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Short Biographical Statement

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Abstract

High-Speed Rail (HSR) investments in the United States have been justified as an economic stimulus. However, international experiences raise the question of whether the economic benefits conferred by HSR investments are truly generative or largely redistributive. This article examines business agglomerations around 17 Tokaido Shinkansen, 30 Northeast Corridor, and 25 California HSR stations. Cluster analysis formed eight agglomeration types for each of the corridors, reflecting variations in sizes, trends, balances and specializations. Past experiences and patterns revealed by these typologies suggest that HSR is likely to induce greater economic benefits in knowledge-intensive businesses, though they are mostly limited to large, globally connected cities at the expense of small intermediate ones. The redistributive effects of HSR within a region need not be "zero-sum". When leveraged through proactive policies, increased business agglomerations that take form through redistribution can have generative economic qualities, to the benefit of the region at large.

Keywords: high-speed rail, public investment, economic development, business agglomeration, globalization

High-Speed Rail and Economic Development:

Business Agglomerations and Policy Implications

America's deep recession of the past few years has sparked interest in building High-Speed Rail (HSR) systems as an economic stimulus. HSR investments are thought to increase firm productivity, resulting in new businesses and jobs as well as higher wages and income. Subscribing to this view, in 2009 the Obama Administration pledged US$8 billion to 13 HSR projects across 31 states under the American Recovery and Reinvestment Act (ARRA). Nevertheless, the federal HSR stimulus money was subsequently rejected by the newly elected governors of Wisconsin, Ohio and Florida, fearing the proposed HSR projects would be too costly to taxpayers and the project risks outweigh the economic benefits. As a result, federal funds to construct HSR lines have been redirected to key corridors in other states where the economic benefits of intercity railway investments are thought to be high and projects are ready for implementation (Figure 1).

{Figure 1 about here}

In recent years, some researchers have questioned the net downstream benefits of HSR investments (Levinson, 2010; Levinson, Kanafani, & Gillen, 1999; Levinson, Mathieu, Gillen, & Kanafani, 1997; Givoni, 2006). Doubts largely turn on the question of whether gains are truly generative, representing net increases in economic productivity and real increases in income and wealth or are pecuniary and redistributive in nature, simply transferring taxpayer monies and economic activities from one physical location to another. The relocation of businesses, such as from a highway corridor to a HSR station area, need not always be zero-sum outcome. To the degree that rail stations support higher development densities, benefits might accrue from the agglomeration economies of high-skilled, knowledge-based workers being in close physical proximity to each other. Not all businesses, however, benefit from physical clustering and some, like manufacturing plants and distribution centers, likely value low-density development with good highway access far more than proximity to a HSR stop.

The primary and most direct benefits of HSR investments accrue to users, mainly in the form of travel-time savings. To the degree they occur, economic development impacts are mostly second-order and indirect in nature. Examining the potential economic development impacts of HSR is important from a public-policy perspective because the ability of these investments to recover their full lifecycle costs through direct user benefits, especially in automobile-oriented societies like the United States, has been questioned by many. Economic Justification of these multi-billion dollar investments could hinge crucially on their abilities to generate external benefits, such as stimulating new generative economic activities.

Most of our knowledge about the impacts of HSR systems is drawn from two sources: inferences from studies on the impacts of metropolitan rail systems on land use and development activities; and comparative insights gained from experiences with HSR in other countries, notably Japan and France. The transferability of metro-rail experiences to HSR is subject to question. As intra-metropolitan systems, economic impacts of metrorail systems take place within a totally different context. Metrorail investments influence firm locations and economic activities within metropolitan labor-sheds and trade-sheds. Economic activities that might benefit from improved rail access within an urbanized region tend to occur on a regular basis – e.g., daily access to labor and workplaces, regular and routine access to consumer outlets among households in a region, etc. Thus the accessibility benefits conferred by new metrorail systems can be expected to influence the location of firms seeking improved access to labor and customers as well as households seeking better access to workplaces and shops. HSR systems, on the other hand, serve mainly inter-city, inter-regional, and transnational travel markets, albeit on a more sporadic basis. As with air travel, the vast majority of households and workers within a region make long-distance trips on a less-than-routine, irregular basis. Yes, a family might take a HSR train or catch a flight to go to major leisure destinations or visit relatives, however for most the infrequency and irregularity of such travel does not prompt locational or lifestyle adjustments.

With the increased globalization of economic production, some firms and businesses do carry out inter-city, transnational, and international business transactions on a fairly regular basis. These tend to be highly specialized business-service firms with high-skilled, knowledge-based labor whose clients are spread throughout a state, country, or region of the globe. To the degree that HSR enhances physical access of financial analysts, engineering consultants, legal advisors, and other specialists to their spatially dispersed business clients, then areas surrounding HSR stations can be expected to attract new knowledge- and service-based firms and investments drawn by the accessibility advantages. And to the degree that the higher densities supported by HSR stops (vis-à-vis highway corridors) yield agglomeration benefits – in the form of productivity gains, knowledge spillovers, and innovations allowed by increased face-to-face interactions, subcontracting, and external transactions - the demand to be in these choice locations will intensify. With a finite, limited supply of land near HSR stops, rents and property values will rise as companies bid up the price of doing business in these preferred locales. Thus a different economic dynamic is likely be to be unleashed by the opening of an inter-city HSR vis-à-vis an intra-city metrorail station, represented by a different composition of firms and businesses drawn to station locations.

Lessons from abroad perhaps better reflect the accessibility-induced economic shifts that might occur following a HSR investment. However experiences in countries like Japan and France are shaped in part by their unique historical, cultural, and geopolitical contexts. Additionally, some analysts (Giuliano, 1995, 2004; Graham & Marvin, 1996) contend that future railway investments, whether intra- or inter-metropolitan in design, are likely to generate smaller accessibility improvements than in years past which, along with recent telecommunication advances, will mute their economic impacts.

The ability to link economic outcomes to HSR investments is fraught with the same kinds of methodological difficulties that plague all social science research – the absence of randomized trials. Past investigations of HSR investments and ensuing economic activities that have been conducted in other countries have certainly uncovered statistically significant correlations. However as with any post-hoc, cross-sectional study, the inability to isolate out the influences of HSR from everything else that affects job growth and economic productivity over time means one can never demonstrate causality. However the existence of enough positive correlations across independent cross-sectional studies suggests something is going on. The consensus view of past studies is that under supportive conditions HSR can be a contributor to real economic growth but is never sufficient in and of itself (Givoni, 2006; Levinson 2010).

This paper probes the economic development impacts of HSR by focusing on the kinds of companies that have been drawn to HSR stations based on experiences in the country with the longest history of HSR services -- Japan. Using location quotients and other metrics, we study the kinds of firms and businesses that have been most attracted to Japan's Shinkansen HSR station environs and how patterns vary across station groupings. We then investigate the degree to which districts around proposed HSR stations in California and stations slated for "Core Express" services in the North Corridor have been attracting similar types of economic activities as in Japan. Based on Japan's experiences, we also speculate about the settings that are most likely to reap economic development benefits along the two most populous U.S. corridors slated for HSR services. The paper concludes by discussing the public-policy implications of the research findings.

Literature Review

HSR investments have transformed the economic geographies of city-regions in Asia and Europe to varying degrees. Countries like China, Korea, Taiwan, and Spain have invested heavily in HSR in recent years partly to meet rising demands for inter-city travel but also in hopes of stimulating economic growth. This is despite the fact that empirical evidence to date on HSR and economic growth, drawn mainly from Japan, France, and Germany, has been mixed and inconclusive.

The most studied HSR system is the world's oldest -- Japan's Shinkansen, whose Tokaido Line connecting the mega-cities of Tokyo and Osaka opened in 1964. Sands (1993) reviewed the development effects of the Shinkansen's Tokaido line as of the early 1990s. He found that the cities and regions served by Shinkansen line experienced higher employment and population growth rates than areas not served by HSR. Particularly high rates of growth were recorded for information exchange industries (business services, banking services, real estate) as well as higher education in areas surrounding Shinkansen stations. Buoyant population and commercial growth was also recorded along secondary intra-metropolitan transit corridors that connected to Shinkansen stations. Focusing on longer-term impacts, Banister and Berechman (2000) concluded that the Shinkansen (and other railway systems) influenced Japan's employment growth patterns at the regional and local levels and increased station-area land values as a function of travel times to Tokyo station and other large cities. The degree to which the Shinkansen network was the dominant agent behind recorded growth could not be confirmed by either Sands (1993) or Banister and Berechman (2000), at least not in a pure causal sense.

