# Economic Impacts of High-Speed Rail: A Review

Project 2255
December 2022

Adam Cohen

High-speed rail (HSR) is a passenger rail system that operates at speeds greater than 125 mph (or greater than 200 kph). Examples of existing HSR systems around the world include the Acela in the United States, the Alta Velocidad Española (AVE) in Spain, the High Speed 1 and 2 (HS1/HS2) in the United Kingdom, the Lignes à Grande Vitesse (LGV) in France, the Shinkansen in Japan, the Super Rapid Train (SRT) in South Korea, and the High-Speed Rail (THSR) in Taiwan. In North America, planned HSR systems include Brightline West (Las Vegas to Southern California), the California High-Speed Rail Authority (Los Angeles to San Francisco), and Texas Central (Dallas to Houston).

An increasing body of literature documents the economic impacts of HSR, although more research is needed. Broadly, the economic impacts of HSR can be grouped into five categories: 1) job creation and economic output (including direct, indirect, and induced effects); 2) tourism; 4) housing; 4) station area and regional development; and 5) other economic impacts. Each of these are discussed in greater detail in the sections that follow. However, documenting the economic impacts of high-speed rail systems is inherently difficult due to limited economic data on a fine-grain spatial scale, vast differences in models, data collection, and study methodologies, all of which frequently produce a range of findings which are often difficult to compare even when using a meta-analysis approach.

## Job Creation and Economic Output

Traditional economic analyses of high-speed rail projects attempt to identify direct spending (e.g., direct jobs and value of contracts for primary contractors and subcontractors), indirect spending (e.g., products and services ordered from local suppliers), and induced spending (e.g., every dollar spent on HSR will result in additional consumer spending) (Blanquart & Koning, 2017). Several ex-ante studies have attempted to forecast the potential economic impacts of planned and under construction HSR projects (Blanquart & Koning, 2017). In the United Kingdom, the construction of High-Speed 2 (HS2) is forecast to generate more than 22,000 direct and indirect jobs within five-years of the system opening in the mid-2020s (Eyles, 2013). Similarly, the “Basque Y” high-speed rail in Spain is estimated to generate 100,000 jobs including 40,000 direct jobs, 30,000 indirect jobs, and 30,000 induced jobs (Fernandez-Macho, Bhogal, Diaz-Emparanza, & Gonzalez, 2012). Nixon et al. (2018) estimate that the planned HSR system in California will generate more than 25,000 full-time equivalent job years, valued at $67,200 per a job year between 2015 and 2029 under the most conservative scenario evaluated (Nixon, Holian, Niles, & Pogodzinski, 2018).

In addition to these forecasts, several retrospective studies have attempted to study the economic impacts of completed projects (Blanquart & Koning, 2017). A study of HSR in Europe by Cheng et al. (2015) found that employment growth is generally higher in urban centers with high-speed rail (Cheng, Loo, & Vickerman, 2015). Another study by Fouqueray (2016) found that the construction of the Tours and Bordeaux HSR line created nearly 14,000 jobs and contributed €1.6 billion GDP, including induced effects of 18 to 25% (Fouqueray, 2016). Zhang et al. (2019) discuss two hypotheses about the economic impacts of HSR on smaller cities. One hypothesis is that the improved accessibility from HSR attracts investment and other economic activity, which in turn helps smaller cities grow and reduce spatial inequality between rich and poor regions. Another hypothesis suggests that HSR causes a "siphon effect" where workforce talent and investment flow from smaller cities to larger ones (Zhang, Wan, & Yang, 2019).

Rothengatter (2019) argues that traditional cost-benefit analysis methods are insufficient to evaluate the economic impacts of HSR because the spillover economic impacts at a micro-scale around stations, meso-scale for regions and corridors, and macro-scale for an economy (Rothengatter, 2019). According to Wetwitoo and Kato (2019), "the effect of HSR on the economy can be seen in many indicators … production, measured by gross domestic product (GDP), could be the most straightforward indicator for determining the contribution of HSR to the economy. A positive effect of HSR on production and productivity (typically measured with a labor productivity index such as GDP per employee) has been seen in many countries" (Wetwitoo & Kato, 2019).

