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Case Study

Socioeconomic and Spatial Impacts of High-Speed Rail on Enterprises: An Ex-Ante Case Study of Ahmedabad Station Area, India

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Abstract: Growth benefits of high speed rail (HSR) for enterprises are not automatic, but require a buoyant local economy and a robust strategy. Against the above background, the main objectives of ex-ante case study have been to investigate local socio-economic and spatial impacts of proposed HSR project around Ahmedabad station area on the Mumbai-Ahmedabad HSR corridor, analyze the opportunities and challenges of HSR development and draw policy implications. Qualitative research methodology has been used to elicit the perceptions and perspectives of randomly selected 43 small, medium and large enterprises. Data has been analyzed using descriptive statistics. The study reveals that HSR induced greater human interaction will activate the local economy, improve business efficiency and generate employment. Frequent travels on business trips can influence enterprises' decision to settle near HSR stations for easy access and likely to promote realty development. The proposed HSR project should be developed in synergy with the urban dynamics of cities in transition and metropolitan service cities. Poor public transport connectivity is likely to be a major challenge in improving HSR accessibility and enhancing overall impacts of HSR, which can be improved by developing an integrated urban transport system, for which cooperation of all stakeholders and coherence with firms' strategies is essential.

***Keywords*:** high speed rail project, enterprise, infrastructure, socio-economic, spatial impacts, urban development, policy

JEL Codes: L26, L92, O18, O29, R12, R40

1. Introduction

Infrastructure development positively impacts urban development, land use pattern, land price and revenue generation (Shibasaki et al., 2020). Transport infrastructure stimulates economic growth, which also depends on the buoyancy of the local urban conditions (Renzhi, 2020). Robust transportation plays a significant role in the development of agglomeration economies, improves productivity, and access to resources and innovation spillovers (Wetwitoo, 2020). Firms become more productive due to high competition and agglomeration benefits of the city economy. Regional impacts of improved transportation cause higher aggregate real income. Public transportation increases regional accessibility, improves business and residential areas (Albalate & Bel, 2012), which increases employment

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growth and enhances urban productivity due to a significant reduction in travel time and cost and agglomeration benefits (Glaeser, 2000). New transport infrastructure leads to better accessibility, attractiveness and development of the regions and reduces travel times. High-speed rail (HSR) is one of the major determinants of urbanization and economic growth (Berger & Eno, 2017). HSR accelerates the local and regional economy (Yin et al., 2015) and generates wider economic impacts (Graham & Melo, 2011) through a frequent business contact, time savings and market information (Vickerman, 2017). HSR is critical for economic development and technological innovation, which led many economies to invest in its development (Renzhi, 2020). However, high cost impedes infrastructure development for HSR projects (Nakamura et al., 2019).

Land acquisition is a major hurdle in infrastructure development for an HSR project (Yoshino et al., 2020). However, HSR increases tax revenue, boosts tourist inflow and attracts private investment (ADBI, 2018; Seetha Ram & Bharule, 2019). Besides spillover impacts of HSR projects (Yoshino & Abidhadjaev, 2017), interventions to improve the quality of life including safety and amenities are needed in station areas for higher transit ridership (Nakamura et al., 2017). HSR projects also led to spatio-temporal variations in land cover and land value (Kanasugi & Ushijima, 2017), bringing economic, environmental, and social benefits within urban agglomerations and outside the areas of the HSR network by connecting the neighborhood locations, which require well planned station location and design (Yu et al., 2014). HSR stimulates economic development, changes land use patterns, and creates new opportunities for firms. Growth of population and employment are positively linked to the presence of HSR stations compared to regions without direct HSR services. HSR services improve accessibility (Cao et al., 2013; Zhao & Yu, 2018), promote tourism, services and industrial sectors, enhance productivity by developing markets and generate more equitable development. In India, Mumbai-Ahmedabad HSR (MAHSR) project is the first HSR system initiative, which intends to link metropolitan city of Mumbai and Ahmedabad. Both cities are India's growing business and financial hubs. MAHSR project is primarily based on Japanese experience of bullet trains. It will bolster Japan-India relations in HSR system. MAHSR is expected to cover a distance of about 500 km between Mumbai and Ahmedabad in 2 hours compared to existing 7 hours and 1.5 hours respectively through express train and air travel. MAHSR is expected to generate substantial socio-economic gains and economic growth in station areas and HSR line. Therefore, this study intends to find out the perceived direct and indirect effects of MAHSR development on small, medium and large enterprises covering secondary and tertiary sectors focusing on manufacturing, real estate, wholesale and retail, banking and finance, information technology, commercial services, environmental and sanitation, scientific research and technical services, transport, hotels, education, and culture and public management.

