Measuring Economic Benefits of Commuter Rail

Khalid Bekka, Ph.D., MBA
• Why Economic Assessment of Rail Investments
• Commuter Rail Characteristics
• Taxonomy of Commuter Rail as a Transit Mode
• Measuring Commuter Rail Benefits
• Case Studies
Why Economic Assessment?

Test 1

- Potential Infrastructure Project
  - Delivery Options
    * D-B-B
    * CM@Risk
    * Design-Build
    * Various Acceleration Processes
  - Financing Options
    * Pay as you Go
    * G. Obligation Bonds
    * Revenue Bonds
    * Grants
    * Development Fees
    * Fed. Loans
    * Private Loans
    * etc.

Meet Public Sector Goals?

Financially Feasible?

Yes
- Yes
  - Develop/Build

No
- No
  - Change Configuration/Scope

Test 2

Yes
- No
  - Change Configuration/Scope
Economic Assessment Use

• GAO (2005): Use of Cost-Benefit Analysis in project evaluation not Systematic in US
• More than half of DOTs and transit agencies surveyed use it less than half the time
• Key recommendation for investment decision-making: Increase use (and utility) of CBA
• GAO (2008) Benefit-cost a way to identify projects with the greatest net benefits and compare alternatives for individual projects.
Transit, In General, Has Two Kinds of Economic Impact

1. Market Impacts
   - Employment and Personal Income
   - Employment and Income Multiplier Effects
   - Business Income
   - Business Multiplier Effects
   - Tax Revenues

2. Non-Market Impacts
   - Access to Employees, Students, and Disadvantaged Groups
   - Affordable Mobility to Economically Disadvantaged Groups
   - Stimulation of Community Development
   - Reduction in Congestion and Delay

Traditional Methodology Covers Market Impacts Only, while New One Covers Both Market and Non-Market Impacts
Analytical Framework

- **Affordable Mobility/ Cross Sector Benefits**: These are the benefits from providing low-cost mobility to transit depend households and budget savings for welfare and social services due to the presence of transit.

- **Congestion Management Benefits**: Congestion management benefits are the savings in vehicle ownership and operating cost, travel time, accidents and environmental emissions.

- **Economic Development Benefits**: Proximity to transit has a positive effect on residential property values and the commercial activities due to the increased availability of travel opportunities.

- **Additional Quantifiable Benefits** include: Parking Cost Savings, Infrastructure Cost Savings, Fiscal Impacts, Labor Market Impacts, and Income Impacts.

- **Potential financial savings** to existing freight rail on commuter line through cost sharing.
Typical Characteristics of Commuter rail

Â Typical Design
Â Diesel or diesel electric
Â Route length: 20 ÷ 50 miles
Â Station spacing: 1 to 4 miles

Â Typical Operations
Â Avg. speed 40 mph (with stops)
Â Service: 30 min peak, 60 other

Â Land Use/Development
Â Cost-effective for low densities
Â Reliant on park & ride lots
Â Moderate economic development potential
Commuter rail vs other transit types

Â Network Coverage
Â Commuter rail is typically 30 to 40 miles in terms of network size; and
Â Stations are several miles apart- LRT stations are typically between ¼ mile and a mile.

Â Frequency of Service
Â Commuter rail is less frequent than light rail service. Typically, light rail has a peak headway of 2-15 minutes. Commuter rail is often at least 30 minutes of headway during peak hours;
Â Frequent Peak Hour trips, sometimes no weekend off peak trips (e.g. MARC and VRE) ; and
Â Others have weekend trips (e.g. SEPTA and MBTA).
Commuter Rail vs other Transit Types

Lower average cost of construction per passenger mile than heavy rail

<table>
<thead>
<tr>
<th>Transit Type</th>
<th>Miles</th>
<th>Cost for Fixed-Guideway Infrastructure ($ millions)</th>
<th>Dollars per mile (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus Rapid Transit</td>
<td>357.5</td>
<td>3,692.40</td>
<td>10.3</td>
</tr>
<tr>
<td>Busway</td>
<td>0.6</td>
<td>48.3</td>
<td>80.5</td>
</tr>
<tr>
<td>Light Rail Transit</td>
<td>179.6</td>
<td>19,022.60</td>
<td>105.9</td>
</tr>
<tr>
<td>Commuter Rail</td>
<td>177.7</td>
<td>20,493.70</td>
<td>115.3</td>
</tr>
<tr>
<td>Heavy Rail Transit</td>
<td>26.3</td>
<td>10,121.00</td>
<td>384.8</td>
</tr>
</tbody>
</table>