A study of the economic impacts of HSR in France found that regions with HSR tend to have higher per capita GDP compared with adjacent regions without rail service (Bouf & Desmaris, 2020). Studies from Spain suggest that HSR has had a positive impact on GDP and employment, largely attributed to improvements in accessibility. Using a structural equation model applied to a case study of Spain, Chen and de Abreu e Silva (2014) found that investments in high-speed rail paired with higher levels of educational attainment increases employment and GDP output (Chen & de Abreu e Silva, 2014). Another study of HSR in Germany found that a 1% increase in market access is correlated with 0.25% growth in GDP. The study examined case studies of Limburg and Montabaur and found that both stations were associated with a 2.7% increase in GDP compared to the rest of the study area (Ahlfeldt & Feddersen, 2010). Studies from the UK also indicate that HSR could enhance the economy through an agglomeration effect—where a large number of industries co-locate around HSR and benefit from cost reductions and efficiency gains as a result of their proximity to one another (Graham & Melo, 2011). In Japan, Nickelsburg et al. (2018) found a temporary increase in GDP growth rates as infrastructure and housing built along a HSR line are constructed (Nickelsburg, Ahluwalia, & Yang, 2018). Studies from South Korea also indicate that HSR has had a positive impact on regional GDP (Kim, Lee, & Park, 2013).

## Tourism

Previous studies have examined the potential impacts of HSR on business and leisure travel, often with conflicting results. A study by Bonnafous (1987) looked at the impacts of high-speed rail in France on tourism. The study found that high-speed rail induced demand for same-day travel while reducing demand for overnight trips in larger station cities (Bonnafous, 1987). However, this study may have limited utility given its age. Campa et al. (2016) studied HSR in Spain and found that it has a somewhat positive affect on attracting international tourists. This study found that HSR service was associated with 1.3% more foreign tourists and 1.7% more tourism revenue (Campa, Eugenia López-Lambas, & Guirao, 2016). Another study cited by the World Bank examined the Shinkansen lines that opened in the early 2000s found a 20% increase in leisure travelers (The World Bank Group, 2014). Other studies of HSR in China, Japan, and Taiwan found that HSR can increase leisure travel (Wang, Huang, Zou, & Yan, 2012) (Cheng Y.-H. , 2010). Another study of systems in Spain and France found that HSR contributes to the growth of business and leisure travel (Todorovich, Schned, & Lane, 2011) (Ureña, Menerault, & Garmendia, 2009) (Bazin, Beckerich, & Delaplace, 2015). However, a multi-city study by the South East England Development Agency comparing 13 case studies in France, Germany, the Netherlands, and the UK found that few cities experienced an increase in tourism due to HSR (South East England Development Agency, 2008). Others have critiqued that HSR could have negative impacts on tourism by potentially reducing the length of trips (e.g., fewer hotel nights and tourism taxes) (The World Bank Group, 2014) (Fernandez-Macho, Bhogal, Diaz-Emparanza, & Gonzalez, 2012) (Mannone, 1995) (Chen X. , 2013).

### Housing

Several studies have examined the impact of rail transport on residential prices and affordable housing. Many of these studies have examined the potential economic benefits associated with rail station and transit-oriented developments (Murakami & Cervero, 2010) (Belzer, et al., 2011) (Chandra, Thai, Mishra, & Wong, 2021). These studies suggest that land use policy, transit-oriented development, joint development, and value capture are important policies that can help maximize real estate development around HSR stations.

Hensher et al. (2012) found that HSR can have mixed impacts on property values (Hensher, Mulley, & Li, 2012). Hensher et al. (2012) conducted a meta-analysis and found that HSR was attributed to higher land and property values in China, France (Le Mans, Lyon, and Nantes), Italy (Naples and Turin), Japan, UK (Ashford and London), and Spain (Ciudad Real). The study also found that HSR had no impact of property values in France (Le Creusot and Strasbourg), German (Berlin), Italy (Florence), and Taiwan (Tainan). The study found that HSR had a negative impact on land and property values in France (Paris) and Italy (Milan and Rome) (Hensher, Mulley, & Li, 2012).