2. Review of literature

The trains operating the exclusive rolling stock and running at above 250 km per hour on modernized consecrated rail lines and 200 km or 220 km per hour on improved rail lines are termed as HSR (UIC, 2008). HSR refers to a passenger train at a designed speed of 250 km/h or more, with a maximum speed of 250 km/h for mixed passenger-freight trains (Blanquart & Koning, 2017). HSR lines can be defined in terms of a rail network, infrastructure and function costs, and anticipated demand (Campos & de Rus, 2009). HSR services generate substantial demonstrable effects in urban economic transition (Ahlfeldt & Feddersen, 2018; Coronado et al., 2019). HSR is the more desired mobility option than road and air travels over long distances (Hayashi et al., 2015) and serves as an alternative to traditional rail (Givoni & Dobruszkes, 2013), aircraft (Dobruszkes et al., 2014), and automobiles (Campos & De Rus, 2009) due to more efficient use of land for transportation (Wee et al., 2005). HSR is one of the major determinants of urbanization (Coronado et al., 2019), economic development (Ahlfeldt & Feddersen, 2018; Chen & Haynes, 2017; Vickerman, 2018) and economic growth (Chen et al., 2019; Vickerman, 2018).

HSR plays a significant role in the development of agglomeration economies (Wang et al., 2019), regional economy (Yin et al., 2015), and local economy (Chen & Hall, 2012) through wider economic impact (Guirao et al., 2017; Vickerman, 2018), social impact (Chen & Vickerman, 2021; Kanasugi & Ushijima, 2017; Wang, 2018), and environmental impact (Chen et al., 2016; Jayal, 2021; Robertson, 2018) on land use pattern (Moyano et al., 2018), land value (Kanasugi & Ushijima, 2017; Yoshino & Abidhadjaev, 2016; Zhang et al., 2020), and revenue generation (Shibasaki et al., 2020; Watson et al., 2019) within urban agglomerations and outside the areas of the HSR network by connecting the neighborhood locations (Chen & Vickerman, 2021), which also depends on buoyancy of the local urban

conditions (Coronado et al., 2019; Vickerman, 2018).

HSR improves the transportation system (Lemoine et al., 2015), increases accessibility (Chai et al., 2018; Jiao et al., 2017; Moyano et al., 2018), enhances regional attractiveness and development (Yu & Yao, 2019), improve businesses and residential areas (Beckerich et al., 2019), creates new commercial, leisure and office facilities (Matas et al., 2020), fosters new opportunities, modernity and innovation and facilitates frequent business contact (Zunder & Islam, 2018), which increase employment growth and boost urban productivity (Coronado et al., 2019) due to time savings (Shen et al., 2017), better market information (Vickerman, 2018), a significant reduction in business cost (Diao et al., 2019), and agglomeration benefits and higher aggregate real income (Ahlfeldt & Feddersen, 2018).

