10-10-2014

Examining the Role of Internal Planning Decisions in Improving Transit Performance and Economic Outcomes

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OTREC at PSU
Friday Transportation Seminar,
October 10, 2014

What are **Internal Planning Decisions**?

Transit improvement strategies

focused on adjusting the

internal performance factors

Transit Performance Factors

Internal Factors

- Related to service parameters and other characteristics **controlled directly by transit planners and managers**
  - Frequency
  - Service accessibility
  - Travel Speed
  - Network coverage
  - Network layout

External Factors

- Characterize the **external setting** of the environment served by transit which is **not fully controlled by transit planners**
  - Population density
  - Employment density
  - Urban form
  - Affordability of other modes (e.g. automobile)

Source: Taylor and Fink (2003)

Background of the study

Scholars investigating performance of U.S. transit systems noticed **substantial differences in ridership patterns**.

They have also noticed **various approaches to internal factors** among the transit agencies.

They have focused on the role of **internal planning decisions**, trying to determine whether specific decisions result in increased ridership.

Scholars have identified several types of **internal planning decisions** that appear to have significant influence on transit ridership**:**

Higher **frequency** (incl. off-peak periods)

Improved **connectivity:**

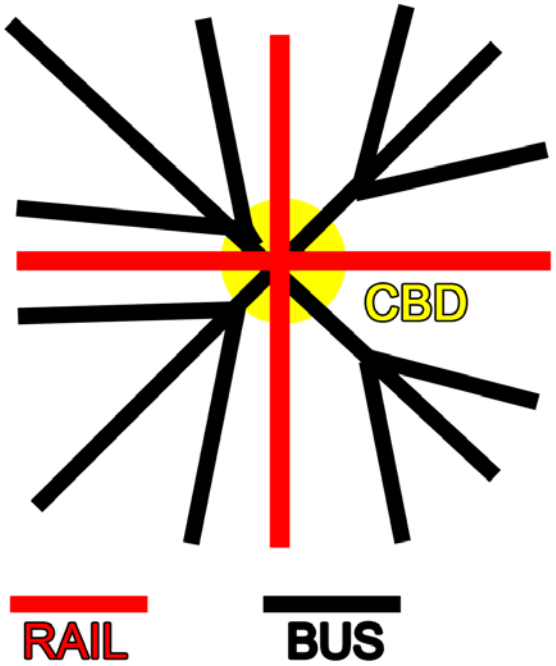
- shorter transfer times
- better intermodal integration (bus and rail)

Better **coverage of residential** and **employment** locations

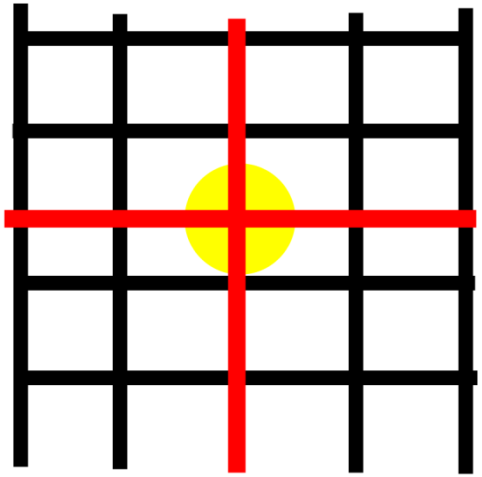
Multi-destination network structure

Two Archetypes of Transit Network Layouts

Radial
(CBD-oriented)



Multi-destination
(decentralized)



Multi-destination network layout appears to be better adjusted to the current spatial distribution of population & employment.

Excerpt from the Literature:

Selected results of the studies evaluating the role of internal decisions

Thompson & Matoff, 2003 (9 systems)

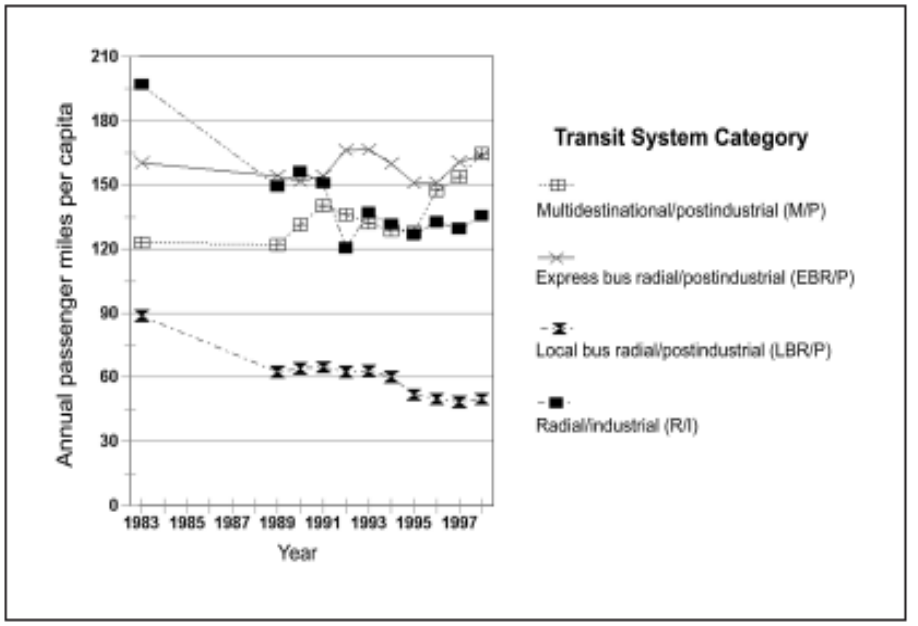


FIGURE 4. Ridership in different public transit system categories, 1983–1998.