Gargiulo and de Ciutiis (2010) found that average property values in the 10th arrondissement in Paris increased by 2.18 percent, compared to a 4 percent increase in all of Paris the year that the Gare de l'Est station was redeveloped for HSR (Gargiulo & de Ciutiis, 2010). The study also found the average price of properties decreased by 13 percent (compared to 7 percent citywide) between 1994 and 1995 when HSR service between Paris and the Channel Tunnel opened. Kilpatrick et al. (2007) also found that proximity to a rail corridor without direct access to that rail network has a negative effect on housing values (Kilpatrick, Throupe, Carruthers, & Krause, 2007).

However, Diaz and Mclean (1999) found that an increase in rail accessibility was positively correlated to higher real estate prices (Diaz & Mclean, 1999). A study by Brandt and Maennig (2012) found that the presence of a railway station in Hamburg, Germany contributed to condominium prices that were 4.6% higher (Brandt & Maennig, 2011). Cascetta et al. (2010) and Pagliara et al. (2010) found that HSR contributed to a modest increase in land prices around St. Pancras station in London (Pagliara, Barrasso, & Preton, 2010) (Cascetta, Pagliara, Brancaccio, & Preston, 2010). Preston and Wall (2008) found that the opening of the Ashford HSR station was correlated with a three percent increase in housing prices compared to the rest of Southeast England (Preston & Wall, 2008).

### Station Area and Regional Development

Tierney (2012) argues that HSR in the United States could expand and connect megaregions forming the corridors of housing, employment, and recreation in the more densely populated areas of the country. The paper argues that HSR could transform auto-dependent suburbs into dense transit-oriented development around station areas (Tierney, 2012). Studies of HSR in Europe have found that medium-sized cities within 1 hour travel time on HSR of a larger city have transformed from being spatially isolated to becoming integrated with larger metropolitan areas (Garmendia, de Ureña, Ribalaygua, Leal, & Coronado, 2008). A study of HSR in Japan by Nickelsburg et al. (2018) found that over a 55-year period, HSR helped alleviate pressure on home prices in major cities (Nickelsburg, Ahluwalia, & Yang, 2018). Wetwitoo and Kato (2019) conclude that HSR has a significant effect on the local economy for approximately 6 to 18 miles (10 to 30 km) around a station, depending on the characteristics of the local economy (Wetwitoo & Kato, 2019).

A number of European studies have found that HSR can support economic development in larger station communities while having a neutral to negative impact on the economic development in smaller station communities and peripheral cities that are not directly connected to the rail network (Vickerman,1997) (Gutiérrez, 2001) (Monzón, Ortega, & López, 2013) (Chen & Haynes, 2015) (Jia, Zhou, & Qin, 2017). Vickerman (2015) found that the new stations in medium-sized cities between larger metro areas in Europe are mostly located in exurban areas (e.g., Haute Picardie, Lorraine) with limited public transportation options (Vickerman, 2015). Vickerman (2015) concludes that there has been limited local economic development at these station locations and that supportive feeder transit and land use policy are needed to help transform these station locations into destinations. Other studies from Germany, South Korea, and Taiwan have found lower ridership and economic development from poorly sited HSR stations, often in suburban locations (Marti-Henneberg, 2015) (Yin, Bertolini, & Duan, 2015). Kim et al. (2018) concludes that planning new HSR stations in small and medium-sized cities in proximity to central places (e.g., destinations) is the single most important factor to enhance the economic impact of HSR. Kim et al. (2018) also concludes that HSR in suburban locations requires careful land use planning to maximize ridership and economic development impact (Kim, Sultana, & Weber, 2018).