Cervero and Bernick (1996) examined the likely redistributive effects of Shinkansen on urban activities. Their analysis showed that some thirty years after Tokaido services began, the Shinkansen had failed to induce significant employment and population shifts to intermediate cities along the corridor between Tokyo and Osaka. They concluded that the economic roles of intermediate cities, like Nagoya and Kyoto, within the nation's urban hierarchy had weakened. With a hub-and-spoke design that delivered the greatest incremental increases in accessibility to Tokyo and Osaka, both mega-cities reaped the lion's share of economic benefits conferred by Shinkansen. It is, of course, not the physical infrastructure itself that induces economic change but rather the quality of services and most notably speed when it comes to HSR. Takagi (2005) reported that in more recent times the Tokaido Line's high-speed services have become slower because of the increased number of intermediate stops, inferring that Shinkansen's economic benefits have likely also slowed down.

Across Europe, experiences to date suggest that, as in the case of Japan, the economic development benefits of HSR systems have accrued mainly to large cities at the expense of smaller and intermediate ones. Gutierrez, Gonzalez, and Gomez (1996) predicted that Europe's planned HSR network would increase territorial polarization between major cities and their hinterlands, with major urban centers like London and Paris becoming the chief beneficiaries of this new spatial order. Vickerman (1997) similarly predicted that long-term economic development in peripheral small cities would be suppressed if global and regional firms that locate in large cities are able to capture the bulk of HSR's accessibility benefits. To a large degree, experiences have borne out these predictions. In London, for example, new HSR links have been credited with attracting global finance and business service jobs to districts near central terminal stations, such as King's Cross-St Pancras, which through multiplier effects has spurred the regeneration of once-distressed urban districts (GLA, 2008; Bertolini & Spit, 1998). Freeman (2007) documents that London's HSR-served hubs have claimed a relatively large share of the city's "creative businesses", ones that thrive on face-to-face communications for the exchange of knowledge and ideas.

In France, the TGV has also been viewed as a catalyst for Paris-based global and regional firms to expand their potential markets in Europe. Cervero and Bernick (1996) argued that the first generation of TGV services benefited secondary cities, such as Lyon and Lille, every bit as much as Paris. More recently, Garmendia, de Urena, Ribalaygua, Leal, and Coronado (2008) examined the development impacts of HSR lines on small and large intermediate cities in France and Spain. The impacts of HSR services on residential growth were found to be quite modest. There was some evidence that small cities attracted immigrant households in the wake of HSR investments. With regard to intermediate cities, Urena, Meneraut, and Garmendia (2009) concluded that Spain's and France's HSR systems helped them attract mid-level business and technical consultancy firms, urban tourism, and interregional conferences. HSR was credited with strengthening the central-place hierarchy of intermediate cities in relation to smaller ones.

The spatial and economic-growth ramifications of new HSR investments in today's fast-changing informational age are yet to be told. Hall (2009) sees HSR as a competitive boon to “edge city” station locations (Garreau, 1991), especially where HSR services link edge cities directly to major international airports. This is in keeping with Kasarda’s vision of the “aerotropolis” wherein multi-functional airports and their environs become the dominant economic hubs of the 21st century (Kasarda, 1999, 2001). In his recent writings, Kasarda (2009, 2010) contends that the connection of airport cities with high-speed rail services will stretch clusters of aviation-linked businesses and associated residential development some 30 kilometers outward from major international airports. Edge cities connected to airport hubs via HSR can reap competitive advantages in the global marketplace by dramatically expanding labor-, trade-, and knowledge-sheds. Experiences in Lyon, France could be a harbinger of things to come. The integration of a HSR station with an airport terminal on the eastern edge of Lyon spawned the construction of nearby hotel, conference and retail facilities. In recent years, the Satolas airport TGV station has become a focal point of Lyon’s marketing and economic development strategy. Lyon’s success lends credence to arguments of Thompson (1995) that HSR-airport interchanges combined with state-of-the-art telecommunication facilities are poised to reap an economic windfall by facilitating commercial trade and exchange worldwide without the diseconomies of congestion.

Methodology

This study investigates the locational characteristics of job markets around both already developed and newly proposed stations on the Japanese Tokaido Shinkansen, Northeast Corridor and California HSR systems. The analysis focuses on market trends around planned stations with an eye toward exploring whether public policies might be able to harness and leverage these trends to induce greater economic benefits. Trends in the Northeast Corridor and California are then compared to job market experiences in Japan. Such comparisons, we believe, shed light on the kinds of long-term economic development impacts that might occur along the U.S. corridors slated for HSR and importantly the kinds of public policy interventions that might meaningfully influence outcomes. Our analysis, then, does not predict likely economic development impacts but rather applies interpretative methods to investigate station-area employment patterns that might unfold and the roles that public policies might play in leveraging positive outcomes.

Units of Analysis

This analysis assumes that the economic development impacts of HSR investments are largely confined to areas around stations. In studies of urban transit systems, "station catchment area" is often defined as a 500 meter radius buffer from the station. However, because of the much larger accessibility benefits conferred, the station catchments of HSR systems stretch considerably farther than the 500 meter radius (Catz & Christian, 2010). In addition, the exact locations of many of the proposed HSR stations in California (and other states) are yet to be determined, so the station catchment areas could very well shift by more than 500 meters when all is said and done. For these reasons, this analysis looks at the latest data on job market profiles within 5 km of: 17 existing Shinkansen stations on the Japanese Tokaido Line (Figure 2); 30 developed Amtrak stations on the Northeast Corridor (Figure 3) slated for new HSR services; and 25 proposed HSR stations in California (Figure 4).

{Figure 2 about here}

{Figure 3 about here}

{Figure 4 about here}

The Tokaido Shinkansen was opened as the world's first HSR system in 1964. The current 552.6 km service with 17 stops[2] between Tokyo and Osaka is regarded as the world's most successful HSR corridor in terms of ridership, averaging 378,000 passengers per day and capturing 82 % of the intercity passenger flows in 2009. This corridor is fairly comparable to the Northeast Corridor and California HSR in terms of intercity service characteristics (Table 1). The world's most profitable line, we note, averages very high urban densities. The average number of jobs and population within 5 km of the Tokado Shinkansen's business stations are around twice as large (dense) as the averages within 5 km of existing or planned stations on the Northeast Corridor and California HSR.

{Table 1 about here}

The Northeast Corridor functions as the region's economic spine, connecting Boston, New York, Philadelphia, and Washington, DC. More than five million jobs are within 5 km of its 30 intercity Amtrak stations. Since 2000, Amtrak has operated the nation's only HSR service (Acela Express) at 14 of the 30 stops as well as lower-speed intercity trains (Northeast Regional) on the same tracks. The federal government, states and Amtrak are currently joining forces to improve the HSR service by replacing aging bridges, expanding constrained stations, and upgrading track and power systems.

The California High-Speed Rail Authority (CHSRA) has proposed stations that will connect San Francisco, Los Angeles/Anaheim/Irvine, the Central Valley, Sacramento and San Diego by trains traveling up to 220 miles per hour (354 kilometers per hour). The CHSRA predicts that the nation's first HSR system operating on a dedicated right-of-way will directly create 600,000 construction-related jobs and indirectly induce 450,000 permanent new jobs over the next 25 years. In our analysis, we exclude the Hanford/Visalia/Tulare stop because the multiple station options publicized by CHSRA are still sketchy and contain too few nearby business establishments for job market analysis.

Analytical Approaches

Our analysis classifies types of economic activities around the HSR stations developed and proposed with respect to their market sizes, growth trends, job-population balances, and business specializations. To build a typology for each of the three corridors, cluster analysis is applied. The technique of agglomerative hierarchical clustering systematically combines cases into a reasonable set of clusters on the basis of their similarities (i.e., squared Euclidean distances) across input variables (Aldenderfer & Blashfield, 1984). The job market profile for each station catchment area is quantified by four measures: (1) total job number; (2) recent change in total job number; (3) job-population gap index; and (4) job location quotient. The gap index and location quotients used for cluster analysis were computed as follows:

$$\textbf{Gap Index} = \frac{\text{(\# of Jobs within 5km of a Station - \# of Population within 5km of a Station)}}{\text{(\# of Jobs within 5 km of a Station + \# of Population within 5 km of a Station)}}$$

where: the station catchment has more jobs than population, the Gap Index becomes closer to +1; and the station catchment has more population than jobs, the Gap Index becomes closer to -1.

$$\textbf{\textit{Location Quotient (the Sector i)}} = \frac{\dfrac{\textit{(\# of Jobs in the Sector i within 5 km of a Station)}}{\textit{(\# of All Jobs within 5 km of a Station)}}}{\dfrac{\textit{(\# of Jobs in the Sector i in the Region)}}{\textit{(\# of All Jobs in the Region)}}}$$

where: the sector i is seven business categories (Heavy Industry [20], Manufacturing [30], Logistics [40], Knowledge Business [50], Social Service [60], Leisure Service [70] and Other Service [80]); and the region comprises Tokyo, Kanagawa, Shizuoka, Aichi, Gifu, Shiga, Kyoto, Osaka and Hyogo (Tokaido Shinkansen), MA, RI, CT, NY, NJ, PA, DE, MD and DC (Northeast Corridor), or CA (California HSR).

