Fast Trains & Economic Development: Prospects for California

Robert Cervero
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Churchill College, University of Cambridge
HSR in California (8th largest economy in the world)

Connect the state’s 2 mega-regions – Los Angeles & San Francisco Bay Area (380 miles apart) – and spur growth in the Central Valley, to relieve urbanization pressures on the coast.

**Economic Stimulus:** California is the largest beneficiary of national aid, receiving a federal economic stimulus package of **$3.89 billion**.

**State Support:** The passage of Proposition 1A in 2008 authorized **$9.95 billion** in the state’s general obligation bonds.

**Jobs:** The California HSR Authority projects the HSR project will create **600,000** construction-related jobs and **450,000** permanent new jobs over the next 25 years (CAHSRA, 2010).
Economic Stimulus?

U.S. High-Speed Intercity Passenger Rail Program

California HSR
US$3.89 billion +

Northeast Corridor
US$1.64 billion +

Chicago Hub
US$1.38 billion +

Federal Investments, 2009 - 2011
US$10.1 billion

Source: U.S. DOT, 2012
Why HSR in California?

- **Curbs Congestion**
  - LAX to SFO is the Busiest Short-Haul Market in US
  - 1 in 6 Flights out of LA Heads to Bay Area
  - Six of Top 30 Congested Urban Areas in US Located in California

- **Population Growth Estimated to Reach 50 Million by 2030**

- **Air Quality/Sustainability**
  - Meets Goals of AB 32/SB 375

- **Alternatives are Costly**
  - 2-3 Times More Expensive?
Projections for California

- By 2030, the system will reduce VMT by 14.8 billion
- By 2040, the system will reduce VMT by 49.6 billion

Daily Number of Flights Diverted

- By 2030, CA will see a daily reduction of 93 to 171 flights
- By 2040, CA will see a daily reduction of 97 to 180 flights

Statewide Air Quality Improvement (by 2030)

- At least 225 tons of volatile organic compounds reduced (VOCs)
- At least 1,000 tons of particulate matter reduced (PM 2.5 and PM 10)
- More than 12,000 tons of ozone precursors reduced (VOCs, CO, NOx)

DAILY AVERAGE POLLUTION

The World Health Organization (WHO) guidelines consider anything over 10 micrograms per cubic meter of PM2.5 to be hazardous to health.

10 WORST CHINESE CITIES

<table>
<thead>
<tr>
<th>City</th>
<th>PM2.5 (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xingtai</td>
<td>155.2</td>
</tr>
<tr>
<td>Shijiazhuang</td>
<td>148.5</td>
</tr>
<tr>
<td>Baoding</td>
<td>127.9</td>
</tr>
<tr>
<td>Handan</td>
<td>127.8</td>
</tr>
<tr>
<td>Hengshui</td>
<td>120.6</td>
</tr>
<tr>
<td>Tangshan</td>
<td>114.2</td>
</tr>
<tr>
<td>Jinan</td>
<td>114.0</td>
</tr>
<tr>
<td>Langfang</td>
<td>113.8</td>
</tr>
<tr>
<td>Xi’an</td>
<td>104.2</td>
</tr>
<tr>
<td>Zhengzhou</td>
<td>102.4</td>
</tr>
</tbody>
</table>

10 WORST U.S. CITIES

<table>
<thead>
<tr>
<th>City</th>
<th>PM2.5 (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakersfield, Calif.</td>
<td>18.2</td>
</tr>
<tr>
<td>Merced, Calif.</td>
<td>18.2</td>
</tr>
<tr>
<td>Fresno, Calif.</td>
<td>17.0</td>
</tr>
<tr>
<td>Hanford, Calif.</td>
<td>16.2</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>16.2</td>
</tr>
<tr>
<td>Modesto, Calif.</td>
<td>15.3</td>
</tr>
<tr>
<td>Visalia, Calif.</td>
<td>15.2</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>15.0</td>
</tr>
<tr>
<td>El Centro, Calif.</td>
<td>14.0</td>
</tr>
<tr>
<td>Cincinnati</td>
<td>13.8</td>
</tr>
<tr>
<td>Washington</td>
<td>10.6</td>
</tr>
</tbody>
</table>