Brown & Thompson, 2008 (45 systems)

System category	*# of cases*	Median **Riding Habit** (Pass miles per capita)			Median **Productivity** (Pass miles per revenue miles)		
		1984	**2004**	**Change**	**1984**	**2004**	**Change**
Multidestination, Bus & Rail	10	128	149	**9%**	11.3	9.3	**-13%**
Multidestination, Bus only	6	53	68	**-11%**	8.9	7.4	**-15%**
Radial, Bus & Rail	9	82	81	**-12%**	9.8	7.2	**-25%**
Radial, Bus only	20	37	29	**-13%**	8.6	5.9	**-26%**

Purpose of the Study

Previous studies have evaluated the **internal decisions** focusing primarily on **ridership indicators** *(boardings per mile, trips per capita, average vehicle load, etc.)*

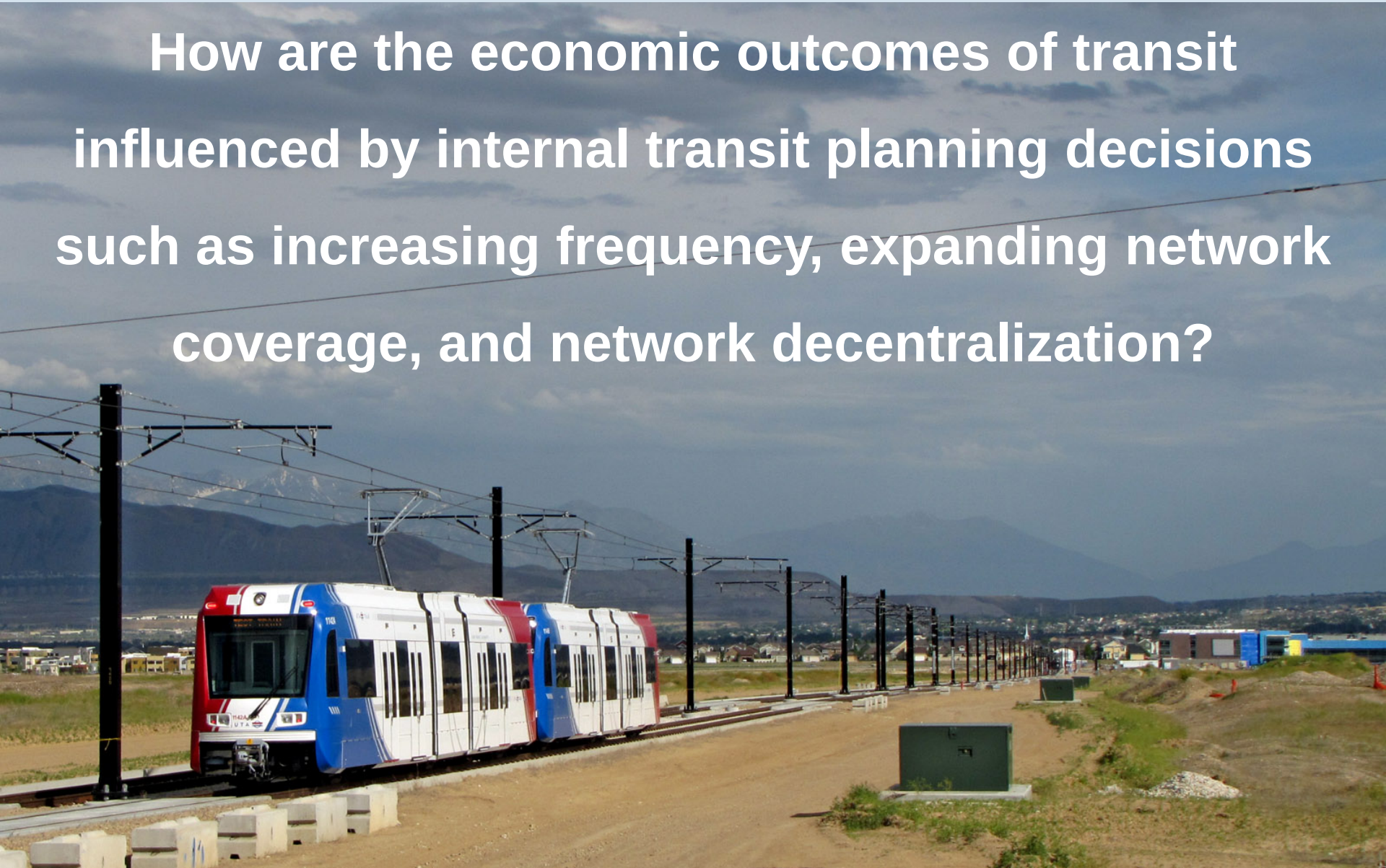
However, these studies **have not** determined full **economic outcomes (benefits & costs)** of adjusting the internal factors.