Data Sources

Precise locations of the 17 stations on the Tokaido Shinkansen were obtained from the geographic information system (GIS) shapefile provided by the Japanese National and Regional Planning Bureau (Government of Japan [GOJ], 2009). Also, GIS point shapefiles for the 30 Amtrak stations on the Northeast Corridor were extracted from the National Transportation Atlas Database (U.S. Bureau of Transportation Statistics, 2010). As noted, many of the proposed HSR station sites in California are still under review and thus preliminary. Some stations are to be connected to existing intercity railway terminals and local transit centers, while others might be sited on the edge of cities like Bakersfield and Fresno. The proposed station locations were identified based on the public outreach materials and preliminary alternatives analyses that are posted on the CHSRA's official website (CHSRA, 2010). GIS point shapefiles for these stations were produced using online satellite imagery techniques (Monkkonen, 2008).

Japan's job market data in 2001 and 2006 were extracted from the Establishment and Enterprise Census of Japan (GOJ, 2010a). Population data in 2005 came from the Population

Census of Japan (GOJ, 2010b). These census data were then spatially related to the 17 station catchment areas along the Tokaido Shinkansen. U.S. job market data in 2002 and 2008 were collected from the ZIP Business Patterns (U.S. Census Bureau, 2011). U.S. population data (at the census block group levels) for 2007 were obtained from ESRI. Both the ZIP code and brock-group level datasets in the U.S. were geographically reassigned to the 5km catchments of the 30 existing Amtrak stations on the Northeast Corridor and 17 proposed HSR stations in California.

To calculate location quotients that were comparable across the three settings, a correspondence table was created between 14 Japanese major business categories and the 18 North American Industry Classification System (NAICS) codes (Table 2). The job market data from Japan and the United States were aggregated into seven core business categories: Heavy Industry [20]; Manufacturing [30]; Logistics [40]; Knowledge Business [50]; Social Service [60]; Leisure Service [70]; and Other Service [80].

{Table 2 about here}

Results of Cluster Analysis

Tokaido Shinkansen

Our cluster analysis quantitatively classified the 17 Shinkansen stations into eight job market types: (1) Global Business Center; (2) Waterfront Information Center; (3) Regional Business Center; (4) Large Leisure City; (5) Large Business City; (6) Medium Intermediate City; (7) Small Manufacturing City; and (8) Small Leisure City. These titles reflect the size, specialization and balance attributes of station-area job markets. Table 3 summarizes the characteristics of the eight groupings by presenting statistical averages for the variables used to form clusters.

{Table 3 about here}

Table 3 reveals that agglomeration patterns along the Tokaido Shinkansen were highly varied. With more express trains, Tokyo and Shinagawa stations have attracted world-class finance and information business activities. Secondary business and leisure service clusters have formed around Shin-Osaka, Nagoya, and Kyoto stations. Despite a slowdown in growth, the Shin-Yokohama station area remains a large and important business cluster on the western edge of Tokyo. Other intermediate cities served by HSR, however, have generally experienced job losses. From the mapping of location quotients in Table 3, we note that medium-size intermediate cities exhibit employment characteristics that most closely resemble those of their corresponding regions. The smallest clusters along the Shinkansen corridor - Kakegawa, Gifu-Hashima, Maibara, and Atami - feature small manufacturing and leisure service activities. In recent years, they have witnessed slight job gains.

Northeast Corridor

The 30 Amtrak stations were also grouped into eight categories, similar to those of the Tokaido Shinkansen. Table 4 shows that stations along the Northeast Corridor are characterized by contrasting business activities. Served by the Acela Express, stations in New York City and Washington, DC are home to knowledge- and service-based businesses that cater to both global and regional markets. Jobs in both areas have been on the upswing. In contrast, economic activities in the region's secondary business and medium-size manufacturing cities have slowed around the Amtrak stations. BWI Airport today supports an active and growing business cluster, taking on some of the characteristics of an emerging aerotropolis, while economic activities around the Newark Airport have been more tepid and only weakly tied to HSR. As was found along Japan's Tokaido line, medium-size intermediate cities along the Northeast Corridor have employment compositions that most closely match those of their surrounding regions, suggesting that current rail stations themselves have had no particular drawing power that appeals to particular kinds of firms. This could change, of course, with the introduction of upgraded and faster train services at existing Amtrak stations.

{Table 4 about here}

California HSR

Business activities around 25 planned stations in California were similarly clustered into eight categories. Table 5 summarizes key attributes of eight job market types. The California typology has some of the same business agglomeration patterns found on the Tokaido Shinkansen and Northeast Corridor. Within 5km of San Francisco's Transbay Terminal are numerous knowledge-based businesses, in fields like finance, law, insurance, and engineering. Because of the considerably smaller number as well as composition of jobs within 5 km of the planned downtown San Francisco station relative to that found in New York City and Tokyo, we assigned the title of "regional" instead of "global" business center to this planned station. However many knowledge-based and high-tech firms within San Francisco's planned station catchment nevertheless serve worldwide clients and markets, albeit the area's overall employment base is not as globally connected as in New York and Tokyo. Stations planned for Los Angeles and Sacramento, on the other hand, are surrounded by service-based jobs whose customer base is mostly at the regional and state levels. San Jose, Anaheim, Irvine and University City have planned stations comprised of mostly secondary business and edge cities that are experiencing modest rates of growth. Burbank's planned station stands out for its nearby large media cluster. The Ontario Airport forms a sizable manufacturing-logistics cluster, while activities near the SFO Airport and San Diego are heavily oriented toward tourism services. California's intermediate stations, located in the Central Valley, have few firms that specialize in knowledge- and service-based activities. Local-serving retail, light manufacturing, and agri-businesses – activities that generally benefit the least from spatial clustering and enhanced accessibility to statewide markets – characterize many of the Central Valley's station.

{Table 5 about here}

Key Findings and Discussion

Based on recent trends and experiences in Japan, planned HSR investments in the United States are likely to witness territorially uneven and highly localized economic development impacts. In the Northeast Region and California, HSR is likely to produce agglomeration benefits that accrue mostly to globally connected business centers, and orient some service activities to edge cities, international airports, and leisure-service hubs, mostly at the expense of many small, intermediate cities. This will be all the more magnified as regions and states continue to shift toward knowledge- and service-intensive businesses. This section elaborates on possible shifts in economic activities for four distinct HSR station-area clusters: (1) global/regional business centers; (2) edge cities and aerotropolises; (3) leisure service cities; and (4) other intermediate cities.

Global/Regional Business Centers

Our analysis aligns with that of the existing literature, suggesting that the economic development impacts of HSR will likely concentrate in globally connected business and regional service centers (e.g., New York, San Francisco, Washington, DC and Los Angeles), mimicking Japan's experiences with HSR stations in Tokyo, Osaka and Nagoya. This will especially be the case when both public agencies and private entities aggressively embark on large-scale urban regeneration projects that appeal to high value-added businesses (Murakami, 2010; Curtis, 2009). Around the newly opened Shinagawa Shinkansen station in Central Tokyo, for example, the national government, the privatized Central Japan Railway Company (JR Central), and private real estate developers joined forces to co-develop prestigious office towers and shopping malls (Figure 5). The project features high-quality public green plazas and attractive pedestrian-ways as a lure to firms and workers that place a premium on livability and are drawn to urban amenities when deciding where to open a business or take on a new job.

{Figure 5 about here}

Japan's commercial redevelopment efforts aim not only to increase business passengers on the Tokaido Shinkansen but also to promote land value capture around the terminal stations. Figure 6 shows that Tokyo, Shinagawa and Nagoya have experienced rising commercial land prices within 5 km of the Shinkansen stations, fueled by large-scale redevelopment projects created through public-private partnerships. In contrast, other HSR station settings have seen commercial property values fall. Compared to many private intracity railway corporations that built suburban railways outside of Tokyo and Osaka, the former Japanese National Railways was passive in promoting and leveraging land development around Shinkansen stations. However, in response to recent market pressures to re-urbanized city centers, the privatized JR Central has sought to maximize real-estate revenue streams, largely from commercial property redevelopment around the Nagoya Shinkansen station. Its proceeds from land development have shot up markedly, from JPY24.3 billion in FY1999 to JPY66.7 billion in FY2009 (JR Central, 2011).

{Figure 6 about here}

Edge Cities and Aerotropolises

Our results are consistent with those of urban scholars, such as Hall (2009) and Kasarda (2010, 2009), who predict that HSR systems will attract knowledge-intensive businesses, convention hotel services, and/or time-sensitive industries and spur economic activities in large edge cities (e.g., Burbank on the northeastern edge of Hollywood, University City on the northern edge of San Diego, and Stratford on the eastern edge of London). HSR investments also hold promise for attracting globally linked businesses near and around international airports (e.g., BWI Airport on the southern edge of Baltimore and northeastern edge of Washington, DC, SFO Airport on the southern edge of San Francisco, Ontario Airport and Irvine on the eastern and southern edges of Los Angeles, and Satolas Airport on the eastern edge of Lyon). Some observers question whether automobile-dependent edge cities will be able to sustain dense agglomerations and suburban transit nodes because of high external costs (e.g., traffic congestion, air pollution, and airport noise) that could cancel out accessibility benefits (Lang, 2003; Tomkins, Topham, Twomey, & Ward, 1997). In lieu of massive roadway and parking infrastructure, HSR could provide a new layer of intercity mobility, relieving suburban gridlock, improving environmental conditions, and sustaining polycentric transit-served urban forms in the United States (as experienced around the Shin-Yokohama Shinkansen station in suburban Tokyo) (Cervero, 2005, 2003; Leinback, 2004; Cervero & Bernick, 1996).