### Long-run Average Costs: San Francisco – Los Angeles, CA

(US$/passenger km traveled)

<table>
<thead>
<tr>
<th>Cost category</th>
<th>Air system</th>
<th>High-speed rail</th>
<th>Highways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure: capital and operating</td>
<td>$0.0182</td>
<td>$0.129</td>
<td>$0.012</td>
</tr>
<tr>
<td>Carrier: capital cost (trains, planes)</td>
<td>$0.0606</td>
<td>$0.016</td>
<td>$0.000</td>
</tr>
<tr>
<td>Carrier: operating cost</td>
<td>$0.0340</td>
<td>$0.050</td>
<td>$0.000</td>
</tr>
<tr>
<td>User: capital &amp; operating</td>
<td>$0.0000</td>
<td>$0.000</td>
<td>$0.086</td>
</tr>
<tr>
<td>User: time</td>
<td>$0.0114</td>
<td>$0.044</td>
<td>$0.100</td>
</tr>
<tr>
<td>User: congestion</td>
<td>$0.0017</td>
<td>$0.000</td>
<td>$0.0046</td>
</tr>
<tr>
<td>External: accidents</td>
<td>$0.0004</td>
<td>$0.000</td>
<td>$0.0200</td>
</tr>
<tr>
<td>External: noise</td>
<td>$0.0043</td>
<td>$0.002</td>
<td>$0.0045</td>
</tr>
<tr>
<td>External: pollution</td>
<td>$0.0009</td>
<td>$0.000</td>
<td>$0.0031</td>
</tr>
<tr>
<td>Total</td>
<td>$0.131</td>
<td>$0.241</td>
<td>$0.230</td>
</tr>
</tbody>
</table>

California HSR would require **a public subsidy of US $590 million per year** to be competitive with air transportation.

Source: Levinson et al., 1997
A STATEWIDE RAIL MODERNIZATION PLAN

Connecting California

- Central Valley “Backbone” of High-Speed Rail
- Caltrain Electrification & early Investments in the Peninsula Corridor
- Regional Enhancements in Southern California
- Statewide Connectivity Projects & Investments

INCREMENTALISM: 2015 to 2029 & Beyond

2029: 520 miles of HSR; 200+ mph; $68 billion (YOE)
NORTHERN CALIFORNIA INVESTMENTS

Connectivity & Bookend Projects

- **BART**: $145 Million, Millbrae Station Track Improvements and New Bart Cars
- **SF Muni**: $61 Million, Light Rail Extension
- **Caltrans/Amtrak Capitol Corridor**: $63 Million, Track Improvements to Increase Service
- **Caltrans/Amtrak San Joaquin**: $41 Million, Construction of New Track to Increase Service
- **Altamont Commuter Express (ACE)**: $11 Million, Stockton Passenger Track Extension
- **Sacramento RT**: $30 Million, Intermodal Facility Improvements
Partnerships for progress

$13 billion leveraged for HSR and improvements to existing rail systems and bookends
AMERICA’S FIRST HIGH-SPEED RAIL

- Initial Operation Section: 300 Miles – $31 billion
- Central Valley to San Fernando Valley
- Operational by 2022?

Why start in Central Valley?
Serve as the “Backbone” system that knits together California’s urban hubs
Fastest Growing Region in the State
Revitalize Central Valley Downtowns
Creates Jobs in a Region with High Unemployment

Best, Most Cost-Efficient Location for Testing

A source of sprawl? – expand laborshed & reservoir of affordable housing...occurred in Tokyo
“I would like to be part of the group that gets America to think big again.”