### Other Economic Impacts

A number of studies have also attempted to quantify economic impacts associated with time savings, reduced congestion, and lower emissions (pollution and greenhouse gas (GHG)). Edwards (2012) identifies upwards of $48 billion AUD in direct user benefits and externalities to society. The study quantifies time savings valued at $31 billion AUD, GHG and pollution savings valued at $2.06 billion AUD, congestion savings of $11 billion AUD, and savings associated with reduced vehicular accidents estimated at $4 billion AUD (Edwards, 2012). In 2019, the California High-Speed Rail Authority commissioned an Equivalent Capacity Analysis study to estimate what it would cost to add the equivalent of the 500-mile high-speed rail system's people-carrying capacity by expanding highways and airports instead (WSP, 2019). The study found that it would cost an estimated $122-199 billion to provide the equivalent highway and airport capacity that the San Francisco to Los Angeles high-speed rail network would provide (WSP, 2019). This included an estimated $102-165 billion to add 4,196 lane miles of highways and $21-34 billion to add two runways and 91 gates to California's airports (WSP, 2019). The study concludes that the equivalent roadway and airport capacity would cost about twice as much as high-speed rail and result in greater greenhouse gas emissions (WSP, 2019).

## Key Takeaways

An emerging body of literature largely published before the global pandemic indicates that HSR has a variety of micro-, meso-, and macro- economic impacts such as job creation and increased economic output. However, studies also indicate uncertain impacts on tourism because the increased access that HSR provides can both induce demand for leisure and business trips but also contribute to shorter trip lengths. Additionally, research also suggests mixed impacts on housing affordability, station area development, and broader regional location decisions. A number of studies suggest that HSR has the potential to encourage station area development in the immediate vicinity of HSR stations. However, this can also contribute to higher land values, gentrification, and displacement. Additionally, the access gained through HSR has the potential to expand access to additional housing options along a high-speed network but could also contribute to longer commutes and possible suburbanization. Moreover, documenting the economic impacts of high-speed rail systems is difficult due to limited fine-grained economic data, and differences in models, data collection, and study methodologies, which frequently produce inconsistent findings. Most existing studies were also completed before the pandemic and therefore fail to account for other changes in travel behavior such as the growth of telework. As travel behavior continues to stabilize in the post-pandemic period, high-speed rail may have to reinvent itself in response to these changes in order to maximize potential economic benefits.

## References


Ahlfeldt, G., & Feddersen, A. (2010). From periphery to core: economic adjustments to high speed rail. London: London School of Economics.

Bazin, S., Beckerich, C., & Delaplace, M. (2015). Desserte TGV et villes petites et moyennes. Une illustration par le cas du tourisme à Arras, Auray, Charleville-Mézières et Saverne. Charleville-Mézières: Les Cahiers scientifiques du transport.

Belzer, D., Srivastava, S., Austin, M., Wood, J., Bump, T., & Popuch, E. (2011). Transit and Regional Economic Development". Chicago: Center for Transit Oriented Development.

Blanquart, C., & Koning, M. (2017). The local economic impacts of high-speed railways: theories and facts. European Transport Research Review.

Bonnafous, A. (1987). The regional impact of the TGV. Transportation, 127–137.

Bouf, D., & Desmaris, C. (2020). Spatial equity and high speed trains: the example of France. Sociology and Anthropology, 143-158.

Brandt, S., & Maennig, W. (2011). The impact of rail access on condominium prices in Hamburg. Transportation, 997-1017.

Campa, J., Eugenia López-Lambas, M., & Guirao, B. (2016). High speed rail effects on tourism: Spanish empirical evidence derived from China's modelling experience. Journal of Transport Geography, 44-54.

Cascetta, E., Pagliara, F., Brancaccio, V., & Preston, J. (2010). Evaluating regeneration impact of the Channel Tunnel Rail Link. XVI PANAM. Lisbon: Pan-American Conference of Traffic and Transportation Engineering and Logistics.

Chandra, S., Thai, T., Mishra, V., & Wong, P. (2021). Evaluating Innovative Financing Mechanisms for the California High-Speed Rail Project. San Jose: Mineta Transportation Institute.