Leisure Service Cities

Our research also suggests that a HSR system might be able to enhance the economic advantages of tourist-oriented clusters in relatively large cities (e.g., Kyoto in the western side of Japan, Anaheim and San Diego in Southern California) rather than small coastal towns (e.g., Atami in the southwestern end of Greater Tokyo and Westerly on the southwestern shoreline of Rhode Island). Japan's ancient capital city, Kyoto, has seen appreciable gains in the number of regional businesses, local services, and educational institutions within 5 km of the terminal station. It has also become one of Japan's most popular cultural and leisure destinations. Taking advantage of Kyoto's historical resources and national location, the privatized JR Central aggressively marketed new high-speed "tourists services" that connected Greater Tokyo and Kyoto (13.4% of the JR Central group's revenues were from hotel and leisure service businesses in FY2006 [JR Central, 2007]). Anaheim and San Diego in Southern California similarly have a number of entertainment, recreational, hotel, and food-service businesses in 5 km of the proposed HSR stations. The cities could likewise be promoted as easy to reach leisure destinations for tourist markets in Northern California. However, the proposed siting of Anaheim's HSR station next to the massive SR 57 Freeway interchange could suppress development activities immediately around the station itself, at least in comparison to what has occurred in Kyoto.

Other Intermediate Cities

A central question remains: does HSR yield regional accessibility and agglomeration benefits that accrue principally to major cities at the expense of smaller ones? Japanese experiences reveal that very small and intermediate cities fail to reap economic development benefits from HSR, largely because of their manufacturing- and service-industry economic bases. This is also how employment growth is trending along the Northeast Corridor and around the planned California HSR stations.

The causality between HSR service and territorial transformation is always uncertain. In the case of Japan, the spatial redistributions of economic activities between major and minor cities have been strongly associated with the Tokaido Shinkansen's intercity service patterns over the last two decades. Figure 7 illustrates that the privatized JR Central set up the "Nozomi" services that skip through 11 of the 17 Tokaido Shinkansen stations. The Nozomi services have increasingly replaced the "Hikari" services that, since 1992, were designed to stop by 5 of the 11 intermediate stations (Odawara, Shizuoka, Hamamatsu, Gifu-Hashima, and Maibara). Apparently, these 5 intermediate stops have become less attractive destinations for business passengers and less profitable for the privatized JR Central. New intercity service patterns have been matched by falling commercial land values in the minor intermediate cities (presented in Figure 6).

{Figure 7 about here}

Public policies might have intervened to alter market trends. Expanded local feeder services as well as land use deregulations, for example, could have been a lure to new private investments and thus strengthen business agglomerations in the station catchment areas. Nevertheless, the comparative advantage of small intermediate cities still appears to be in areas like agriculture and traditional manufacturing, the kinds of economic activities that find little value in being near a high-speed passenger rail station in a clustered configuration. Without both clear regional strategies and proactive local efforts, proposed HSR projects in the United States could end up saddling local governments of medium-size cities with high ancillary costs like expanding local bus services and upgrading sewer-water facilities without an expanded tax base from high value-added industries. Regional policies should aim to redress such potential inequities.

Conclusion and Policy Implications

We believe that, on the whole, the economic development impacts of HSR investments in major city-regions of the United States are likely to be more redistributive than generative. Past experiences from Japan and market trends around areas planned for HSR services in the U.S. suggest this to be the case. However, net overall benefits can accrue from spatial redistribution, in the form of strengthening the global competitiveness (and the associated spillover benefits) of largest urban centers. HSR's business relocation effects within one region need not be a simple "zero-sum" game. The knowledge-intensive businesses, time-sensitive industries, and tourist-oriented services shifting from somewhere to higher density, more accessible, and high amenity nodes, like New York City, Washington, DC, San Francisco and Los Angeles, could generate net increases in wealth and economic development that benefit metro-regions at large (Cervero & Aschauer, 1998; Weisbrod & Weisbrod, 1997). Some observers maintain that the direct user benefits of new HSR and local transit systems alone will unlikely be large enough to cover the full lifecycle costs of HSR investments in a traditional automobile-oriented society like the U.S. External accessibility and agglomeration benefits, if leveraged by proactive public policies that reward efficiencies and appeal to high value-added businesses, could help tilt the benefit-cost equation in HSR’s favor. The net economic impacts of HSR investments will likely be negative unless public policies appropriately guide market shifts to station catchment areas that, based on Japan’s experiences, offer comparative business advantages.

In light of these findings, four policy responses are recommended for leveraging the economic development impacts of HSR:

1. **Polycentric development as a global competition strategy:** HSR investments in the United States are in a position to strengthen major city-regions’ polycentric form and in so doing increase global competitiveness. This could occur by efficiently linking central business districts, edge cities, international airports, and tourist destinations. Such integration could offer more advantageous business locations and localize greater development benefits in the station catchments. Economic linkages might also be improved over an even larger mega-regional level (e.g., between city pairs within states), dramatically expanding the market-sheds and labor-sheds of firms seeking a competitive edge – e.g., enhanced co-matching between businesses seeking specialized labor inputs

and workers seeking the most promising and gratifying employment opportunities. If synergetic and spillover effects conferred to globally-connected establishments by HSR are to be fruitfully leveraged, strategic planning needs to occur on a larger geographic scale to reflect the mega-territorial reach of an inter-city HSR investment. This speaks to the need for more proactive state, sub-state, and inter-state level land-use planning and growth management. Institutionally, there needs to be a close geographic correspondence between the trans-metropolitan coverage of expanded economic interactions and the territorial space in which land-use planning and growth management takes place. In general, current extra-territorial planning structures in the U.S., like councils of government (COGs) and metropolitan planning organizations (MPOs), are too geographically constrained to carry out the kind of strategic and far-sighted planning needed to successfully tie HSR investments to mega-scale economic development.

2. **Pro-business state assistance as a regional development strategy:** HSR investments in the United States will likely need “pro-business” policy interventions to guide HSR-induced economic activities at the sub-state level. Permissive zoning, targeted public infrastructure investments, expanded and improved feeder bus services that tie into HSR stations, flexible funding programs, and expedited environmental reviews could help leverage private investment and facilitate the location of co-dependent business activities that are naturally drawn to HSR stations. Public-private co-ventures should be aggressively pursued in this regard. Both sides bring to the table the kinds of complementary resources (e.g., eminent domain powers of government and the

entrepreneurial instincts of private investors) needed to share near-term risks and downstream benefits inherent with mega-projects like HSR.

3. **Land value capture as an infrastructure financing strategy:** HSR authorities should aggressively pursue joint development opportunities to recoup the costs of mega-transit projects from the accessibility and agglomeration benefits that would be capitalized largely into commercial land values near major intercity terminals. Properly designated value capture applications for HSR projects could balance global corporate profits and local public interests, discourage excessive levels of rent-seeking investments, and maximize long-term revenue streams by encouraging high-density, mixed-use, and amenity property packages around HSR terminals. Useful lessons on recapturing accessibility and agglomeration premiums created by investments in fast train services can be drawn from experiences in Hong Kong under its Rail+Property program (Cervero & Murakami, 2009).

4. **Transit-oriented development as a community improvement strategy:** With the help of federal and state funding programs, local governments in small and intermediate cities can play pivotal roles in assembling land parcels, promoting affordable housing, providing feeder bus services, and rationalizing parking policies (so as not to detract from high-quality pedestrian environments) around HSR stations. Local business entities also need to proactively seize upon community development opportunities created by HSR projects. Under the right market conditions, the provision of high-quality pedestrian infrastructure and urban designs could create a livability premium in the vicinity of HSR

stations of large urban centers. This in turn could help business centers attract and retain high-skilled, knowledge-based workers. HSR investments, backed by public-private co-ventures that leverage high-quality transit-oriented development, could be a boon to economic growth and expansion in select urban markets for years to come. Successful transit-oriented developments (TODs) around HSR stations, however, are likely to be considerably different than that of metropolitan rail systems, thus the same design templates should not be employed. Whereas housing is often a prominent feature of urban-rail TODs in the U.S., due to HSR's logistical designs, busy intermodal connections, and the potentially higher nearby land prices that are bid up by time-sensitive firms, office and retail uses are apt to be more common in HSR TODs. To the degree TODs are embraced as strategies for charting more sustainable urban futures, as stressed in California's landmark Senate Bill 375 (carbon emission legislation), new forms of TODs conducive to HSR services should be pursued.