Commuter Rail vs other Transit Types (cont’d)

- Speed: Commuter rail trips faster than other transit types, at an average 31.6 mph;

![Average Miles Per Hour](chart)

Source: Litman 2010

- automobile travel averages about 35 mph overall (NPTS 1999).
**Commuter rail vs highway**

- Cheaper to construct than additional highway capacity, as shown in the March 2007 Financial & Economic Benefits Report for the Austin-San Antonio Commuter Rail Project:
  - Construction cost savings for two additional freeway lanes within 112-mile Austin-San Antonio corridor = approximately $380 million (assuming ROW is available and commuter rail uses existing rail infrastructure)

- ASA Commuter Rail Project is cheaper to maintain
  - Maintenance cost savings for two additional freeway lanes of 112 miles = $9.9 million per year or total savings of $275 million cumulatively through year 2030

- Commuter rail will decrease congestion; additional highway capacity does not. Vehicle-miles-traveled increases roughly one-for-one with miles of roads built (Duranton and Turner, 2008).
Commuter Rail vs other Transit Types (cont’d)

- Average cost of vehicle operation per passenger mile for commuter rail (about $0.40) is less than light rail at about (about $0.60) (APTA 2002)

- Environmental Savings of Commuter Rail:
  - One study compared Caltrain Commuter Rail of San Francisco to 3 other transit types (BART, Muni Light Rail, and Boston’s Light Rail Green Line) found that not one network outperformed the other for all CAP categories (Chester 2008).
  - However, commuter rail less energy consumption per passenger mile than light rail (Ibid) (see next slide)
Commuter Rail vs other Transit Types (cont’d)

Lifecycle Energy Consumption

![Graph showing lifecycle energy consumption for different modes of transportation. The graph compares the energy consumption per pass-mile for various types of vehicles, including buses, trains, aircraft, and personal vehicles.](image-url)
Commuter Rail Economic Development Impacts
## Residential Properties

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of Study</th>
<th>System</th>
<th>City</th>
<th>Distance Measured</th>
<th>Residential Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Cervero and Michael Duncan</td>
<td>2002</td>
<td>Coaster</td>
<td>San Diego, CA</td>
<td>0.5 miles</td>
<td>17%</td>
</tr>
<tr>
<td>Gruen &amp; Associates</td>
<td>1997</td>
<td>Metra</td>
<td>Chicago, IL</td>
<td>1,000 ft</td>
<td>20%</td>
</tr>
<tr>
<td>Armstrong</td>
<td>1994</td>
<td>MBTA Fitchberg Commuter Line</td>
<td>Boston, MA</td>
<td>Within census tracts</td>
<td>6.70%</td>
</tr>
</tbody>
</table>

All studies use hedonic price estimation to determine premiums for housing properties within a certain distance of the commuter rail stations.
Studies that examine the commercial property premiums created by commuter rail find a large impact. Differences between the two studies are again due to ridership.

For Coaster, the differences are due to properties NOT downtown along the commuter line that are not valued.

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of Study</th>
<th>System</th>
<th>City</th>
<th>Distance Measured</th>
<th>Commercial Property Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landis et al</td>
<td>1995</td>
<td>CalTrain</td>
<td>Santa Clara County, CA</td>
<td>0.25 miles</td>
<td>More than 120%</td>
</tr>
<tr>
<td>Robert Cervero and Michael Duncan</td>
<td>2002</td>
<td>Coaster</td>
<td>San Diego, CA</td>
<td>0.5 miles</td>
<td>91% in the downtown; -9.9% not downtown</td>
</tr>
</tbody>
</table>
Meta Analysis on Commuter Rail Premium

- A consistently higher positive impact on the property value compared to light rail (14% higher) and heavy railway/Metro stations.

- An average of 3% higher effect on property value for every 250m closer than the effect of light rail stations.