Future Funding Options:
- Private Financing/Investors
- Federal Grants/Loans
- CA Cap & Trade Revenue
- TOD Revenues
- Concessions

World Bank (2014 report):

Capital Cost per km:
- California HSR = $56 million
- China HSR = $17-21 million
- European HSR = $25–39 million
Hyperloop: SF-LA in 40 minutes at 600 mph, for $16 billion?

Elon Musk: “a cross between a Concorde, a railgun and an air hockey table”
Agglomeration benefits reflect the **higher productivity** associated with increased **proximity & access to external resources** made available by higher-density rail-served development. The benefits are **capitalized into land values**, bid up for competitive locations (TCRP Report 36, 1998).
Higher employment and population growth rates, particularly in knowledge-based & information exchange industries; strongest job growth in Primary Cities (Tokyo & Osaka), particularly at terminal stations or within 1 hr (Sands, 1993; Cervero & Bernick, 1996).

Weakened economic roles of intermediate cities between Tokyo and Osaka; little greenfield development (Cervero & Bernick, 1996; Takagi, 2005).
Intercity: Travel Advantage

e.g., Japanese Shinkansen (from Tokyo)

552.6 km
2 hrs 25 mins (to Osaka)
89%

894.2 km
3 hrs 48 mins (to Hiroshima)
38%

1,174.9 km
4 hrs 50 mins (to Fukuoka)
16%

versus

11%

62%

84%

Source: Central Japan Railway Company, 2012
Impacts on Smaller, Intermediate Cities?

New HSR projects in the U.S. are likely to confer accessibility & agglomeration benefits predominantly to major cities at the expense of smaller and intermediate cities. e.g., Stockton, Modesto, Merced, Fresno & Bakersfield in California Odawara, Shizuoka, Hamamatsu, Gifu-Hashima & Maibara in Japan

Stockton Station, CA  
Gifu-Hashima Station, JAPAN
Other Intermediate Cities

In Japan, the **spatial redistribution of economic activities** between major and small intermediate cities are **strongly associated with** the Tokaido Shinkansen Line’s **intercity service patterns**.

### Changes in Intercity Service Patterns, 1987-2006

<table>
<thead>
<tr>
<th>Year (in April)</th>
<th># of Trains per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>87'</td>
<td>144</td>
</tr>
<tr>
<td>88'</td>
<td>146</td>
</tr>
<tr>
<td>89'</td>
<td>158</td>
</tr>
<tr>
<td>90'</td>
<td>170</td>
</tr>
<tr>
<td>91'</td>
<td>182</td>
</tr>
<tr>
<td>92'</td>
<td>188</td>
</tr>
<tr>
<td>93'</td>
<td>34</td>
</tr>
<tr>
<td>94'</td>
<td>34</td>
</tr>
<tr>
<td>95'</td>
<td>34</td>
</tr>
<tr>
<td>96'</td>
<td>34</td>
</tr>
<tr>
<td>97'</td>
<td>34</td>
</tr>
<tr>
<td>98'</td>
<td>45</td>
</tr>
<tr>
<td>99'</td>
<td>51</td>
</tr>
<tr>
<td>00'</td>
<td>51</td>
</tr>
<tr>
<td>01'</td>
<td>53</td>
</tr>
<tr>
<td>02'</td>
<td>75</td>
</tr>
<tr>
<td>03'</td>
<td>75</td>
</tr>
<tr>
<td>04'</td>
<td>137</td>
</tr>
<tr>
<td>05'</td>
<td>149</td>
</tr>
<tr>
<td>06'</td>
<td>156</td>
</tr>
</tbody>
</table>

6 stations only: 11 stations

All stations
Guided Decentralization: TOD as a *Necklace of Pearls* in the spine of the state

Northern California Mega-Region?