Despite the high investment in HSR development (Ansar et al., 2016), HSR benefits the regional governments from an increase in tax revenue (Yoshino & Abidhadjaev, 2017; Watson et al., 2019), tourist inflow (Chen & Haynes, 2015; Pagliara et al., 2017; Pagliara & Mauriello, 2020; Wang et al., 2018; Gao et al., 2019; Wetwitoo, 2020), and better performance of private investors (ADBI, 2018; Seetha Ram & Bharule, 2019). The impact of HSR projects on regional tax revenue (Yoshino & Abidhadjaev, 2017), productivity (Wetwitoo & Kato, 2017), and urban expansion (Long et al., 2018) have been widely analyzed. Chen and Haynes (2017) analyzed HSR's impact on economic agglomeration and growth, which benefits small and medium-sized cities around megacities (Jie et al., 2019). Large cities attract additional resources from nearby small and medium-sized cities, thereby reducing the agglomeration capacity of these cities, while larger cities benefit more compared to small and medium-sized cities due to resource outflow. Therefore, efficient markets and proactive government policies are essential to guarantee economic development and competitiveness (Zhihua et al., 2019).

HSR improves interregional mobility and spurred business activity (Hayashi et al., 2017). Technological upgrading improves security, spurs frequency and increases travel quality (KOTI, 2015). HSR produces less carbon footprint than other types of high-powered mobility (Hayashi et al., 2017). HSR substantially impacts the local economy by increasing public tax revenue (Hernandez & Jimenez, 2014; Yoshino & Abidhadjaev, 2017), developing new industrial sites (Han et al., 2012), increasing local efficiency (Wetwitoo & Kato, 2017), land and assets values (Andersson et al., 2010; Kanasugi & Ushijima, 2017), enlarging urban spaces (Long et al., 2018) and boosting socioeconomic development (Proville et al., 2017). HSR generates significant socioeconomic and environmental gains to local urban economy and its vicinity due to impacts of urban agglomerations (Javier et al., 1996) and facilitates mega urban centres to link sharply into surrounding areas with better and reasonable residential and business spaces (Sean, 2012). However, all this gains need robust station area development (Yu et al., 2014) to facilitate stronger urban economic transition around sub-urban HSR stations (Chen & Peter, 2011).

Despite high cost of HSR projects (Ansar et al., 2016; Chen et al., 2019; Crescenzi et al., 2016; Matas et al., 2020; Nakamura et al., 2019) compared with tax revenues (Watson et al., 2019), many economies invested in HSR development (Renzhi, 2020). Japan is the leader in HSR development (De Souza et al., 2018). The Republic of Korea has developed the HSR based on the Japanese HSR model (KOTI, 2015). HSR in Taipei, China had considerable success in the recent past. The People's Republic of China (PRC) is the leader in the length of HSR line with the highest speed of 350 km per hour on the Beijing-Tianjin route and Beijing-Shanghai and Beijing-Guangzhou routes (UIC, 2008). HSR network has crossed over 30000 km in the PRC by 2020, which generated substantial business activities by improving mobility (Li et al., 2016) and accessibility (Amos et al., 2010; Ollivier et al., 2014). In Europe, HSR development has been led by private investors and supported by the funding from European Union (EU). In France, HSR development has been supported by substantial funding from the government, which led to significant social returns since 1981. Spain, Germany and Italy also invested substantially in the development of HSR network in the early 1990s (Givoni, 2006). In recent years, Indonesia and Thailand envisaged to develop HSR lines in collaboration with the PRC.

The ratio of infrastructure investment to tax revenues is as high as 49.1% in South Asia (Yoshino et al., 2020). India also planned to develop seven HSR lines, the first being Mumbai-Ahmedabad HSR in collaboration with the Japan International Cooperation Agency (JICA). The growth benefits of HSR services are not automatic (Chen et al., 2019; Vickerman, 2018), but require a buoyant local economy and a robust strategy to reap the opportunities of improved transport links. The huge potential of HSR to promote economic development can be tapped by building high class urban places consisting of new parks and open spaces including residential and commercial centers and tourism development (Chen & Haynes, 2015; Pagliara et al., 2017; Wang et al., 2018; Zhou & Li, 2017; Gao et al., 2019).