Ridership goes up…

But maybe these strategies are too costly to implement?

Major Research Question

How are the economic outcomes of transit influenced by internal transit planning decisions such as increasing frequency, expanding network coverage, and network decentralization?



Area of Study

The analysis focused on
13 U.S. bus & light rail systems.
All fixed-route services were considered.

Selection Criteria:
All metro areas with a modern light rail system, except for systems that also include heavy rail

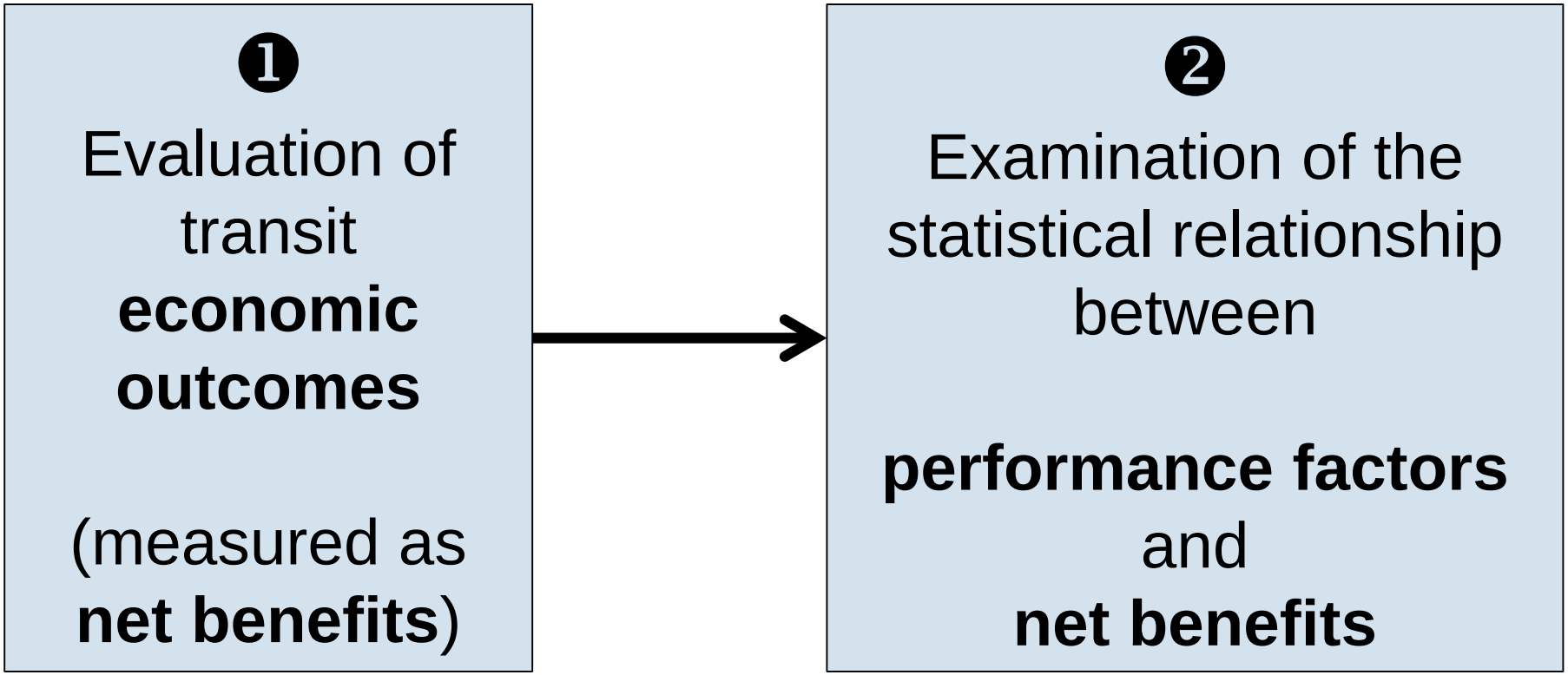
Previous research placed much emphasis on evaluating multimodal transit systems:

Good performance is essential for systems that include rail mode. Otherwise the rail investment appears to be inefficient and redundant.

- Buffalo
- Charlotte
- Dallas
- Denver
- Houston
- Minneapolis
- Phoenix
- Pittsburgh
- Portland
- Sacramento
- Salt Lake City
- San Diego
- St. Louis

Period of analysis:
2001-2011

Research Design



Additional analyses will be discussed later.

Stage I Benefit-Cost Analysis

- **Economic outcomes** of transit systems were evaluated by a **benefit-cost analysis** framework.

- The B/C Analysis gives a broader overview of transit economic effects if compared to a simple financial analysis.

The non-direct benefits play an important role in assessing transit spending.