Need for Extra-territorial/Sub-state Planning
Fresno: Current densities in the study area
(1 square mile around the HSR station)

- Residential north of downtown: 6.5 units per acre
- Maubridge Apartments (if converted back to residential use): 55 units per acre
- H Street lofts: 25 units per acre
- Residential south of downtown: 5 units per acre

Legend:
- Red: downtown retail
- Purple: public buildings
- Light purple: warehouses / retail
- Gray: residential
- Blue: Central Business District

HSR station location

5, 10, 15 minute walk from station

Fulton Mall (historic core of downtown)

H Street lofts image courtesy of City of Fresno Planning and Development Department.
Visual impact of a 60’ structure in an urban context.
Scale comparison between the proposed elevated structure (left) and one of the highest buildings in downtown Fresno, San Joaquin Light and Power Corporation Building (right)
Integrating an Elevated HSR into the Urban Fabric / Minimizing Visual Impacts

- mixed-use office buildings along the HSR corridor, acting as a visual and sound buffer
- Use the space under the structure as parking for nearby buildings
- Create a pedestrian-oriented street design
Japanese Experiences: 45+ Years of Evidence

17 Shinkansen Stations in Japan
Units of Analysis (Station Catchment Areas):

In **5 km** of the 26 California HSR & 17 Tokaido Shinkansen Stations

1. The HSR project must economically encompass a larger radius around the proposed stations than the 500 meter radius (e.g., 1-3 miles; Catz and Christian, 2010).

2. The exact locations of many of the 26 HSR stations are still unknown, so the station catchment areas are likely to shift more than 500 meters.
# Job Market Typology

## 8 Types on the Tokaido Shinkansen, 2006 (attributes within 5km of station)

<table>
<thead>
<tr>
<th>Type</th>
<th>Global Business Center</th>
<th>Waterfront Information Center</th>
<th>Regional Business Center</th>
<th>Large Leisure City</th>
<th>Large Business City</th>
<th>Medium Intermediate City</th>
<th>Small Manufacturing City</th>
<th>Small Leisure City</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Jobs, 2006</td>
<td>3,121,398</td>
<td>1,710,524</td>
<td>892,298</td>
<td>476,752</td>
<td>438,888</td>
<td>158,086</td>
<td>59,848</td>
<td>23,794</td>
</tr>
<tr>
<td>Change in # of Jobs, 2001-06</td>
<td>+40.879</td>
<td>+139.542</td>
<td>+172.152</td>
<td>+121.561</td>
<td>-20.787</td>
<td>-6.910</td>
<td>+6.285</td>
<td>+2.650</td>
</tr>
<tr>
<td>Job-Pop. Gap Index [1--1], 2006/05</td>
<td>+0.497</td>
<td>+0.334</td>
<td>+0.078</td>
<td>-0.140</td>
<td>-0.234</td>
<td>-0.214</td>
<td>-0.299</td>
<td>-0.216</td>
</tr>
<tr>
<td>Job LQs [Code], 2006</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Diagram" /></td>
<td><img src="image7.png" alt="Diagram" /></td>
<td><img src="image8.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- Heavy Industry [20]
- Manufacturing [30]
- Logistics [40]
- Knowledge Business [50]
- Social Service [60]
- Leisure Service [70]
- Other Service [80]
Rail Urban Regeneration: Joint Developments in Japan

Development Tools

- Air-Rights Leasing above depots
- Land consolidation/ readjustment
- Density bonuses
- Expedited project reviews
- Property tax exemption
- Local infrastructure provision
- Public space requirement
Tokyo Station City: Large-Scale, Mixed-Use JR East’s Joint Development Project

Retain historical railway station

Class-A office towers, retail centers & high-end hotels

Tokyo Station City
HSR Joint Developments in Japan

Commercial Land Values on the Tokaido Shinkansen, 2000 & 2010
Non-primary-city growth occurred mostly where substantial investment in secondary distribution systems – LRT, BRT (e.g., Shin-Yokohama)
Growth along Rail Connector to Shin-Yokohama Station
Industrial Typologies: California