Zhao and Yu (2018) studied micro-level accessibility impacts of HSR project. At the micro-level, HSR services offer wider economic effects (Chen & Hall, 2012; Rothengatter, 2020) through improved mobility patterns (Wang et al., 2020), energy consumption (Cui et al., 2016), and service quality (Wee, 2016). This facilitates communication and cooperation among businesses (Xinze et al., 2017), and offers time-space shrinking, spurs business and boosts leisure travel (Beckerich et al., 2019; Matas et al., 2020). Boulton et al. (2018) argued that HSR impact remains low in sub-urban areas compared to city centers. However, the socio-economic and spatial impacts of HSR project (Jiao et al., 2020) around the station area have received little attention. Therefore, the present study is an attempt in this direction.

Based on the research gaps identified in the detailed review of extant literature, the main objectives of this ex-ante case study have been to investigate the local socio-economic and spatial impacts (Wang et al., 2018) of the proposed HSR project around the Ahmedabad station area on the Mumbai-Ahmedabad HSR (MAHSR) corridor in India, to analyze the opportunities and challenges of HSR development and to draw policy implications.

3. Materials and methods

There are a number of methodological issues related to this research linking to intrinsic complexities to separate the HSR impacts from other development factors (Facchinetti-Mannone, 2019) including short-term and long-term effects (Beckerich et al., 2017). There exists no reflexive and methodical link between HSR and spatial and socio-economic impact (Chen et al., 2019). Therefore, the study of impacts of major transportation projects should focus on regional and time specific impacts (Chen et al., 2019; Crescenzi et al., 2016; Matas et al., 2020). Extant research on local socio-economic and spatial impacts of HSR is quite scant, which is investigated in this ex-ante case study with a major goal to integrate HSR development into policy and planning.

Qualitative research methodology has been used to elicit the perceptions and perspectives (Atkinson et al., 2001) of the targeted population on the phenomenon under investigation (Punch, 2013). The study has used a descriptive ex-ante case study of a proposed Ahmedabad-Mumbai HSR project (Pistol & Bucea-Manea-Tonis, 2017). Ex-ante case study reflects a 'what if analysis' (Bourguignon & Ferreira, 2003). This has been used to understand the socioeconomic and spatial impacts of HSR in the Ahmedabad station area and to draw the best policy options for efficient implementation of the project. The descriptive case study approach has been highly useful to understand an unexplored phenomenon (Creswell, 2009). A comprehensive and in-depth analysis of the targeted population (Simons, 2009) has been undertaken to draw practical lessons. The data and information have been collected from the sampled small, medium, and large enterprises operational in the Ahmedabad station area using the random sampling technique. This ex-ante case study has analyzed issues such as enterprises' preferences to relocate their workplaces to near the HSR station area due to suitable accessibility, which can improve the business operations (Beckerich et al., 2019; Matas et al., 2020), socio-economic and spatial impacts (Jiao et al., 2020) including employment opportunities, long-distance workplaces, a surge in property demand, land values, and property prices around the station (Chen & Haynes, 2015) and other types of impacts (Wang et al., 2019). All efforts have been made to maximize transparency and minimize bias in this qualitative research (Mohajan, 2017).

This ex-ante case study is qualitative and provides the social impacts of HSR on daily life and citizens' lives; economic impacts of HSR on urban economic opportunities, property development, urban quality, urban dynamics, local tourism and recreational activities, indirect effects around the station area, transport demand of enterprises and enterprise operations; and spatial impacts of HSR on redistribution and relocation, and impact on creating an extended functional region. The study has also analyzed the opportunities and challenges of HSR development and drawn significant policy implications