Notes

1. U.S. High-Speed Intercity Passenger Rail (HSIPR) Program was established to build new high-speed rail corridors, upgrade existing intercity passenger rail corridors, and plan future high-speed rail services through corridor and state planning efforts. On May 9, 2011, U.S. Transportation Secretary announced US$2.02 billion in high-speed rail awards. The Federal Railroad Administration selected 15 States and Amtrak to receive $2.02 billion for 22 high-speed intercity passenger rail projects, nearly 100 % of which will go to construction of rail projects. Thus, some corridors funded for planning studies from 2009 through 2011 are not presented in Figure 1.
2. A new stop at Shinagawa Station opened in October 2003. The new intercity terminal development was accompanied by a major timetable change that increased the number of "Nozomi" express services and urban regeneration projects that aimed to revitalize the business climate in Central Tokyo.
3. Data on Japan's commercial land values publicly assessed in 2000 and 2010 were obtained from the Geographic Information Systems (GIS) download services provided by the Japanese National and Regional Planning Bureau (GOJ, 2011). The assessed land values in 2000 were adjusted by the Consumer Price Index (CPI) in 2010. And then, the average values in both 2000 and 2010 were computed for each station catchment area. In Figure 6, Atami is not included because the station catchment area has too few nearby assessment points for commercial land analysis.

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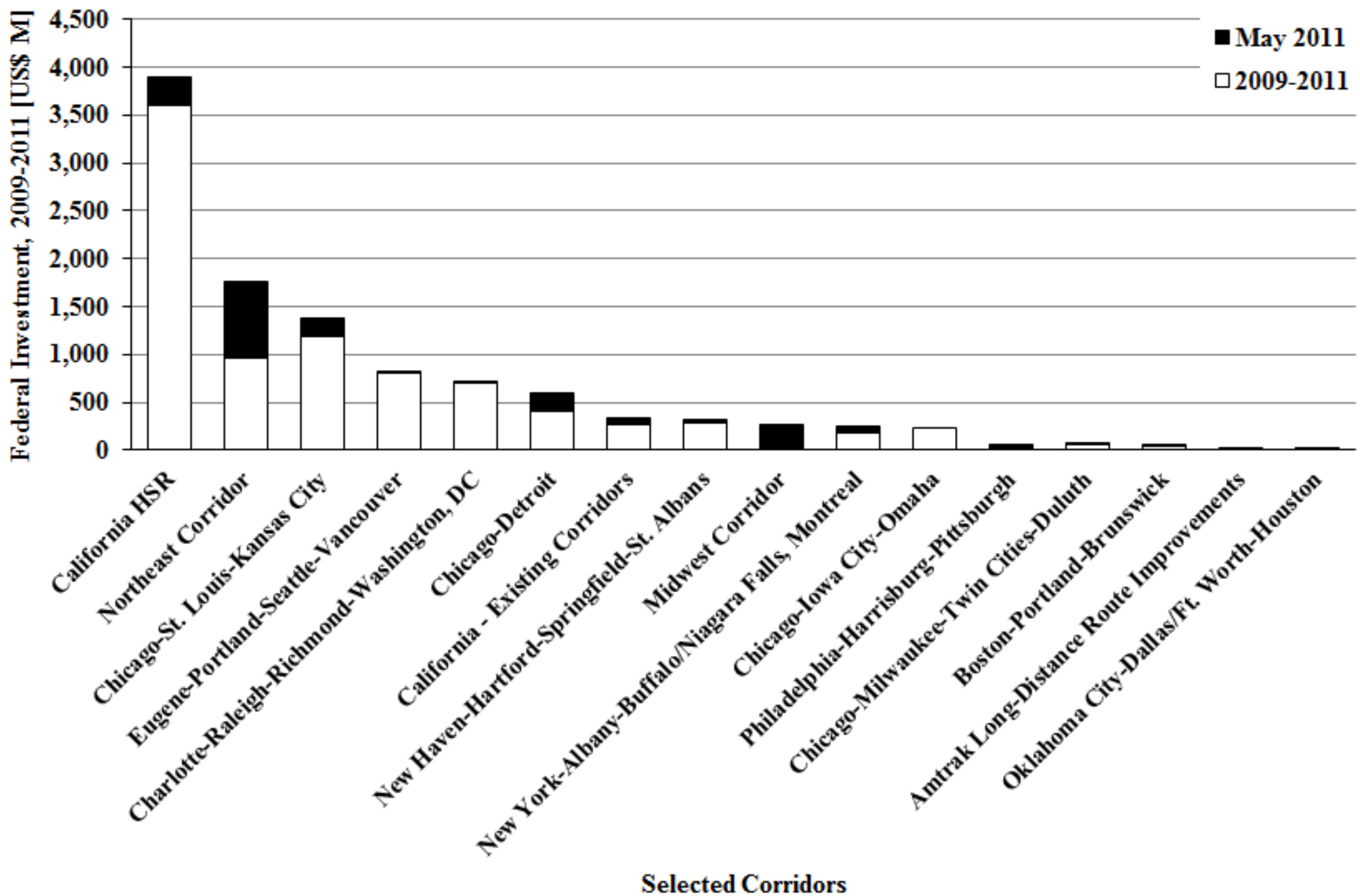

Figure 1. High-Speed Intercity Passenger Rail Program: Federal investment highlights, 2009-2011[1]

SOURCE: U.S. Federal Railroad Administration (2011).