Job Markets

2002

8 Types

Legend

Job Market Typology, 2002

- Knowledge-based Business (KB)
- Public & Finance (PF)
- Transportation (TP)
- Public Service (PS)
- Information + Entertainment (IE)
- Leisure Service (LS)
- Agriculture (AG)
- Energy (EG)
Industrial Typologies: California

Job Markets

2002

2008

8 Types

Legend

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- Energy (EG)

Legend

Job Market Typology, 2008
- Finance + Business Service (FB)
- Industrial + Business Service (IB)
- Public Service (PS)
- Agriculture (AG)
- Energy (EG)
- Information + Entertainment (IE)
- Leisure Service (LS)
- Education + Business Service (EB)
Industrial Typologies: California

Job Markets

2002

2008

FB: Finance + Business Service

San Francisco

Los Angeles

Legend

Job Market Typology, 2002
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Legend

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- Leisure Service (LS)
- Education + Business Service (EB)
Global Economic Hubs

HSR can be expected to strengthen the knowledge- and service-based business agglomerations that have formed in central LA and San Francisco – network of large, globally connected cities.

San Francisco & Los Angeles
Last-Mile Costs: San Francisco

Transbay Transit Center

- The new Transbay Transit Center will centralize the region’s transportation network by accommodating nine transportation systems under one roof, including AC Transit, Caltrain, Muni, Golden Gate Transit, SamTrans, Greyhound, BART, WestCAT and California HSR.

- The area surrounding the Center will be redeveloped to include housing, retail and an adjacent tower poised to redefine the city’s skyline.

US$4.18 billion (est.)

Source: Metropolitan Transportation Commission, 2008
Industrial Typologies: California

Job Markets

2002

2008

IB Industrial + Business Service

SFO Airport

City of Industry

Norwalk

Irvine

Ontario Airport

Legend

Job Market Typology, 2002

- Knowledge-based Business (KB)
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- Public Service (PS)
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Legend

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- Energy (EG)
- Information + Entertainment (IE)
- Leisure Service (LS)
- Education + Business Service (EB)
Aerotropolises

The HSR investments: a possible link to time-sensitive manufacturing and business activities near international airports

e.g., SFO Airport, Ontario Airport & Irvine

Orange County, John Wayne Airport  
Ontario Airport, CA
Global Supply Chain - Apple iPhone5
Zhengzhou, China Assembly Complex

Cities Grow out to Airports as Air Transport Exerts Pull
Prospective HSR Hubs:

Might strengthen economic role of HSR-served “edge cities”, especially when linked to major airports (Hall, 2009).

HSR could extend the spatial reach of emerging “aerotropolises” – aviation-linked businesses (Kasarda, 2010; 2014).
Industrial Typologies: California

Job Markets

2002

IE: Information + Entertainment
L: Leisure Service
EB: Education + Business Service
Leisure Destination: Kyoto

Pedestrian Flow

Design, Proximity, & Historic Preservation matter
CA’s potential HSR Leisure Destinations

The HSR projects might be able to promote regional tourism and local leisure services in relatively large cities, aided by high-quality urban designs and an emphasis on livability.

Anaheim Station Site, CA  San Diego, CA
Productivity Change: London

Urban Densification Programmes around the HSR Terminuses


38.0% higher productivity than the UK average in 2001

Sources: GMJ CityModel, 2010; GLA Economics, 2008
US City-Regions’ Productivity

\[ \ln MP_{i,t+l} = \gamma + \sum \alpha \cdot BA_{i,t} + \sum \beta \cdot RN_{i,t} + \nu_i + \epsilon_{i,t} \]