Micro-survey approach has been used to analyze the objectives of the case study using primary data collected from management executives of local small, medium and large enterprises around the proposed HSR station area in Ahmedabad city of Mumbai-Ahmedabad corridor to ascertain the likely magnitudes of socio-economic and spatial effects. Interviews of the management functionaries involved in enterprise operations have been conducted to ascertain the impacts of the proposed HSR Mumbai-Ahmedabad corridor focusing on how enterprises and employees are expected to use HSR and how the use of HSR is likely to impact their work patterns, daily life and enterprise decision-making. Keeping in view the local economic structure of Ahmedabad city, the interviewees have been selected as diversely as possible. A total of 43 enterprises consisting of small enterprises (24), medium enterprises (11) and large

enterprises (8) from secondary and tertiary industries have been selected as sample size. The selected enterprises were engaged in manufacturing (15), real estate (4), wholesale and retail (3), banking and finance (3), information technology (2), commercial services (2), environmental and sanitation (3), scientific research and technical services (1), transport (2), hotels (3), education (3), and culture and public management (2). The data has been analyzed using descriptive statistics.

4. High speed rail: Experiences around the world

The first HSR line, called the *Shinkansen*, was built in Japan, which linked Tokyo to Osaka in 1964 with a speed of 210 km/h in 3 hours and 10 minutes, and 270 km/h in 2 hours and 30 minutes in 1992 using existing railway stations, while some cities and towns were served by new stations. In Europe, the first HSR lines were built in the 1980s by connecting important cities involving private operators and EU funding beginning with France connecting Paris and Lyon in 1981 for regional development followed by Spain connecting Madrid and Seville in 1992, which becomes the largest HSR network in Europe by 2010 and reaching over 3200 km in 2020. In 1991, Germany started InterCity Express (ICE) to connect major cities of France, the Netherlands, Switzerland, Denmark, Belgium, and Austria. In 1992, Italy started its first HSR service connecting Rome and Florence.

In the Republic of Korea (ROK), the operation of the HSR service since 2004 significantly reduced intercity travel. In the PRC, a new generation of HSR with a maximum speed of 350 km/h was opened in 2008 as a green-field project connecting most of the metropolitan regions by 2013 and is likely to reach 30,000 km by 2020 to rejuvenate economic activities in most of the cities in western and central regions. Taipei, China operates the privately funded HSR for commercial, residential, and recreational needs.

In recent years, the Asian countries of India, Indonesia, and Thailand have proposed to develop HSR lines. In 2010, India announced the construction of seven HSR lines connecting major cities, with its first 508 km HSR line connecting Mumbai and Ahmedabad, for which India and Japan entered an agreement in 2015 to adopt Japanese *Shinkansen* technology to be operational by late 2023 at a cost of US$16 billion with funding from the JICA. In 2008, Indonesia announced the Java HSR project connecting Jakarta and Surabaya with a 730 km HSR line and its 150 km initial phase at an estimated cost of US$5.5 billion as part of the PRC's One Belt One Road initiative (BRI) is likely to be operational by early 2021. In 2010, Thailand approved five HSR lines covering a 1,500 km network converging Bangkok at an estimated cost of $30 billion under official development aid projects to be completed by 2036, with the operation of the first phase in 2021.

Japan initiated rail-integrated land development using the *Shinkansen* corridors for the development of services and industries agglomerations, which has had a tremendous impact on Japanese economy and society. ROK integrated regional public transport with HSR corridors and stations to increase accessibility and revenue. Taipei, China established station-to-city center bus services to increase ridership and revenue growth. In China, HSR services have led to improved accessibility and expansion of business-centric regions (Jiao et al., 2017), which led to an increase in employment, average income, production, and property prices (Chen & Haynes, 2015). HSR resulted in savings of travel time (Diao et al., 2019), better safety, comfort, punctuality, and frequency of trains, which enhanced business activity and productivity (Jiao et al., 2017). Improved accessibility strengthens intercity economic links and builds urban agglomerations along the HSR corridors. HSR is preferred over automobiles and planes for long-distance travel due to better safety, frequency and ride quality. HSR generates a very low carbon footprint (Chen et al., 2016) compared with other high-capacity transport. In the construction phase, HSR led to high land prices and property tax revenues near the HSR stations and transformed the regional economy. Despite rapid growth in HSR networks, the potential and challenges of HSR infrastructure remained and need to be addressed.