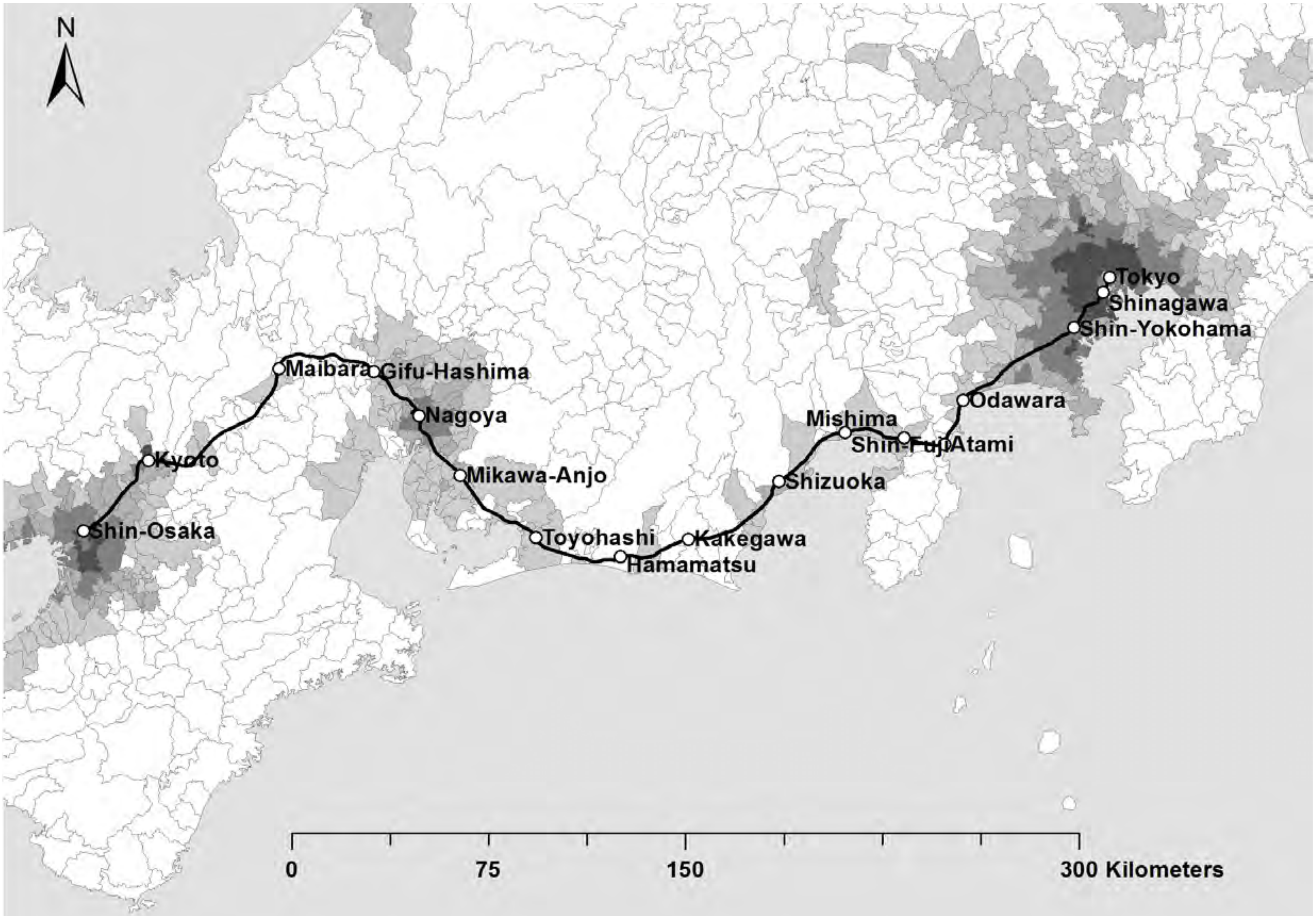

Figure 2. 17 Shinkansen stations on the Tokaido Line

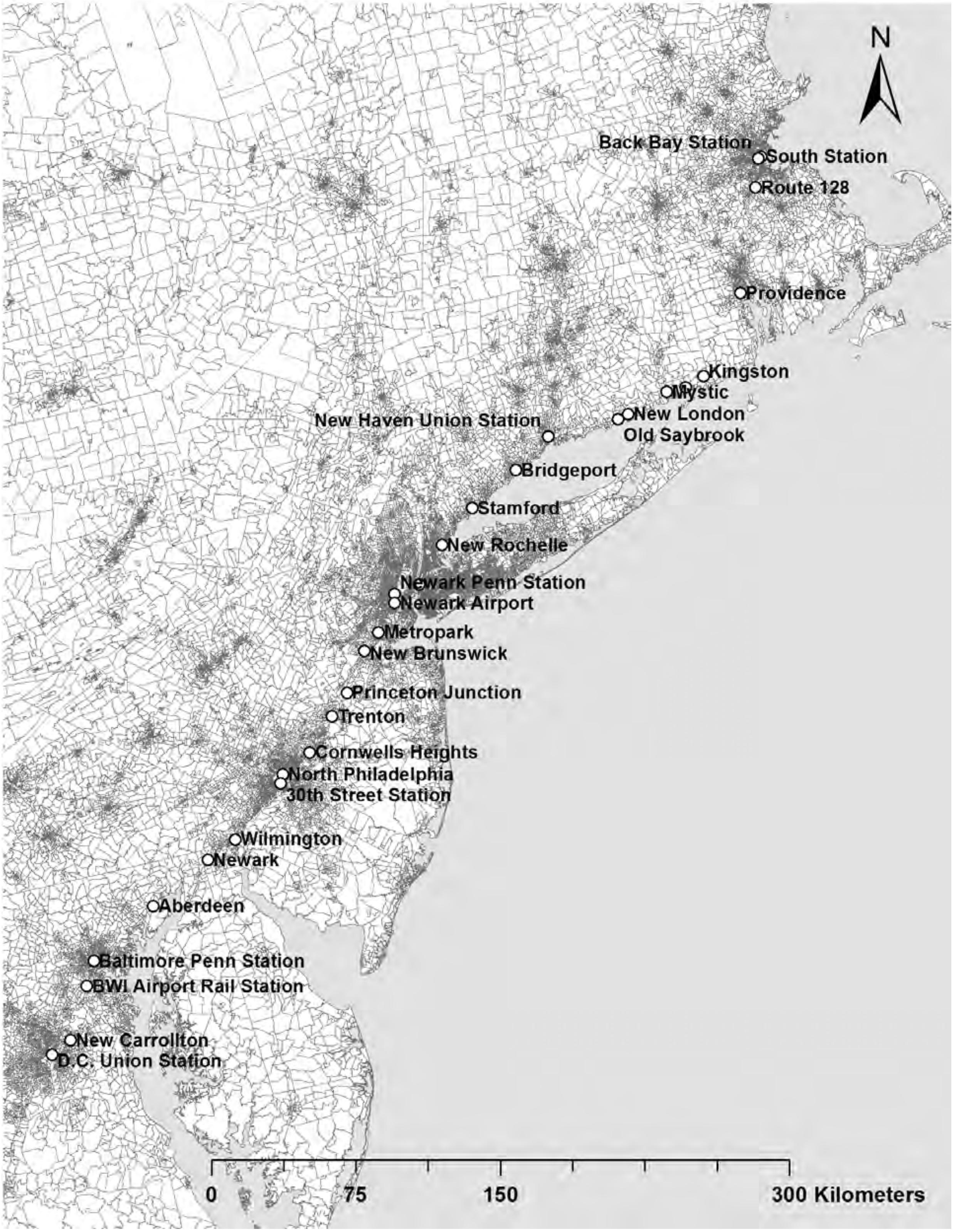

Figure 3. 30 Amtrak stations on the Northeast Corridor

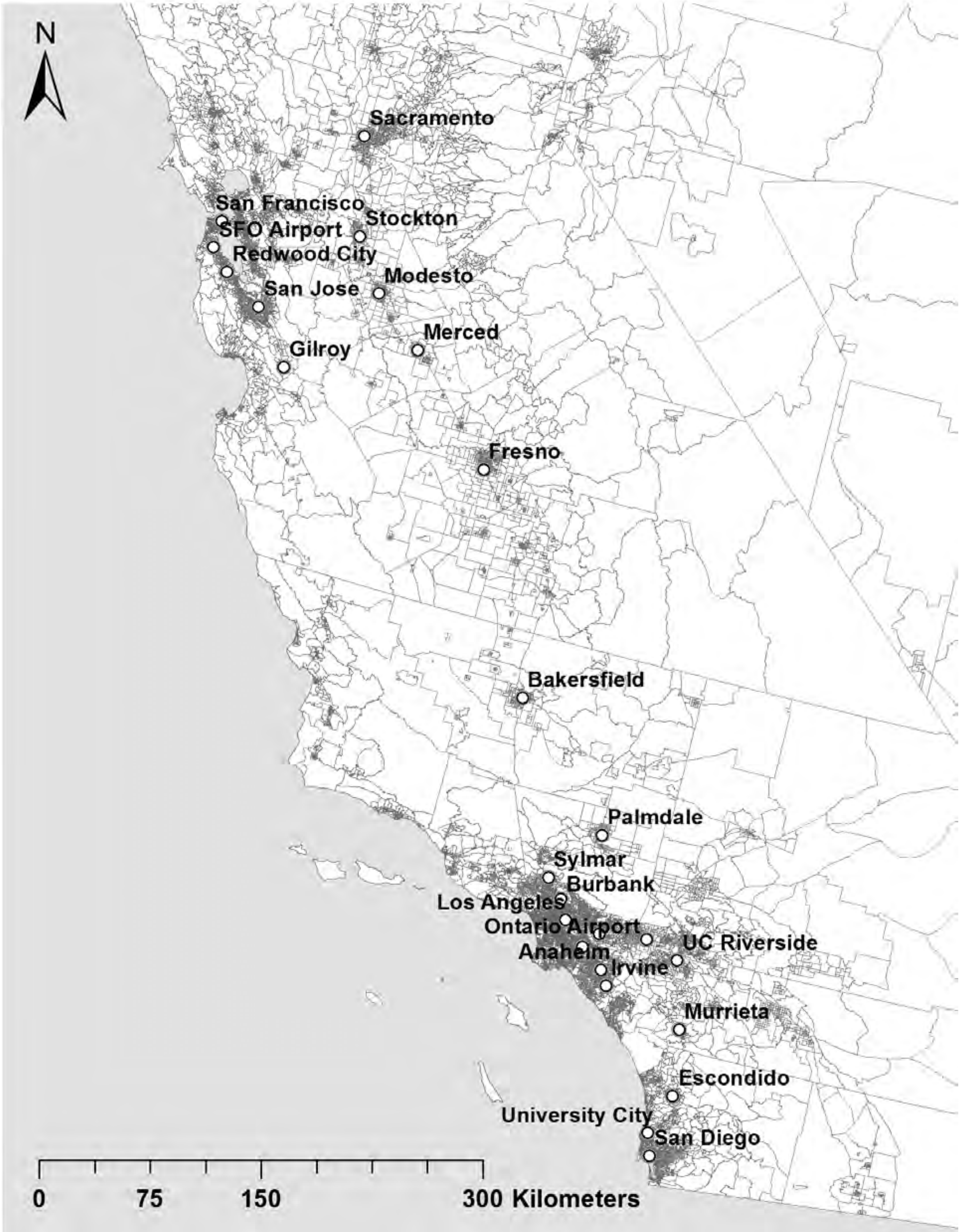

Figure 4. 25 HSR stations in California

Figure 5. Transit-joint redevelopments around the newly opened Shinagawa Shinkansen station, 2003