MP: Gross Metropolitan Product (GMP) per Worker  
BA: Business Agglomeration Indicators (knowledge-based)  
RN: Rail Network Indicators  
\( \alpha, \beta \): Parameters  
\( \gamma \): Constant  
\( \nu \): Time-constant error  
\( \epsilon \): Random error  
\( i \): U.S. metropolitan area (1~27)  
\( t \): Year (1998~2009)  
\( l \): Time lag (0~5 years)
Network Changes

Example: *Portland Rail Investment 1998*

1998

**Indicators**

- Length = 54.3 km
- # of Links = 55
- # of Stations = 52
- # of Circuits = 4
- Alpha = 0.040
- Beta = 1.058
- Gamma = 0.367
- Eta = 0.986 km
- Diameter = 45.3 km
- CA = 0.340 %
- Pi = 1.199
- Airport Connect = 0
Network Changes

Example: *Portland*
Rail Investment 1998-2001

**2001**

**Indicators**

- Length = 71.1 km
- # of Links = 93
- # of Stations = 88
- # of Circuits = 6
- Alpha = 0.035
- Beta = 1.057
- Gamma = 0.360
- Eta = 0.764 km
- Diameter = 45.3 km
- CA = 0.405 %
- Pi = 1.570
- Airport Connect = 1
Network Changes

Example: *Portland*
Rail Investment 1998-2001-2004

2004

Indicators

- Length = 80.8 km
- # of Links = 105
- # of Stations = 98
- # of Circuits = 8
- Alpha = 0.042
- Beta = 1.071
- Gamma = 0.365
- Eta = 0.769 km
- Diameter = 45.3 km
- CA = 0.476 %
- Pi = 1.785
- Airport Connect = 1
Network Changes

Example: *Portland*


**2007**

**Indicators**

- Length = 83.9 km
- # of Links = 114
- # of Stations = 107
- # of Circuits = 8
- Alpha = 0.038
- Beta = 1.065
- Gamma = 0.362
- Eta = 0.736 km
- Diameter = 45.3 km
- CA = 0.495 %
- Pi = 1.853
- Airport Connect = 1
Network Changes

Example: *Portland*

### 2009 Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length = 123.0 km</td>
<td>+78.7 km</td>
</tr>
<tr>
<td># of Links = 140</td>
<td>+85</td>
</tr>
<tr>
<td># of Stations = 131</td>
<td>+79</td>
</tr>
<tr>
<td># of Circuits = 10</td>
<td>+6</td>
</tr>
<tr>
<td>Alpha = 0.039</td>
<td>-0.001</td>
</tr>
<tr>
<td>Beta = 1.069</td>
<td>+0.011</td>
</tr>
<tr>
<td>Gamma = 0.362</td>
<td>-0.005</td>
</tr>
<tr>
<td>Eta = 0.879 km</td>
<td>-0.107 km</td>
</tr>
<tr>
<td>Diameter = 45.3 km</td>
<td>+/-0.0 km</td>
</tr>
<tr>
<td>CA = 1.026 %</td>
<td>+0.686</td>
</tr>
<tr>
<td>Pi = 2.718</td>
<td>+1.519</td>
</tr>
<tr>
<td>Airport Connect = 1</td>
<td>+1</td>
</tr>
</tbody>
</table>

From a “Simple Corridor” to a “Expanded Network” & Vastly Improved Transit Access
Agglomeration Changes

Example: *Portland*
Rail Investment 1998

1998 Location Quotients of Knowledge Businesses

**Indicators**
- Emp. D = 55.62 sq. km
- Pop. D = 106.21 sq. km
- LQ 50 = 1.048
- CBD ED All = 354.20
- CBD ED 50 = 180.03
- CBD ED 30 = 19.33
- MI All = 0.1011
- MI 50 = 0.0816
- GC All = 0.449
- GC 50 = 0.430
- GI 50 = 1.482
- H 50 = 0.00857
- EG 50 = -0.01183
- MS 50 = -0.01268