- A larger catchment area – i.e. a wider service range – than other transit types.
Case Studies
For Rockingham Planning Commission:

BCA on completing the expansion of MBTA commuter service to Plaistow, New Hampshire, and building the new layover facility for TIGER II Federal Funding Application in August 2010

Benefits to New Users to be:

- Travel time;
- Vehicle operating costs (i.e., fuel, oil, depreciation, tire wear, maintenance/repair); and
- Rail fare.

For travelers to Boston and other destinations where parking is relatively more expensive, parking savings will also be achieved; for example, parking at the new Plaistow Station is expected to be $2 daily, as compared to an average of $20 in Boston.
## Plaistow Commuter Rail Results

<table>
<thead>
<tr>
<th>BENEFITS</th>
<th>Millions of 2010$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits to Existing Users</td>
<td>$11.30</td>
</tr>
<tr>
<td>Benefits to New Users</td>
<td>$87.80</td>
</tr>
<tr>
<td>Pavement Maintenance Savings</td>
<td>$0.30</td>
</tr>
<tr>
<td>Accident Reduction Savings</td>
<td>$45.60</td>
</tr>
<tr>
<td>Congestion Cost Savings to</td>
<td>$155.30</td>
</tr>
<tr>
<td>Remaining Highway Users</td>
<td></td>
</tr>
<tr>
<td>Environmental Benefits</td>
<td>$10.00</td>
</tr>
</tbody>
</table>

**TOTAL BENEFITS** $310.40

**PV of Total Benefits** $83.70

<table>
<thead>
<tr>
<th>COSTS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Costs</td>
<td>$24.80</td>
</tr>
<tr>
<td>Capital Costs</td>
<td>$29.50</td>
</tr>
</tbody>
</table>

**TOTAL COSTS** $54.20

**PV of Total Costs** $35.60

**Net Present Value (NPV)** $48.10

**Benefit-Cost Ratio (BCR)** 2.3

Discounted million of dollars at 7% discount rate
PVPC Knowledge Corridor Improvements

For PVPC Pioneer Valley Planning Commission (PVPC), with support from the Vermont Agency of Transportation a BCA was completed for proposed Knowledge Corridor Improvements.

BCA was completed for 3 alternatives:

1. Realignment: Creating a more direct route reducing trip length by 11 miles;
2. Enhanced Intercity: Additional rail service and station development in Holyoke; and
3. Commuter: Commuter level service providing more frequent service, one additional round trip from New Haven, CT, to White River Junction, VT, and eight round trip extensions of the New Haven-Springfield shuttle north to Greenfield with concentrations in the morning and evening commute periods
## PVPC Knowledge Corridor Improvements Results

<table>
<thead>
<tr>
<th>Benefits ($ Millions)</th>
<th>Realignment</th>
<th>Enhanced Service</th>
<th>Commuter Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time Savings - Existing Riders</td>
<td>32.7</td>
<td>32.7</td>
<td>32.7</td>
</tr>
<tr>
<td>User Benefits - Induced Riders</td>
<td>16.7</td>
<td>236</td>
<td>289.1</td>
</tr>
<tr>
<td>Reduced Emissions</td>
<td>5.9</td>
<td>19</td>
<td>17.8</td>
</tr>
<tr>
<td>Reduced Highway Maintenance</td>
<td>32.6</td>
<td>33.8</td>
<td>33.9</td>
</tr>
<tr>
<td>Congestion Relief Benefits</td>
<td>152.7</td>
<td>608.5</td>
<td>1,035.1</td>
</tr>
<tr>
<td>Freight Shipping Cost Savings</td>
<td>69.2</td>
<td>69.2</td>
<td>69.2</td>
</tr>
<tr>
<td>TOTAL BENEFITS</td>
<td>309.8</td>
<td>1,002.2</td>
<td>1,477.8</td>
</tr>
<tr>
<td>PV of Total Benefits</td>
<td>121.2</td>
<td>362.1</td>
<td>534.1</td>
</tr>
</tbody>
</table>