5. Mumbai-ahmedabad high speed rail

The Vision 2020 of the Indian Railways identified the MAHSR corridor with a route length of 506 km, as one of the HSR corridors to be developed in India, for which a memorandum of cooperation between the Government of Japan and the Government of India was signed in December 2015. In early 2016, the Japan International Cooperation Agency (JICA) assigned Japan International Consultants for Transportation, Co., Ltd. (JIC) for consulting services

in formulating the technical standards for the MAHSR corridor. In mid-2017, officials of the National High Speed Rail Corporation Limited (NHSRCL) visited Japan to gain knowledge of Japan's HSR system under JICA's capacity building and training program. The work on the MAHSR corridor with the Japanese bullet train system-the *Shinkansen* was commenced in 2018 with an estimated cost of US$14.52 billion to be completed by 2023. MAHSR will cover a distance of 508 kilometers (km) between Mumbai and Ahmedabad in around 2 hours at a maximum speed of 320 km/hour covering 12 HSR stations with Mumbai, Ahmedabad, and Sabarmati as busy stations and Surat and Vadodara as semi-busy stations.

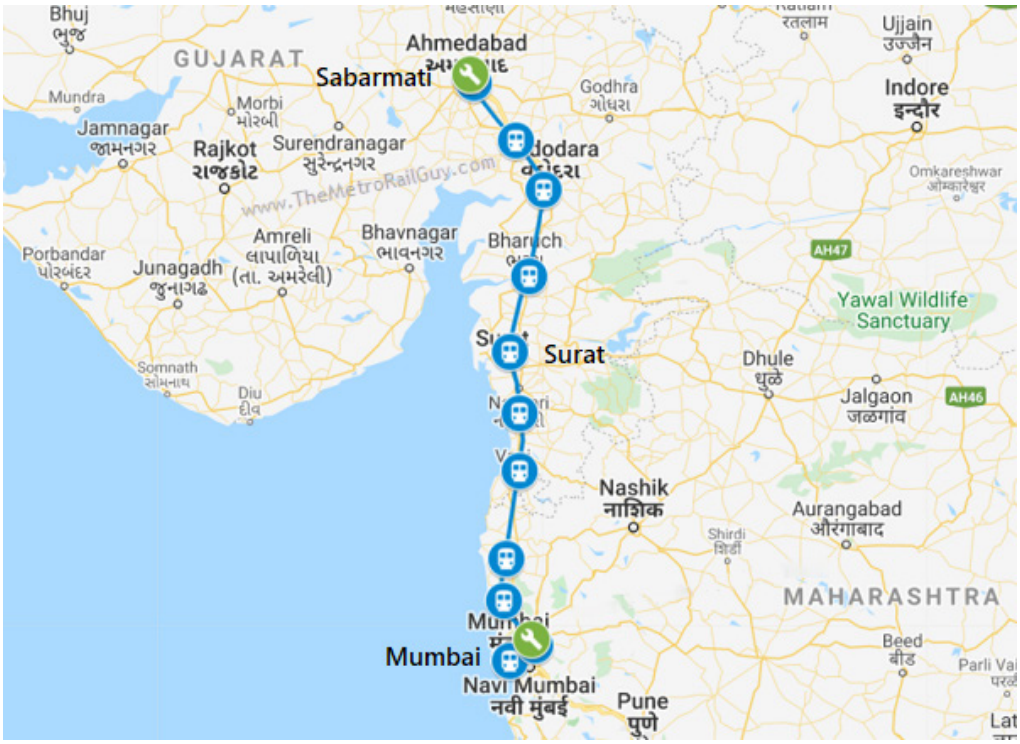

Figure 1. Mumbai-Ahmedabad bullet train route

The average distance between the proposed stations has been 46 km and the proposed HSR fare is 1.5 times of 1A class fare of Indian railways. Vadodara, Ahmedabad, and Sabarmati HSR stations are located on top of a conventional line station. New metro rail lines are under construction close to Ahmedabad HSR Station and Sabarmati HSR Station. A new central business district and a metro rail station are planned to be developed to connect Mumbai-Bandra Kurla Complex. MAHSR project explored integrated station area development (SAD) for reducing CO2 emissions and improving the quality of life in its surroundings. Mumbai-Ahmedabad HSR is expected to carry 40,000 passengers daily in 2023, which is likely to be 200,000 by 2053. Initially, the alignment was a mix of viaduct and grade, which has been changed to complete alignment on a viaduct and a perfect grade separation throughout the alignment. MAHSR project is expected to be completed over a period of seven years from 2017 to 2023 (IBEF, 2019).

6. Results

HSR leads to improved mobility, bolstered convenience, and enhanced interregional economic linkages. HSR directly reduced travel time, increased security, enhanced wellbeing, improved reliability, and boosted economic activity and business efficiency. Improved market access can provide new business opportunities to firms along the HSR routes,