Net Benefits

=

direct revenues

+

non-direct benefits

–

operating costs

–

capital costs

Stage I Benefit-Cost Analysis

Benefit / Cost Category	Description, Method of Estimation	Key Assumptions
BENEFITS		
Direct revenue	Fares and other transit-related revenues	
Consumer Surplus (rider benefits)	Difference between riders' willingness-to-pay for transit and the actual fare	CS = ridership x (fare/elasticity) x 0.5 Rail elasticity = -0.3 Bus elasticity = -0.4
Externalities	Reduction in the costs of negative impacts of motorization: - Environmental impacts - Costs of accident victims recovery - Social costs of traffic congestion	For environmental impacts: $0.089/passenger mile For accident recovery: $0.138/passenger mile Congestion costs taken from the Urban Mobility Report
COSTS		
Operating Costs	Operating costs reported by agencies	
Capital Costs	Annualized costs of capital expansion, estimated considering deprecation and capital lifecycle	Lifecycles from 15 to 70 yrs., depending on category. Discount rates: 1.0% to 1.9%

Benefit-Cost Analysis Results

Benefits were discounted by passenger miles to make the results comparable across cases.

Net benefits per passenger mile, 2011 dollars

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	-$0.35	-$0.52	-$0.60	-$0.68	-$0.68	-$0.73	-$0.84	-$0.79	-$0.73	-$0.77	-$0.75
Charlotte							-$0.42	-$0.43	-$0.17	-$0.46	-$0.42
Dallas	-$0.11	-$0.26	-$0.25	-$0.27	-$0.27	-$0.23	-$0.41	-$0.60	-$0.76	-$0.77	-$0.79
Denver	$0.02	-$0.01	-$0.09	-$0.09	-$0.12	-$0.11	-$0.11	-$0.03	-$0.11	-$0.19	-$0.17
Houston				-$0.15	-$0.24	-$0.18	-$0.23	-$0.27	-$0.34	-$0.44	-$0.52
Minneapolis				-$0.19	-$0.08	-$0.07	-$0.06	-$0.07	-$0.12	-$0.13	-$0.18
Phoenix									-$0.57	-$0.54	-$0.44
Pittsburgh	-$0.03	-$0.14	-$0.16	-$0.29	-$0.39	-$0.47	-$0.39	-$0.49	-$0.50	-$0.62	-$0.78
Portland	$0.16	$0.07	$0.02	$0.03	-$0.06	-$0.04	-$0.02	-$0.10	-$0.07	-$0.14	-$0.10
Sacramento	$0.04	$0.09	-$0.13	-$0.33	-$0.44	-$0.41	-$0.36	-$0.35	-$0.24	-$0.29	-$0.33
Salt Lake	-$0.26	-$0.29	-$0.18	-$0.34	-$0.21	$0.06	-$0.04	-$0.03	-$0.27	-$0.27	-$0.38
San Diego	$0.30	$0.32	$0.27	$0.21	$0.17	$0.14	$0.29	$0.27	$0.34	$0.29	$0.49
St. Louis	-$0.07	-$0.03	-$0.11	-$0.16	-$0.18	-$0.23	-$0.22	-$0.21	-$0.27	-$0.33	-$0.34

We see substantial differences across our cases.
What factors are responsible for these differences?

Stage II Factors of Economic Outcomes

Is there any relationship between performance factors and the net benefits generated by a transit system?

A panel regression fixed-effects model was designed to examine that relationship.

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \ldots + \beta_k X_{k,it} + \ldots + \delta_2 T_2 + \ldots + \delta_t T_t + u_{it}$$

$Y -$ $dependent\ variable,$ $X_{1,2,\ldots,k} - independent\ variables,$

$\beta_{1,2,\ldots,k} - coeficients,$ $T_{2,\ldots,t} -$ $time\ periods\ (years),$

$\delta_{2,\ldots,t} -$ $fixed\ time\ effects\ for\ year\ t,$ $i -$ $observation\ groups\ (cities)$

- **Net benefits** serve as the **dependent variable,**
- **Performance factors** are the **independent variables**

Stage II Factors of Economic Outcomes

Model Specification

Variable	Hypothesized influence on benefits	Description
Internal factors		
Decentralization Ratio	**+**	% of service not entering the CBD.
Service Density	**+**	Service volume per service area
Average Headway	**-**	Average time between departures.
External factors		
Population density	**+**	The external factors were added to the model to reinforce its explanatory power and control for possible external influences on the economic outcomes.
Unemployment	**-**	
Median Income	**+**	
Zero-vehicle households	**+**	
Gas Price	**+**	
TTI (congestion)	**+**	Travel Time Index – the ratio of actual travel time compared to travel time in uncongested conditions