Chen, G., & de Abreu e Silva, J. (2014). Estimating the provincial economic impacts of high-speed rail in Spain: An application of structural equation modeling. Procedia - Social and Behavioral Sciences, 157-165.

Chen, X. (2013). Assessing the Impacts of High Speed Rail Development in China's Yangtze River Delta Megaregion. Journal of Transportation Technologies, 113-122.

Chen, Z., & Haynes, K. (2015). Impact of high speed rail on housing values: an observation from the Beijing–Shanghai line. Journal of Transport Geography, 91-100.

Cheng, Y.-H. (2010). High-speed rail in Taiwan: New experience and issues for future development. Transport Policy, 51-63.

Cheng, Y.-s., Loo, B., & Vickerman, R. (2015). High-speed rail networks, economic integration and regional specialisation in China and Europe . Travel Behaviour and Society, 1-14.

Diaz, R., & Mclean, V. (1999). Impacts of Rail Transit on Property Values. American Public Transit Association Rapid Transit Conference Proceedings (pp. 1-8). Washington DC: American Public Transit Association.

Edwards, N. (2012). High Speed Rail Benefits that Add Up. Melbourne: Australian Greens.

Eyles, L. (2013). HS2 – Jobs Analysis. Albion: Albion Economics.

Fernandez-Macho, J., Bhogal, P., Diaz-Emparanza, I., & Gonzalez, P. (2012). Economic impact of the New Basque Railway Network on the BCAC. Madrid: Obras Públicas y Transportes.

Fouqueray, E. (2016). Impact économique de la construction de la LGV SEA Tours-Bordeaux sur les régions traversées. Revue d'Économie Régionale & Urbaine, 385-416.

Gargiulo, C., & de Ciutiis, F. (2010). Urban Transformation and Property Value Variation: The Role of HS Stations. Journal of Mobility, Land Use and Environment, 65-84.

Garmendia, M., de Ureña, J., Ribalaygua, C., Leal, J., & Coronado, J. (2008). Urban Residential Development in Isolated Small Cities That Are Partially Integrated in Metropolitan Areas By High Speed Train. European Urban and Regional Studies, 249-264.

Graham, D., & Melo, P. (2011). Assessment of Wider Economic Impacts of High-Speed Rail for Great Britain. Transportation Research Record: Journal of the Transportation Research Board, 15-24.

Gutiérrez, J. (2001). Location, economic potential and daily accessibility: an analysis of the accessibility impact of the high-speed line Madrid–Barcelona–French border. Journal of Transport Geography, 229-242.

Hensher, D., Mulley, C., & Li, Z. (2012). The impact of high speed rail on land and property values: A review of market monitoring evidence from eight countries. Road and Transport Research, 1-15.

Jia, S., Zhou, C., & Qin, C. (2017). No difference in effect of high-speed rail on regional economic growth based on match effect perspective? Transportation Research Part A: Policy and Practice, 144-157.

Kilpatrick, J., Throupe, R., Carruthers, J., & Krause, A. (2007). The Impact of Transit Corridors on Residential Property Values. Journal of Real Estate Research, 303-320.

Kim, H., Sultana, S., & Weber, J. (2018). A geographic assessment of the economic development impact of Korean high-speed rail stations. Transport Policy, 127-137.

Kim, H.-W., Lee, D.-H., & Park, H.-S. (2013). The impact of Gyeongbu High Speed Rail construction on regional economic growth. Construction Management, 1206-1212.

Mannone, V. (1995). L’impact régional du TGV sud-est. Aix-en-Provence: .

Marti-Henneberg, J. (2015). Attracting travellers to the high-speed train: a methodology for comparing potential demand between stations. Journal of Transport Geography, 145-156.

Monzón, A., Ortega, E., & López, E. (2013). Efficiency and spatial equity impacts of high-speed rail extensions in urban areas. Cities, 18-30.