which in turn enlarge their geographic exposure. Therefore, HSR promotes economic activities across urban centers along the routes and enhances decent living. HSR station areas have immense potential to expand new businesses. HSR projects can generate spillover impacts on small and medium-sized enterprises, realty markets, services sectors, and novel job opportunities, which will significantly boost tax revenues. In the following sub-sections, the qualitative findings of the study have been presented.

6.1 *Gender, age and expected HSR trips*

Table 1 provided the information on the sample characteristics by gender, age and expected HSR trips by enterprises. The majority of the respondents were males and above 25 years of age engaged as high level management executives in the selected enterprises and performed travel linked professional tasks. Besides leisure trips, the majority of respondents were expected to perform business trips covering a distance of more than 200 km with a likely trip duration of fewer than two days after the operation of HSR.

Table 1. Gender, age and expected HSR trips by enterprises (%)

Characteristics	Small	Medium	Large
Gender			
Male	79.2	72.7	75
Female	16.7	27.3	25
Age			
< 25 years	41.7	27.3	25
> 25 years	58.3	63.3	75
Trip purposes			
Business trips	66.7	81.8	87.5
Leisure trips	33.3	18.2	12.5
Trip Distance (km)			
< 200	58.3	27.3	12.5
> 200	41.7	72.7	87.5
Average Trip Duration (days)			
< 2 days	83.3	81.8	75
> 2 days	16.7	18.2	25

Therefore, HSR corridors can develop cultural, entertainment, and education centers along with residential and commercial buildings along the station areas and routes. HSR station areas should develop hotel industries, food and beverages, media, leisure and entertainment services, which can potentially promote intercity leisure travel. Rapid urbanization and population influx to metro cities along the HSR line can increase intense pressure on mass transit systems and traffic jams. Increased economic activities and businesses can improve the financial conditions of business travelers, which can shift a large proportion of commuters to HSR, thus easing peak hour road traffics along the HSR corridor. In recent years, there has been significant growth of domestic tourism in India. During holidays and festive

seasons, traffic congestion and jams have been severe due to a rapid surge in private automobiles. HSR development can benefits the tourist market immensely along the routes.

6.2 *Social impacts of HSR*

Table 2 and Table 3 provided the social impacts of HSR on citizens' daily life. Enterprises expected that HSR is likely to impact people's daily life due to improving service reliability during extreme weather conditions, providing comfortable and spacious carriages and reducing travel time significantly. It was expected that HSR induced greater human interaction can activate the local economy, and increase consumption and capital investment, thereby can improve their business efficiency and generating employment.