NAICS 50 = Knowledge Business; 30 = Manufacturing
Agglomeration Changes


2001

Location Quotients of Knowledge Businesses

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emp. D</td>
<td>57.48 sq. km</td>
</tr>
<tr>
<td>Pop. D</td>
<td>111.88 sq. km</td>
</tr>
<tr>
<td>LQ 50</td>
<td>1.037</td>
</tr>
<tr>
<td>CBD ED All</td>
<td>368.46</td>
</tr>
<tr>
<td>CBD ED 50</td>
<td>192.83</td>
</tr>
<tr>
<td>CBD ED 30</td>
<td>15.69</td>
</tr>
<tr>
<td>MI All</td>
<td>0.1093</td>
</tr>
<tr>
<td>MI 50</td>
<td>0.0887</td>
</tr>
<tr>
<td>GC All</td>
<td>0.446</td>
</tr>
<tr>
<td>GC 50</td>
<td>0.435</td>
</tr>
<tr>
<td>GI 50</td>
<td>1.463</td>
</tr>
<tr>
<td>H 50</td>
<td>0.00776</td>
</tr>
<tr>
<td>EG 50</td>
<td>-0.01151</td>
</tr>
<tr>
<td>MS 50</td>
<td>-0.01226</td>
</tr>
</tbody>
</table>

NAICS 50 = Knowledge Business; 30 = Manufacturing
Example: *Portland*
Rail Investment 1998-2001-2004

**Location Quotients of Knowledge Businesses**

**Indicators**
- Emp. D = 57.42 sq. km
- Pop. D = 116.25 sq. km
- LQ 50 = 1.050
- CBD ED All = 332.16
- CBD ED 50 = 171.75
- CBD ED 30 = 12.83
- MI All = 0.1152
- MI 50 = 0.1042
- GC All = 0.452
- GC 50 = 0.437
- GI 50 = 1.425
- H 50 = 0.00582
- EG 50 = -0.01211
- MS 50 = -0.01275

*NAICS 50 = Knowledge Business; 30 = Manufacturing*
Agglomeration Changes

Example: *Portland*

2007

Location Quotients of Knowledge Businesses

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emp. D = 61.99 sq. km</td>
<td></td>
</tr>
<tr>
<td>Pop. D = 122.53 sq. km</td>
<td></td>
</tr>
<tr>
<td>LQ 50 = 1.045</td>
<td></td>
</tr>
<tr>
<td>CBD ED All = 336.27</td>
<td></td>
</tr>
<tr>
<td>CBD ED 50 = 170.13</td>
<td></td>
</tr>
<tr>
<td>CBD ED 30 = 13.72</td>
<td></td>
</tr>
<tr>
<td>MI All = 0.1162</td>
<td></td>
</tr>
<tr>
<td>MI 50 = 0.1095</td>
<td></td>
</tr>
<tr>
<td>GC All = 0.456</td>
<td></td>
</tr>
<tr>
<td>GC 50 = 0.443</td>
<td></td>
</tr>
<tr>
<td>GI 50 = 1.397</td>
<td></td>
</tr>
<tr>
<td>H 50 = 0.00493</td>
<td></td>
</tr>
<tr>
<td>EG 50 = -0.01205</td>
<td></td>
</tr>
<tr>
<td>MS 50 = -0.01262</td>
<td></td>
</tr>
</tbody>
</table>