Model Results

Dependent Variable: net benefits per passenger mile

Variable	Coefficient	Std. error	t	P>[t]
Decentralization	-0.296	0.310	-0.95	0.34
Headway	-0.010	0.005	**-2.02**	0.05
Service Density	0.001	0.000	**3.26**	0.00
Pop. Density	0.220	0.227	0.97	0.33
Unemployment	0.026	0.015	1.80	0.08
Zero-veh. H-holds	-0.024	0.026	-0.91	0.37
Median Income	0.014	0.009	1.65	0.10
Gas Price	0.102	0.175	0.58	0.56
TTI (congestion)	-2.045	0.626	**-3.27**	0.00
Dummy variables				
2002	-0.067	0.083	-0.81	0.42
2003	-0.177	0.059	**-3.02**	0.00
2004	-0.258	0.058	**-4.41**	0.00
2005	-0.290	0.083	**-3.48**	0.00
2006	-0.350	0.159	**-2.20**	0.03
2007	-0.425	0.164	**-2.59**	0.01
2008	-0.691	0.295	**-2.34**	0.02
2009	-0.651	0.131	**-4.99**	0.00
2010	-0.777	0.246	**-3.16**	0.00
2011	-0.800	0.303	**-2.64**	0.01
Constant	1.507	0.960	1.57	0.12

Frequency and service density appear to be **positively correlated with benefits**

TTI is negatively correlated (transit systems serving less congested cities yield more benefits)

Other variables, incl. decentralization are **not significant determinants** of the net benefits

Stage II Factors of Economic Outcomes

Additional Route-Level Analysis

The effects of internal planning decisions
were investigated primarily at the system-level.

An additional analysis aimed to determine the economic outcomes of specific route categories, important from the perspective of specific internal decisions:

- **bus routes not serving the CBD**
- **bus routes providing access to rail stations**

Route-Level Analysis

Year of Analysis: 2011

Categorization:	Enters the CBD?		Serves a rail station?	
	Non-CBD Service	**CBD Service**	**Routes Serving Rail Stations**	**Routes Not Serving Rail Stations**
Operating Cost per Boarding				
Buffalo	$ 3.69	$ 3.36	$ 3.25	$ 9.05
Denver	$ 5.11	$ 4.53	$ 4.56	$ 5.61
Houston	$ 4.41	$ 5.26	$ 4.97	$ 4.57
Minneapolis	$ 3.64	$ 3.37	$ 3.35	$ 4.23
Phoenix	$ 4.07	$ 3.26	$ 3.67	$ 3.92
Portland	$ 2.75	$ 2.74	$ 2.70	$ 5.81
Sacramento *	$ 1.32	$ 1.35	$ 1.33	$ 1.73
San Diego	$ 2.45	$ 2.58	$ 2.53	$ 2.30
** - Operating Cost per Passenger Mile for Sacramento*				
Farebox Recovery				
Buffalo	0.26	0.29	0.30	0.11
Denver	0.26	0.34	0.30	0.28
Houston	0.15	0.20	0.19	0.13
Minneapolis	0.24	0.32	0.30	0.24
Phoenix	0.22	0.28	0.24	0.22
Sacramento	0.21	0.22	0.22	0.20

Economic outcomes of routes running outside the CBD are comparable to the CBD-bound routes.

Routes serving a rail station seem to have lower per-rider costs and higher farebox recovery than the remaining services.

Another category of internal decisions:

Ownership and Management

The literature indicates that specific decisions regarding transit management and ownership forms, such as:

- **service contracting**
- **unified regional transit governance**

are likely to improve the financial sustainability of transit.

However, the evidence is still limited:

- Previous studies focused on small numbers of cases.
- Not much research exists on economic effects of certain governance forms (most studies limited to policy analysis).

Additional Focus
Ownership and Management Factors

Two additional variables, reflecting the share of contracting and the degree of regional consolidation, were added to the regression model.

Variable	Hypothesized influence on net benefits	Description
Contracting ratio	+	% of transit service contracted to third-party entities
Number of independent governing organizations	-	Number of separate authorities (agencies) possessing transit planning and management functions within a specific metro area

Model Results

with ownership/governance variables

Dependent Variable: *ben_per_pm* (net benefits per passenger mile)

	with network planning variables					*without network planning variables*			
Variable	**Coeff**	**Std. error**	**t**	**P>[t]**		**Coeff**	**Std. error**	**t**	**P>[t]**
Contracting Ratio	0.784	0.24	**3.24**	0.002		0.684	0.24	**2.79**	0.006
# of separate agencies	-0.061	0.02	**-2.63**	0.010		-0.088	0.02	**-3.82**	0.000
Decentralization	-0.088	0.30	-0.30	0.768					
Headway	-0.009	0.00	**-2.08**	0.040					
Service Density	0.001	0.00	**2.85**	0.005					
Pop. Density	0.298	0.21	1.41	0.161		0.359	0.22	1.64	0.104
Unemployment	0.010	0.02	0.62	0.540		0.025	0.02	1.60	0.114
Zero-veh. H-holds	-0.015	0.02	-0.63	0.530		0.014	0.02	0.60	0.550
Median Income	0.006	0.01	0.73	0.470		-0.001	0.01	-0.15	0.878
Gas Price	0.122	0.16	0.75	0.452		0.068	0.17	0.41	0.684
TTI (congestion)	-1.619	0.59	**-2.77**	0.007		-1.322	0.57	**-2.33**	0.022
(Dummy time variables not presented in the results)									
Constant	1.165	0.89	1.31	0.193		0.856	0.76	1.12	0.266

Results indicate that **contracting** and **consolidation of regional transit governance** are positive influences on transit economic outcomes.

