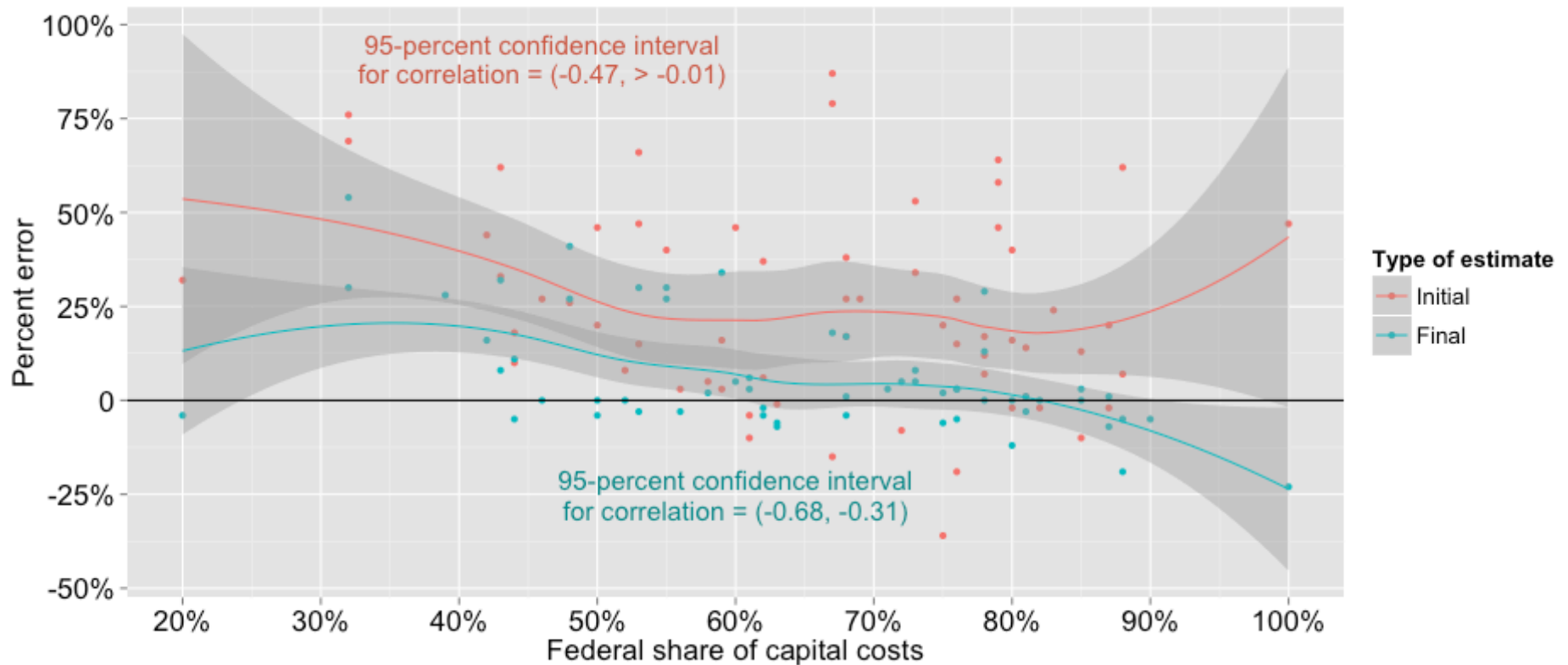INSTITUTE OF TRANSPORTATION STUDIES

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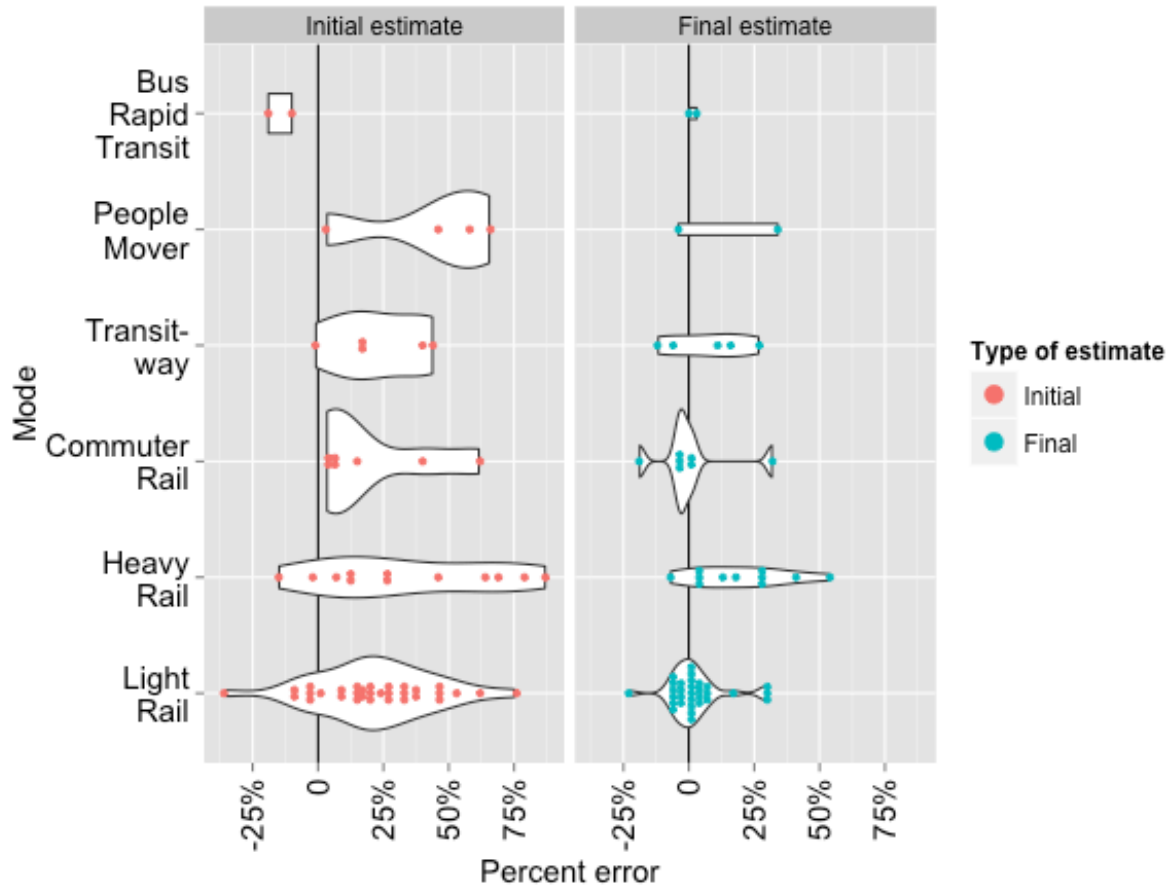
Final cost estimates for heavy rail projects have errors 2 – 31 percentage points higher than those for light rail projects (95 percent confidence).

No other modal differences are significant.

Variation by federal funding share

Model results

Dependent variable:	Symmetric mean percent error of initial cost estimate		Symmetric mean percent error of final cost estimate	
R-squared:	**0.532**		**0.479**	
Independent variables:	**Coefficient estimate**	**p-value**	**Coefficient estimate**	**p-value**
Year of estimate	-0.01 to 0.01	0.582	-0.01 to 0.01	0.582
Existing system: Relative to initial line for new system				
Expansion of existing system	**-0.18 to -0.05**	**0.001**	-0.05 to 0.03	0.564
Renovation of existing line	**-0.14 to -0.02**	**0.024**	-0.06 to 0.02	0.341
Years to opening	-0.02 to 0.03	0.649	-0.01 to 0.03	0.216
Actual cost (billions)	**0.02 to 0.20**	**0.022**	-0.12 to 0.05	0.405
Mode: Relative to light rail				
Heavy rail	-0.04 to 0.12	0.339	**0.03 to 0.13**	**0.003**
Commuter rail	-0.07 to 0.06	0.943	**-0.08 to > -0.01**	**0.048**
Transitway	-0.01 to 0.12	0.101	-0.04 to 0.04	0.964
People mover	-0.03 to 0.07	0.397	-0.03 to 0.04	0.745
Bus rapid transit	**-0.15 to -0.04**	**0.001**	-0.04 to 0.03	0.743
Federal share	-0.41 to 0.27	0.693	**-0.66 to -0.22**	**< 0.001**
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

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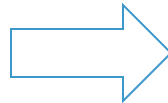
What's going on with federal funding shares?

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

Higher federal share	**X** ⟹	Greater bias in cost estimation

Project completed under budget	⟹	Greater share of actual cost covered by federal grant

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Thank you

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