NAICS 50 = Knowledge Business; 30 = Manufacturing
Agglomeration Changes

Example: *Portland*

### 2009 Location Quotients of Knowledge Businesses

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emp. D = 58.51 sq. km</td>
<td>+2.89 sq. km</td>
</tr>
<tr>
<td>Pop. D = 126.96 sq. km</td>
<td>+20.75 sq. km</td>
</tr>
<tr>
<td>LQ 50 = 1.033</td>
<td>-0.015</td>
</tr>
<tr>
<td>CBD ED All = 323.95</td>
<td>-30.25</td>
</tr>
<tr>
<td>CBD ED 50 = 161.71</td>
<td>-18.32</td>
</tr>
<tr>
<td>CBD ED 30 = 11.43</td>
<td>-7.90</td>
</tr>
<tr>
<td>MI All = 0.1182</td>
<td>+0.0171</td>
</tr>
<tr>
<td>MI 50 = 0.1027</td>
<td>+0.0211</td>
</tr>
<tr>
<td>GC All = 0.457</td>
<td>+0.008</td>
</tr>
<tr>
<td>GC 50 = 0.441</td>
<td>+0.011</td>
</tr>
<tr>
<td>GI 50 = 1.384</td>
<td>-0.098</td>
</tr>
<tr>
<td>H 50 = 0.00540</td>
<td>-0.0317</td>
</tr>
<tr>
<td>EG 50 = -0.01155</td>
<td>+0.00033</td>
</tr>
<tr>
<td>MS 50 = -0.01212</td>
<td>+0.00056</td>
</tr>
</tbody>
</table>

*From monocentric to polycentric clustering*
**Labor Productivity Impacts**

### Predictors of GMP per Worker 2001-2009 (Semi-Log, Fixed-Effects)

<table>
<thead>
<tr>
<th>Business Agglomeration:</th>
<th>3 Year Time Lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Density (per sq. km)</td>
<td>.00197*** (5.22)</td>
</tr>
<tr>
<td>CBD's Effective Density - NAICS 50</td>
<td>.00051*** (2.84)</td>
</tr>
<tr>
<td>CBD's Effective Density - NAICS 30</td>
<td>-.00560*** (-6.64)</td>
</tr>
<tr>
<td>Moran's I - NAICS 50</td>
<td>2.68579*** (5.60)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rail Network:</th>
<th>3 Year Time Lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport Connection Dummy (1/0)</td>
<td>.05393*** (3.51)</td>
</tr>
<tr>
<td>Gamma Index</td>
<td></td>
</tr>
<tr>
<td>LinkDensity (km per sq. km)</td>
<td></td>
</tr>
<tr>
<td>Delta Index</td>
<td></td>
</tr>
<tr>
<td>Area Coverage (%)</td>
<td></td>
</tr>
<tr>
<td>Eta Index</td>
<td></td>
</tr>
<tr>
<td>Pi Index</td>
<td>.07998*** (3.95)</td>
</tr>
<tr>
<td>Constant</td>
<td>10.51366*** (84.53)</td>
</tr>
</tbody>
</table>

**GMP per Worker rose with:**

- Population Densities (t-3)
- CBD Densities in Knowledge Industries (t-3)
- Spatial Clustering in Knowledge Industries (Moran’s I) (t-3)
- Airport Connection (t-3)
- Rail Network Connectivity (t-3)

*Observations = 203, Groups = 24, R-squares within = .6785*

*p<0.10, ** p<0.05, *** p<0.01*
Scenario Test 1

“Urban Regeneration in Downtown Los Angeles”
- Bunker Hill Redevelopment Projects -

CBD Effective Density (Knowledge) 1998-2006

+23.7

GMP per Worker

+1.21 %
2001-2009
“Airport Access Development in San Francisco Bay Area”
- BART-SFO Extension Project -
Global Competitiveness

Source: The Transport Politic, 2012

Beijing
Wuhan
Guangzhou - Shenzhen
Hong Kong

2,250 km
200~350 km/h
About 10 hours
• HSR unlikely to be financially viable in auto-centric settings like California unless significant wider economic benefits accrue, not just in a redistributive form (e.g., construction job creation) but more importantly generatively (e.g., agglomeration and accessibility benefits)

• In robust, growing economies like California, fast inter-city trains can yield wider economic benefits, though only when supported by ‘leveraging’ tools and government pro-activism (notably state-level land-use planning; carbon taxes/cap-and-trade)

• Need more compelling empirical evidence on benefits to de-politicize what otherwise are heavily partisan, politically driven mega-investments