Conclusions and Implications

Two types of internal planning decisions:

increasing frequency and increasing service density

appear to positively influence economic outcomes of bus & light rail transit systems

These results correspond with the previous studies, which have identified the positive role of these factors in determining ridership and average vehicle load.

Conclusions and Implications

Network decentralization seems to have no significant influence on transit benefits and costs, at least in this case.

Future research should investigate more deeply the outcomes of network decentralization.

Service contracting and strong regional governance are positive, significant factors of net benefits in the case of the analyzed 13 bus & rail systems.

Future Research

Similar analysis for **other systems**

Analyze the effects of internal decisions on riders: **travel behavior, accessibility, mobility**

Perform robust evaluation of **internal and external factors** at route- or stop-level

Evaluate transit governance forms, focusing on **ridership and economic effects**

Thank You!

Questions? Comments?

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Acknowledgments:

DeVoe L. Moore Center at
Florida State University

Oregon Transportation
Research and Education
Consortium

Appendix: Additional Results and References

Sensitivity Analysis for Benefit-Cost estimations

	Liberal scenario	Conservative scenario
Average change of the benefits (or costs) after adopting liberal or conservative assumptions for a specific category of benefits (base values for other parameters):		
Consumer Surplus	18%	-8%
Congestion Costs	7%	-7%
Externalities - Air Pollution	7%	-8%
Externalities - Accidents	9%	-9%
Capital Costs	-12%	17%
Average change in benefits if a particular scenario is applied to all benefit and cost categories	42%	-62%
Average change in the amount of costs if a particular scenario is applied to all benefit and cost categories	-2%	3%

Direct Revenue per Pass. Mile

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	$ 0.38	$ 0.36	$ 0.34	$ 0.39	$ 0.36	$ 0.36	$ 0.35	$ 0.33	$ 0.31	$ 0.37	$ 0.35
Charlotte							$ 0.34	$ 0.26	$ 0.46	$ 0.20	$ 0.20
Dallas	$ 0.20	$ 0.26	$ 0.19	$ 0.22	$ 0.19	$ 0.23	$ 0.16	$ 0.18	$ 0.25	$ 0.42	$ 0.29
Denver	$ 0.24	$ 0.25	$ 0.22	$ 0.23	$ 0.21	$ 0.23	$ 0.17	$ 0.29	$ 0.27	$ 0.22	$ 0.22
Houston				$ 0.13	$ 0.12	$ 0.14	$ 0.15	$ 0.12	$ 0.17	$ 0.16	$ 0.18
Minneapolis				$ 0.28	$ 0.27	$ 0.28	$ 0.26	$ 0.24	$ 0.30	$ 0.27	$ 0.27
Phoenix									$ 0.20	$ 0.24	$ 0.24
Pittsburgh	$ 0.22	$ 0.26	$ 0.29	$ 0.29	$ 0.28	$ 0.28	$ 0.26	$ 0.30	$ 0.31	$ 0.33	$ 0.40
Portland	$ 0.26	$ 0.21	$ 0.20	$ 0.20	$ 0.19	$ 0.21	$ 0.29	$ 0.27	$ 0.28	$ 0.28	$ 0.27
Sacramento	$ 0.26	$ 0.33	$ 0.30	$ 0.24	$ 0.22	$ 0.25	$ 0.30	$ 0.27	$ 0.27	$ 0.27	$ 0.28
Salt Lake	$ 0.22	$ 0.25	$ 0.23	$ 0.23	$ 0.22	$ 0.22	$ 0.16	$ 0.22	$ 0.29	$ 0.26	$ 0.24
San Diego	$ 0.16	$ 0.20	$ 0.19	$ 0.20	$ 0.19	$ 0.19	$ 0.36	$ 0.37	$ 0.40	$ 0.43	$ 0.61
St. Louis	$ 0.20	$ 0.19	$ 0.18	$ 0.18	$ 0.19	$ 0.21	$ 0.20	$ 0.23	$ 0.16	$ 0.19	$ 0.18

Congestion Savings per Pass. Mile

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	$ 0.16	$ 0.16	$ 0.16	$ 0.16	$ 0.16	$ 0.16	$ 0.16	$ 0.16	$ 0.14	$ 0.15	$ 0.17
Charlotte							$ 0.19	$ 0.19	$ 0.17	$ 0.17	$ 0.18
Dallas	$ 0.36	$ 0.38	$ 0.30	$ 0.30	$ 0.29	$ 0.30	$ 0.30	$ 0.31	$ 0.33	$ 0.34	$ 0.30
Denver	$ 0.22	$ 0.23	$ 0.23	$ 0.23	$ 0.23	$ 0.23	$ 0.23	$ 0.23	$ 0.23	$ 0.22	$ 0.21
Houston				$ 0.23	$ 0.23	$ 0.24	$ 0.24	$ 0.24	$ 0.26	$ 0.27	$ 0.26
Minneapolis				$ 0.24	$ 0.24	$ 0.24	$ 0.24	$ 0.24	$ 0.26	$ 0.24	$ 0.27
Phoenix									$ 0.19	$ 0.21	$ 0.25
Pittsburgh	$ 0.25	$ 0.25	$ 0.24	$ 0.24	$ 0.24	$ 0.24	$ 0.24	$ 0.24	$ 0.23	$ 0.24	$ 0.27
Portland	$ 0.25	$ 0.25	$ 0.25	$ 0.24	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.26	$ 0.26
Sacramento	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21	$ 0.21
Salt Lake	$ 0.21	$ 0.23	$ 0.24	$ 0.25	$ 0.26	$ 0.24	$ 0.23	$ 0.27	$ 0.39	$ 0.35	$ 0.29
San Diego	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27	$ 0.27
St. Louis	$ 0.19	$ 0.20	$ 0.19	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.19	$ 0.22	$ 0.19