### Costs

<table>
<thead>
<tr>
<th>Costs</th>
<th>Realignment</th>
<th>Enhanced Service</th>
<th>Commuter Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Costs</td>
<td>47.5</td>
<td>80</td>
<td>275</td>
</tr>
<tr>
<td>Annual O&amp;M Cost Change</td>
<td>0</td>
<td>4.9</td>
<td>22</td>
</tr>
<tr>
<td>TOTAL COSTS (Cumulative)</td>
<td>47.5</td>
<td>203.4</td>
<td>824.2</td>
</tr>
<tr>
<td>PV of Costs</td>
<td>44.4</td>
<td>117.6</td>
<td>431</td>
</tr>
<tr>
<td><strong>Net Present Value (NPV)</strong></td>
<td><strong>76.8</strong></td>
<td><strong>244.4</strong></td>
<td><strong>103.1</strong></td>
</tr>
<tr>
<td><strong>Benefit-Cost Ratio (BCR)</strong></td>
<td><strong>2.7</strong></td>
<td><strong>3.1</strong></td>
<td><strong>1.2</strong></td>
</tr>
</tbody>
</table>

Discounted million of dollars at 7% discount rate
For Southern Rapid Rail Transit Commission, a Benefit Cost Analysis of an Intercity Passenger Rail from Baton Rouge to New Orleans (80 miles)

Benefits included:

1. Congestion Management Benefits:
   - Value of Time Savings resulting from reductions in the value of travel time;
   - VOC Savings;
   - Unreliability costs; and
   - Emissions due to the increased efficiency of the passenger rail service. The change in value of travel time includes not only the change in travel time but also the costs associated with comfort and the quality of the time spent in the commute.

2. Operating Cost Reduction Benefits: these are the savings resulting from reductions in the cost of operating existing services (the current commuting option is the LA Swift bus service)

3. Station Area Development Benefits: 8.5% premium is applied to ¼ mile area 4% is applied to the ½ mile corridor. Also, a portion of the development premium is assumed to be capitalized travel benefits and already accounted for in the analysis of user benefits
### Baton Rouge to New Orleans Passenger Rail Results

#### Station Area Economic Development Value Increases:

<table>
<thead>
<tr>
<th>Station Area Planning (Millions of US$) Discounted</th>
<th>1/4 mile</th>
<th>1/2 Mile Donut</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residential</td>
<td>Commercial</td>
<td>Residential</td>
</tr>
<tr>
<td>2008 Total Value</td>
<td>$86.3</td>
<td>$280.2</td>
<td>$245.8</td>
</tr>
<tr>
<td>2040 Forecasted Value</td>
<td>$145.1</td>
<td>$767.9</td>
<td>$359.7</td>
</tr>
<tr>
<td>Total Forecasted Development</td>
<td>$58.8</td>
<td>$487.7</td>
<td>$114.0</td>
</tr>
<tr>
<td>Total Incremental Value Increase</td>
<td>$9.5</td>
<td>$45.4</td>
<td>$10.1</td>
</tr>
<tr>
<td>Total Attributable Incremental Value Increase</td>
<td>$4.7</td>
<td>$22.7</td>
<td>$5.1</td>
</tr>
</tbody>
</table>

- **Benefit Cost Ratio:** 1.40
- **Internal Rate of Return:** 4%

### Pie Chart:

- **VOC:** $121.9M, 20%
- **Emissions:** $13.8M, 2%
- **Time & Reliability:** $476.1M, 78%
Concluding Remarks

• Commuter Rail as other investment should be assessed based on their incremental economic value.

• Economic assessment should account for both market and non-market benefits.

• From the literature review, it is clear that gross property value increases due to rail access can often exceed costs.

• Commuter Rail investments tend to provide a better sustainable option that promotes mobility and accessibility.
References
References

• The Economic Impact of the Proposed New-Haven-Hartford-Springfield Commuter Rail Line, Paul Foster, December 2006
• Effects of Light and Commuter Rail Transit on Land Prices Experiences in San Diego, Robert Cervero and Michael Duncan, June 2002
• Impact of Commuter Rail in Greater Boston, Eric Beaton, September 2006
References (cont’d)

• The Effect of Rail Transit on Property Values: A Summary of Studies, Parsons Brinckerhoff, 2001.
• Life-Cycle Environmental Inventory of Passenger Transportation in the United States, Mikhail Chester, Institute of Transportation Studies UC Berkeley, 2008.
• Rail Transit in America Comprehensive Evaluation of Benefits: VTPI, August 2010.
• Transit value added effects in Santa Clara County CA, Robert Cervero and Michael Duncan, TRB Journal, 2007.
EXAMPLE Study Outcomes
Economic Development Benefits, $Millions