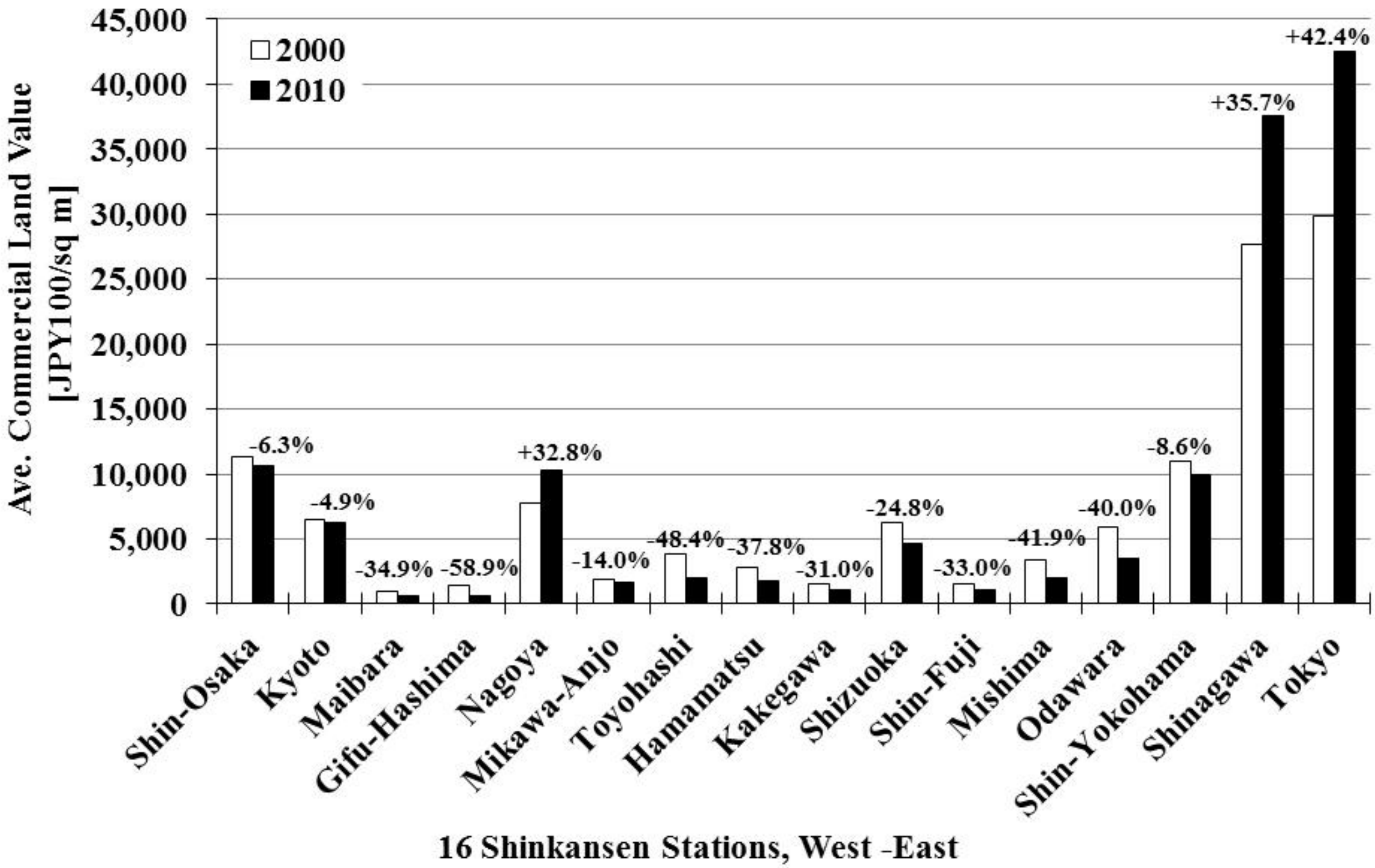

Figure 6. Average commercial land values within 5km of the 16 Shinkansen stations[3], 2000 and 2010
SOURCE: Government of Japan (2011).

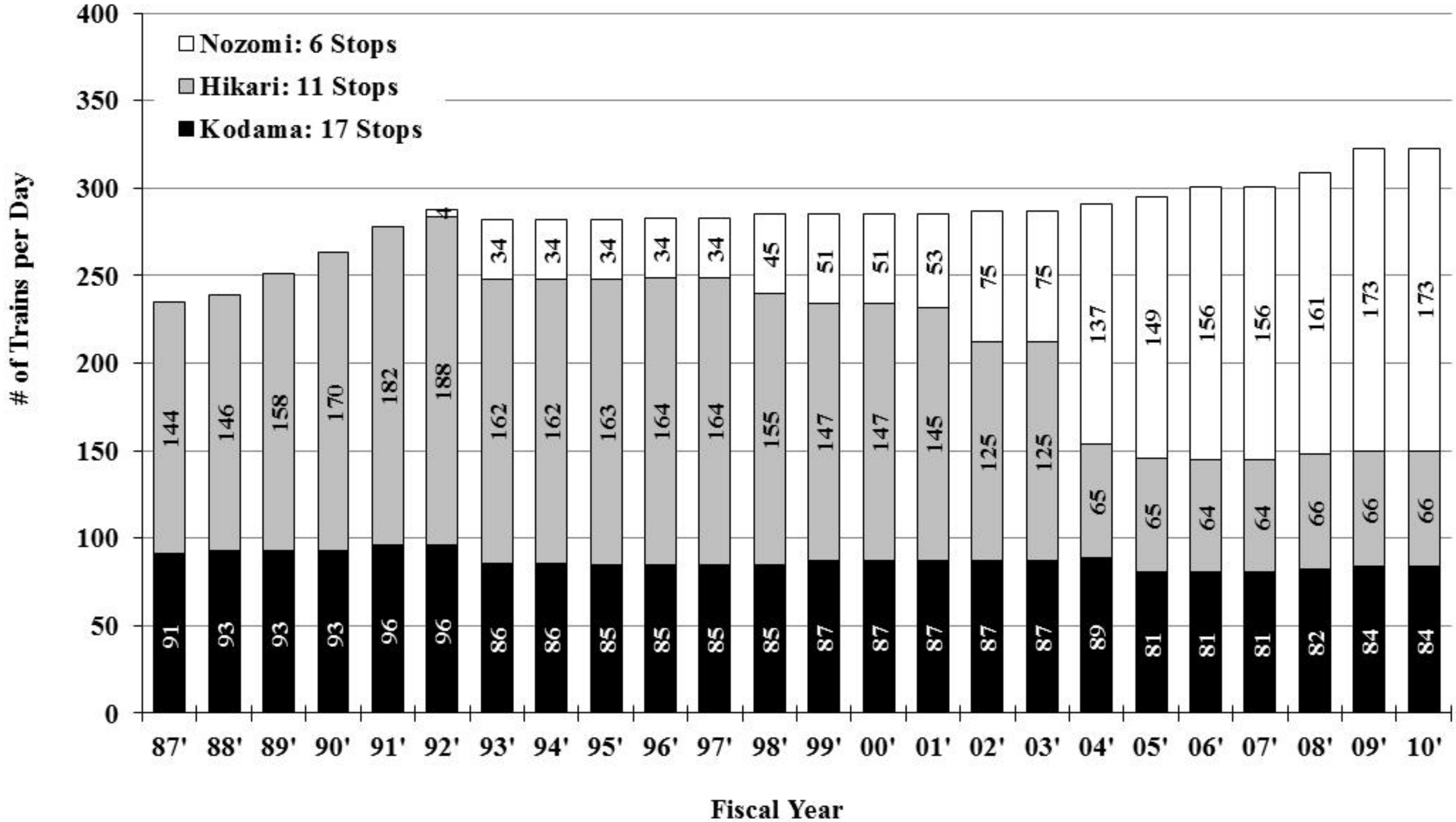

Figure 7. Changes in the Tokaido Shinkansen's intercity service patterns, 1987-2010

SOURCE: Central Japan Railway Company (2011).

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Table 1.

Comparative Statistics: Tokaido Shinkansen, Northeast Corridor and California HSR

	Tokaido Shinkansen	Northeast Corridor	California HSR
Open Year	**1964** (46 years)	**2000** (Acela Express 10 years)	-
Service Distance km	**552.6** (Tokyo and Shin-Osaka)	**584.7** (Boston and Washington DC)	**695.2** (San Francisco and Los Angeles)
# of Stations	**17**	**30**	**25**
Max. Speed kph	**270**	**241**	**354**
Travel Time	**2 hrs 20 mins** (2010)	**6 hrs 40 mins** (2010)	**2 hrs 40 mins** (Estimate in 2010)
Passengers per day	**378,000** (FY2009)	**28,000** (FY2010)	**91,000~194,000** (Phase I Estimate for 2030)
Ave. # of Jobs in 5 km	**259,769** (2006)	**178,645** (2008)	**110,817** (2008)
Ave. # of Inhabitants residing in 5 km	**397,645** (2005)	**219,925** (2007)	**174,868** (2007)

SOURCES: Central Japan Railway Company (2011); Government of Japan (2010a, 2010b); Amtrak (2011); California High-Speed Rail Authority (2010); U.S. Census Bureau (2011); ESRI (2010).