Consumer Surplus per Pass. Mile

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	$ 0.29	$ 0.28	$ 0.27	$ 0.31	$ 0.29	$ 0.28	$ 0.27	$ 0.25	$ 0.24	$ 0.28	$ 0.27
Charlotte							$ 0.11	$ 0.11	$ 0.14	$ 0.14	$ 0.15
Dallas	$ 0.11	$ 0.10	$ 0.09	$ 0.10	$ 0.09	$ 0.15	$ 0.09	$ 0.12	$ 0.13	$ 0.13	$ 0.12
Denver	$ 0.12	$ 0.13	$ 0.14	$ 0.14	$ 0.13	$ 0.13	$ 0.14	$ 0.15	$ 0.17	$ 0.16	$ 0.16
Houston				$ 0.09	$ 0.09	$ 0.09	$ 0.08	$ 0.08	$ 0.11	$ 0.11	$ 0.12
Minneapolis				$ 0.18	$ 0.18	$ 0.19	$ 0.17	$ 0.17	$ 0.19	$ 0.17	$ 0.18
Phoenix									$ 0.11	$ 0.15	$ 0.15
Pittsburgh	$ 0.14	$ 0.17	$ 0.19	$ 0.20	$ 0.19	$ 0.18	$ 0.16	$ 0.19	$ 0.21	$ 0.22	$ 0.26
Portland	$ 0.16	$ 0.15	$ 0.11	$ 0.14	$ 0.15	$ 0.16	$ 0.18	$ 0.18	$ 0.18	$ 0.19	$ 0.20
Sacramento	$ 0.16	$ 0.21	$ 0.17	$ 0.18	$ 0.17	$ 0.18	$ 0.20	$ 0.19	$ 0.19	$ 0.19	$ 0.19
Salt Lake	$ 0.12	$ 0.15	$ 0.12	$ 0.15	$ 0.13	$ 0.09	$ 0.08	$ 0.11	$ 0.16	$ 0.15	$ 0.16
San Diego	$ 0.17	$ 0.18	$ 0.18	$ 0.19	$ 0.19	$ 0.18	$ 0.18	$ 0.18	$ 0.19	$ 0.21	$ 0.20
St. Louis	$ 0.14	$ 0.13	$ 0.14	$ 0.13	$ 0.14	$ 0.15	$ 0.15	$ 0.15	$ 0.15	$ 0.16	$ 0.14

Externalities per Pass. Mile

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	$ 0.21	$ 0.20	$ 0.19	$ 0.18	$ 0.17	$ 0.16	$ 0.15	$ 0.14	$ 0.14	$ 0.13	$ 0.13
Charlotte							$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.13
Dallas	$ 0.23	$ 0.21	$ 0.20	$ 0.19	$ 0.18	$ 0.17	$ 0.16	$ 0.15	$ 0.15	$ 0.14	$ 0.14
Denver	$ 0.21	$ 0.20	$ 0.20	$ 0.19	$ 0.18	$ 0.17	$ 0.17	$ 0.15	$ 0.15	$ 0.15	$ 0.14
Houston				$ 0.19	$ 0.18	$ 0.18	$ 0.17	$ 0.15	$ 0.15	$ 0.14	$ 0.13
Minneapolis				$ 0.19	$ 0.18	$ 0.17	$ 0.17	$ 0.16	$ 0.15	$ 0.15	$ 0.14
Phoenix									$ 0.14	$ 0.14	$ 0.13
Pittsburgh	$ 0.22	$ 0.21	$ 0.20	$ 0.19	$ 0.17	$ 0.17	$ 0.16	$ 0.15	$ 0.15	$ 0.14	$ 0.13
Portland	$ 0.23	$ 0.23	$ 0.22	$ 0.21	$ 0.19	$ 0.18	$ 0.17	$ 0.16	$ 0.16	$ 0.16	$ 0.15
Sacramento	$ 0.23	$ 0.22	$ 0.21	$ 0.20	$ 0.18	$ 0.17	$ 0.16	$ 0.15	$ 0.16	$ 0.15	$ 0.14
Salt Lake	$ 0.20	$ 0.19	$ 0.19	$ 0.17	$ 0.17	$ 0.18	$ 0.17	$ 0.16	$ 0.14	$ 0.14	$ 0.14
San Diego	$ 0.24	$ 0.23	$ 0.22	$ 0.20	$ 0.19	$ 0.18	$ 0.17	$ 0.16	$ 0.16	$ 0.16	$ 0.15
St. Louis	$ 0.22	$ 0.22	$ 0.21	$ 0.20	$ 0.19	$ 0.17	$ 0.17	$ 0.16	$ 0.16	$ 0.15	$ 0.14