Risk analysis produces a range of possible outcomes with associated likelihoods
Residential Properties (cont’d)

- Differences between residential premiums findings are due to:
  - Ridership differences (MBTA Fitchburg Line has lowest ridership of all these studied)
  - Frequency of service (PATCO is more frequent and has a higher premium than SEPTA)
  - Later, Armstrong (1994) showed a decrease in price for single family homes near Boston’s Fitchburg commuter rail line that was also a freight train line that creates noise pollution

- A range of 3.8% - 20%, with 10% intermediate premium on median housing values within a 1, 3 and 5 mile corridor is used the 2007 Economic Impact study for Kenosha-Racine-Milwaukee (KRM) Commuter Rail.

- At least half of a 6% premium that is usually applied to commuter rail is considered for housing units near the new stations for a February 2005 Economic Benefits Report on Amtrak’s extension of the Downeaster line.
Commuter Rail Congestion Management Benefits
Congestion Management Benefits

Base Cost – Auto ($/trip)
- Time
- Out of pocket cost
- Emissions
- Accident

Alt Cost – Auto ($/trip)
- Time
- Out of pocket cost
- Emissions
- Accident

Savings -Auto ($/trip)
- Time
- Out of pocket cost
- Emissions
- Accident

Remaining Auto trips

Total Benefits for Remaining Auto
- Time
- Out of pocket cost
- Emissions
- Accident
Congestion Management
Benefits: Travel Time Savings

Baseline Travel Time (Hour per mile)
- Average Travel Time Saving (hours/mile)
  - Total Travel Time Saving by Vehicle Class (Veh-hour)
    - Total Travel Time Saving ($)

Alternate Travel Time (Hour per mile)
- Alternate Traffic Volume (Veh-mile)
  - Value of Time by Vehicle Class ($/hour)
Congestion Management
Benefits: VOC Savings

Consumption Tables
- Fuel
- Oil
- Tires
- Maintenance & Repair
- Depreciation

Roadway Geometry
Baseline Average Vehicle Speed (mph)

Net Change in VMT due to Mode Shift

Change in Consumption

Cost of Maintenance and Repair ($)

Vehicle Operating Cost Savings ($)

Fuel
Oil
Tires
Depreciation

Consumption per VMT

Baseline
Average
Vehicle Speed
(mph)

Change in Consumption

Vehicle Operating Cost Savings ($)

Baseline
Average
Vehicle Speed
(mph)
Congestion Management
Benefits: Emission Cost Savings

Emission Rate Tables*
- VOC
- CO
- NOX
- PM
- CO2

*Based on EPA’s MOBILE 6 methodology

Alternative
- Network VMT in the No-Build

Alternative
- Network VHT in the No-Build

Alternative
- Average Network Speed in the No-Build

Alternative
- Emission Rates per VMT in the No-Build

Alternative
- Network VMT in the No-Build

Alternative
- Aggregate Emission Volumes (units) In the No-Build

Change in Emissions Costs ($)

Economic Cost of VOC ($/ton)
Congestion Management
Benefits: Accident Cost Savings

- Average Passenger Rail Trip Length (miles)
- 1 / Cars occupancy (cars / person)
- Rail Passenger Demand (persons)

Reduction in Car Miles Traveled (car miles)

New train miles added (train miles)

- Average Cost of Crash ($/car mile)
- Number of train crashes (million train miles)
- Train accident cost per train mile (not available)

Cost of car accidents ($)

Cost of train accidents ($)

Net benefits from reduced accident costs ($)
Proposed Stakeholder Workshop

Attendance Needs
- Project Sponsors
- Local Developers
- Community Leaders
- OASIS Representation

8-12 knowledgeable stakeholders who understand local conditions

½ Day review project section by section

Workshop Evaluation Category
- Current Market Strength
- Expected Improvement in Accessibility
- Residential Desirability
- Commercial Desirability
- Supportive Zoning
- Available Land for Development or Redevelopment
- Major Attractions
- Public Sector Investment / Support
- Private Sector Investment / Support