Murakami, J., & Cervero, R. (2010). California High-Speed Rail and Economic Development: Station-Area Market Profiles and Public Policy Responses . Berkeley: University of California.

Nickelsburg, J., Ahluwalia, S., & Yang, Y. (2018). High-Speed Rail Economics, Urbanization and Housing Affordability Revisited: Evidence from the Shinkansen System. Los Angeles: UCLA.

Nixon, H., Holian, M., Niles, J., & Pogodzinski, J. (2018). Measuring the Economic Impact of High Speed Rail Construction for California and the Central Valley Region. San Jose: Mineta Transportation Institute.

Pagliara, F., Barrasso, C., & Preton, J. (2010). High Speed Rail Accessibility Impact on Property Prices: Evidence from St Pancras International Station in London. XVI PANAM. Lisbon: Pan-American Conference of Traffic and Transportation Engineering and Logistics.

Preston, J., & Wall, G. (2008). The ex-ante and ex-post Economic and Social Impacts of the Introduction of High Speed Trains in South East England. Planning, Practice and Research, 403-422.

Rothengatter, W. (2019). Approaches to Measure the Wider Economic Impacts of High-Speed Rail and Experiences from Europe. Tokyo: Asian Development Bank Institute.

South East England Development Agency. (2008). HST Impact Study. Brussels: La Commission Européenne.

The World Bank Group. (2014). Regional Economic Impact Analysis of High Speed Rail in China. Washington DC: The World Bank Group.

Tierney, S. (2012). High-speed rail, the knowledge economy and the next growth wave. Journal of Transport Geography, 285-287.

Todorovich, P., Schned, D., & Lane, R. (2011). High-Speed Rail: International Lessons for U.S. Policy Makers. Cambridge: Lincoln Institute of Land Policy.

Ureña, J., Menerault, P., & Garmendia, M. (2009). The high-speed rail challenge for big intermediate cities: A national, regional and local perspective. Cities, 266-279.

Vickerman, R. (1997). High-speed rail in Europe: experience and issues for future development. The Annals of Regional Science, 21-38.

Vickerman, R. (2015). High-speed rail and regional development: the case of intermediate stations. Journal of Transport Geography, 157-165.

Wang, X., Huang, S., Zou, T., & Yan, H. (2012). Effects of the high speed rail network on China's regional tourism development. Tourism Management Perspectives, 34-38.

Wetwitoo, J., & Kato, H. (2019). Regional and Local Economic Effects from Proximity of High-Speed Rail Stations in Japan: Difference-in-Differences and Propensity Score Matching Analysis. Transportation Research Record: Journal of the Transportation Research Board, 323-333.

WSP. (2019). 2019 Equivalent Capacity Analysis Report. Sacramento: California High-Speed Rail Authority.

Yin, M., Bertolini, L., & Duan, J. (2015). The effects of the high-speed railway on urban development: International experience and potential implications for China. Progress in Planning, 1-52.

Zhang, A., Wan, Y., & Yang, H. (2019). Impacts of high-speed rail on airlines, airports and regional economies: A survey of recent research. Transport Policy, A1-A19.

## Acknowledgement

The author thanks Lisa Rose, for editorial services, as well as MTI staff, including Executive Director Karen Philbrick, PhD; Deputy Executive Director Hilary Nixon; Public Programs Coordinator Alverina Eka Weinardy; and Graphic Design Assistant Minhvy Tran.

### About the Author

Adam Cohen is an MTI Research Associate and a researcher at the Transportation Sustainability Research Center at the University of California, Berkeley. Since joining the group in 2004, his research has focused on innovative mobility, including shared mobility, smart cities technologies, smartphone apps, automated and connected vehicles, urban air mobility, and other emerging transportation technologies. He has also co-authored numerous peer-reviewed articles and reports on innovative mobility.

This report can be accessed at
transweb.sjsu.edu/research/2255

MTI is a University Transportation Center sponsored by the U.S. Department of Transportation's Office of the Assistant Secretary for Research and Technology and by Caltrans. The Institute is located within San José State University's Lucas Graduate School of Business.