Correlation Coefficients

		dec	*headway*	*revmpe~m*	*pop_dens*	*unempl*	*veh_hh*	*med_inc*	*gas*	*tti*	*contract*	*regional*
Decentralization	*dec*	1.00										
Headway	*headway*	0.35	1.00									
Service Density	*revmpersqm*	0.02	-0.29	1.00								
Pop. Density	*pop_dens*	0.18	-0.25	-0.04	1.00							
Unemployment	*unempl*	0.07	0.09	0.04	-0.05	1.00						
Zero-veh. h-holds	*veh_hh*	-0.53	0.14	-0.03	-0.28	0.02	1.00					
Median Income	*med_inc*	0.41	0.10	0.33	0.21	0.13	**-0.57**	1.00				
Gas Price	*gas*	0.02	0.06	0.10	-0.03	0.31	0.05	0.49	1.00			
Congestion index	*tti*	-0.27	-0.39	0.18	0.47	-0.37	-0.09	-0.18	-0.34	1.00		
Contracting Ratio	*contract*	0.48	0.50	0.10	0.06	0.20	-0.23	0.43	0.16	-0.11	1.00	
# of regional auth.	*regional*	-0.16	0.21	-0.15	-0.03	0.19	0.11	-0.13	0.10	0.22	-0.02	1.00

Decentralization ratio (Percentage of Total Service Volume Allocated to Routes Not Serving the CBD)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	30%	30%	30%	30%	31%	32%	33%	37%	40%	44%	48%
Charlotte							27%	28%	28%	29%	29%
Dallas	54%	53%	53%	52%	53%	55%	57%	59%	62%	64%	66%
Denver	61%	62%	62%	63%	63%	64%	64%	62%	61%	59%	58%
Houston				35%	35%	37%	38%	38%	37%	37%	37%
Minneapolis				37%	38%	37%	37%	37%	37%	36%	36%
Phoenix									67%	64%	62%
Pittsburgh	18%	18%	19%	17%	16%	14%	14%	14%	14%	14%	15%
Portland	46%	47%	45%	42%	40%	38%	35%	36%	37%	38%	39%
Sacramento	60%	61%	63%	63%	63%	63%	62%	61%	60%	63%	65%
Salt Lake City	40%	40%	40%	42%	47%	53%	54%	54%	54%	54%	59%
San Diego	65%	65%	65%	65%	65%	65%	64%	63%	62%	61%	60%
St. Louis	60%	60%	63%	66%	69%	74%	74%	74%	74%	74%	75%

Average headway (in minutes)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	26.1	24.0	24.7	24.5	23.9	22.6	22.6	23.0	21.6	21.9	23.8
Charlotte							28.6	22.3	19.6	21.9	21.5
Dallas	13.3	14.4	13.6	10.0	10.1	11.1	11.6	3.6	12.9	13.4	11.9
Denver	22.3	23.9	22.0	20.6	20.2	21.8	21.2	18.8	20.4	21.4	21.8
Houston				9.5	14.4	14.5	15.9	17.3	16.0	16.2	16.2
Minneapolis				18.0	18.4	16.9	16.8	18.2	19.2	16.9	17.2
Phoenix									27.0	24.2	21.8
Pittsburgh	17.4	16.7	16.9	16.2	17.8	17.9	19.2	19.5	20.1	19.3	20.6
Portland	12.6	10.9	10.2	10.4	10.2	10.5	10.6	10.4	10.3	10.8	11.1
Sacramento	37.0	34.4	33.9	23.8	31.4	33.1	33.3	37.8	32.8	32.5	30.9
Salt Lake City	13.0	13.1	13.8	13.4	14.1	13.9	14.2	16.3	16.7	17.4	21.3
San Diego	21.0	25.0	26.7	24.9	34.9	32.5	29.2	22.8	21.4	25.5	21.9
St. Louis	19.4	20.8	21.6	26.4	27.0	25.9	22.2	23.0	23.7	27.0	22.0

Service Density (Revenue Miles per Service Area Square Mile, 000s)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Buffalo	191	185	182	175	190	199	208	226	252	225	233
Charlotte							143	177	192	187	200
Dallas	321	289	395	365	415	366	352	322	290	280	324
Denver	192	186	185	204	223	237	272	277	270	276	295
Houston				404	389	417	348	369	293	272	264
Minneapolis				499	624	673	722	785	646	702	700
Phoenix									452	416	408
Pittsburgh	362	323	285	289	269	273	305	253	256	244	209
Portland	526	601	608	637	633	663	631	650	709	683	672
Sacramento	224	192	193	233	184	188	190	213	229	213	202
Salt Lake City	81	90	104	89	107	166	179	175	117	131	138
San Diego	573	509	491	503	516	539	543	543	570	368	377
St. Louis	297	355	340	339	356	351	376	396	495	351	405

Source: See Table 3.2

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