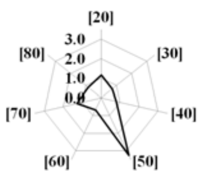
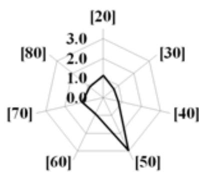
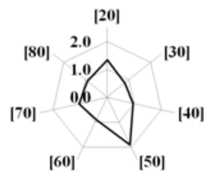
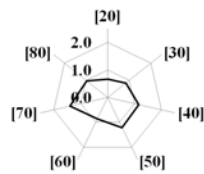
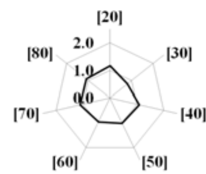
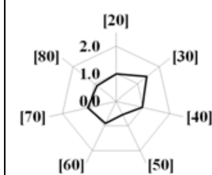
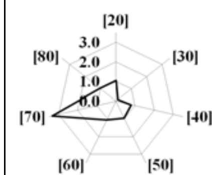
Table 2.

Correspondence Table: Seven Common Business Categories across Japan and the United States

Japan: Major Industrial Categories 2006	**United States: NAICS (2-Digit Codes) 2008**	**Common: Business Categories [Code]**
-Steel -Utility -Construction	-Mining, quarrying, oil & gas extraction (21) -Utilities (22) -Construction (23)	**Heavy Industry [20]**
-Manufacturing	-Manufacturing (31)	**Manufacturing [30]**
-Wholesale & retail -Transportation	-Wholesale trade (42) -Retail trade (44) -Transportation & warehousing (48)	**Logistics [40]**
-Information -Finance & insurance -Real estate -Multiple service	-Information (51) -Finance & insurance (52) -Real estate & rental and leasing (53) -Professional, scientific & technical services (54) -Management of companies & enterprises (55) -Administrative & support services (56)	**Knowledge Business [50]**
-Educational -Medical	-Educational services (61) -Health care & social assistance (62)	**Social Service [60]**
-Restaurant & hotel	-Arts, entertainment & recreation (71) -Accommodation & food services (72)	**Leisure Service [70]**
-Other service	-Other services (81)	**Other Service [80]**

Table 3.

Tokaido Shinkansen: Business Agglomeration Types and Statistics for Key Clustering Variables

Type	**Global Business Center**	**Waterfront Information Center**	**Regional Business Center**	**Large Leisure City**	**Large Business City**	**Medium Intermediate City**	**Small Manufacturing City**	**Small Leisure City**
# of Jobs, 2006	3,121,398	1,710,524	892,298	476,752	438,888	158,086	59,848	23,794
Change in # of Jobs, 2001-06	+40,879	+139,542	+172,152	+121,561	-20,787	-6,910	+6,285	+2,650
Job-Population Gap Index [+1~-1]*, 2006/05	+0.497	+0.334	+0.078	-0.140	-0.234	-0.214	-0.299	-0.216
Location Quotients [Common Business Code]**, 2006								
Stations***	- **Tokyo**	- **Shinagawa**	- **Shin-Osaka** - **Nagoya**	- **Kyoto**	- **Shin-Yokohama**	-Toyohashi -Hamamatsu -Shizuoka -Shin-Fuji -Mishima -Odawara	- Mikawa-Anjo - Maibara - Gifu Hashima - Kakegawa	- Atami

Note.

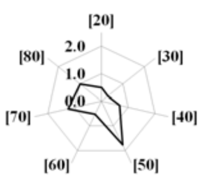
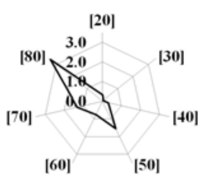
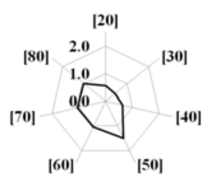
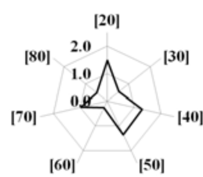
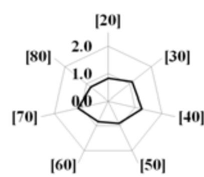
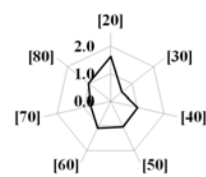
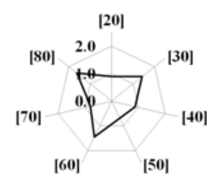
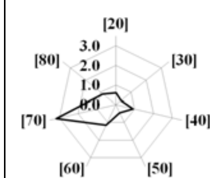
*Formula: (Jobs-Population)/(Jobs+Population); Closer to +1, the catchment area has more jobs than population; Closer to -1, it contains more population than jobs.

**Heavy Industry [20], Manufacturing [30], Logistics [40], Knowledge Business [50], Social Service [60], Leisure Service [70], and Other Service [80].

***__Bold stations__ offer express train services, so-called “Nozomi”.

Table 4.

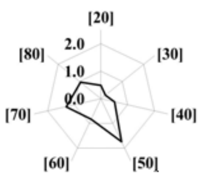
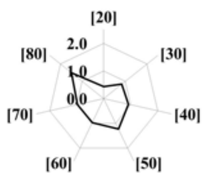
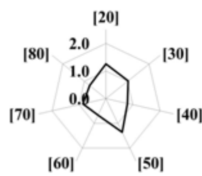
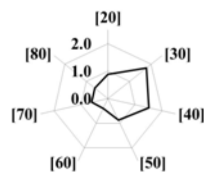
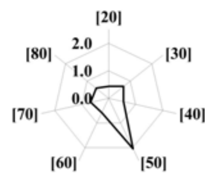
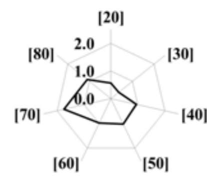
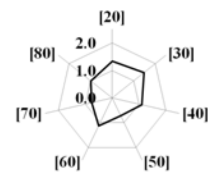
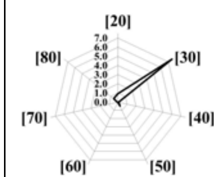
Northeast Corridor: Business Agglomeration Types and Statistics for Key Clustering Variables

Type	**Global Business Center**	**Regional Service Center**	**Large Business City**	**Medium Airport Center**	**Medium Intermediate City**	**Medium Industrial City**	**Medium Manufacturing City**	**Small Leisure Town**
# of Jobs, 2008	1,982,781	378,595	216,560	64,528	61,223	52,049	42,753	8,087
Change in # of Jobs, 2002-08	+91,293	+49,215	-2,753	+11,700	+519	+54	-6,665	+602
Job-Population Gap Index [+1~-1]*, 2008/07	+0.180	+0.062	-0.167	+0.217	-0.273	-0.414	-0.608	-0.394
Location Quotients [Common Business Code]**, 2008								
Stations***	- **New York City**	- **Washington, DC**	- **South Station** - **Back Bay** - **New Haven** - **Stamford** - Princeton - Philadelphia - **30th Street** - **Wilmington** - **Baltimore**	- **BWI Airport**	- **Providence** - Kingston - Mystic - **New London** - Old Saybrook - **Newark Penn** - Newark Airport - **Metropark** - New Brunswick - Cornwells Heights - Newark - Aberdeen	- **Route 128** - New Rochelle - New Carrollton	- Bridgeport - **Trenton**	- Westerly

Note.
*Formula: (Jobs-Population)/(Jobs+Population); Closer to +1, the catchment area has more jobs than population; Closer to -1, it contains more population than jobs.
**Heavy Industry [20], Manufacturing [30], Logistics [40], Knowledge Business [50], Social Service [60], Leisure Service [70], and Other Service [80].
***Bold stations offer high-speed intercity train services, so-called “Acela Express”.

Table 5.

California HSR: Business Agglomeration Types and Statistics for Key Clustering Variables

Type	**Regional Business Center**	**Regional Service Center**	**Large Business City**	**Large Airport Center**	**Large Information City**	**Large Airport-Leisure City**	**Medium Intermediate City**	**Small Manufacturing Town**
# of Jobs, 2008	458,621	207,182	175,787	155,603	141,935	91,296	54,830	1,372
Change in # of Jobs, 2002-08	+29,306	+3,504	+4,834	+28,954	+31,924	+2,447	+2,207	+20
Job-Population Gap Index [+1~-1]*, 2008	+0.114	-0.202	-0.073	+0.119	-0.151	-0.178	-0.450	-0.947
Job Location Quotients [Common Business Code]**, 2008								
Stations	- San Francisco	- Los Angeles - Sacramento	- San Jose - Anaheim - Irvine - University City	- Ontario Airport	- Burbank	- SFO Airport - San Diego	- Redwood City - Gilroy - Merced - Fresno - Bakersfield - Sylmar - Norwalk - City of Industry - UC Riverside - Murrieta - Escondido - Stockton - Modesto	- Palmdale

Note.

*Formula: (Jobs-Population)/(Jobs+Population); Closer to +1, the catchment area has more jobs than population; Closer to -1, it contains more population than jobs.

**Heavy Industry [20], Manufacturing [30], Logistics [40], Knowledge Business [50], Social Service [60], Leisure Service [70], and Other Service [80].