Table 2. Social impacts of HSR on daily life (%)

Social Impacts	Small	Medium	Large
Impacts on daily life	91.7	90.9	87.5
Enhance service reliability	70.8	81.8	50
More comforts and spacious carriages	66.7	36.4	37.5
Shorter travel time	83.3	63.3	62.5
Impacts on regional economy	70.8	54.5	75
Activate local economy	75	36.4	37.5
More consumption activities	66.7	27.3	37.5
More capital investment	54.2	45.4	50
Improve business efficiency	75	27.3	37.5
Increase in workers	33.3	36.4	12.5

Table 3. Impact on citizens' lives (%)

Impact on Citizens' Lives	Small	Medium	Large
Intensify inter-urban integration	83.3	63.3	62.5
Reunion of long-distance couple	62.5	45.4	37.5
Frequent inter-city get-togethers	33.3	72.7	50
Build social networks	33.3	36.4	50
Facilitate business opportunities	54.2	36.4	75

Table 3 showed how the opening of Mumbai-Ahmedabad HSR is expected to impact the citizens' lives. Most small enterprises expressed that the introduction of HSR is likely to intensify inter-urban integration and reunion of long-distance couples, whereas a large number of medium and large enterprises expected that HSR is likely to influence more frequent inter-city get-togethers linked with business or private purposes, which can strengthen the social networks and create new business opportunities. Some enterprises expressed that frequent travels on business trips can influence

their decision to settle near HSR station for easy access from home and increase their trips for shopping and concerts. Therefore, the opening of the HSR station is likely to promote realty development around the HSR station.

Realty development depends on community networks and ease of mobility. High cost housing in city centers forces people to reside in distant places in peri-urban or suburban locations or urban slums. New residential and commercial reality development takes place along the HSR routes due to improved mobility, less travel time, and better safety. Improved access to markets provides better business development opportunities along the HSR line.

6.3 *Economic impacts of HSR*

HSR generates economic benefits along the routes, while outer regions effectively linked to the HSR network could gain from the spread effects of agglomerations along the routes. HSR links urban agglomerations to peri-urban and semi-urban areas with reasonable residential and commercial prices. HSR development can create higher economic growth in HSR stations and suburban stations. HSR can increase economic growth in core urban centers due to the urban agglomeration effect. HSR improves urban accessibility along HSR routes, but increases the accessibility gap in periphery regions. HSR development can bolster tourism attraction along the HSR corridor. HSR development generates wider economic impacts due to substantial behavioral transformation among individuals and enterprises leading to the centralization of economic avenues through savings of time.

HSR development persuades industrial location along the station areas, improves local efficiency, increases property values, expands urban neighborhoods and improves socioeconomics. HSR development improves linkage to urban neighborhoods, provides better habitable community space, civic amenities, reasonable housing, and strong social networks and community cooperation around station areas.

Table 4 revealed the enterprises' expectation of the impact of HSR investment and change in accessibility on the economy via lower travel costs, less travel time and improvement in services through greater human interaction, information exchange, goods movement, which can improve employment and productivity.

Table 4. Economic impact of change in accessibility (%)

Impact on Investment and Accessibility	Small	Medium	Large
Lower travel costs	83.3	81.8	87.5
Less travel time	87.5	72.7	62.5
Improve services	70.8	45.4	75
Greater human interaction	66.7	45.4	62.5
Better information exchange	54.2	36.4	37.5
Speedier movement of goods	33.3	27.3	37.5
Increase employment	20.8	27.3	25
Enhance productivity	20.8	45.4	25

Table 5 revealed the expected impact of HSR on urban economic opportunities. The proposed HSR corridor is likely to increase the opportunity for urban economic expansion in the cities connected to the line via external impulse to an urban region. Enterprises expressed that HSR is expected to reduce transport costs, increase welfare potential within the corridor economy and facilitate the transition from industrial to a service economy. HSR induced external accessibility can increase the urban economic potential in the corridor region. However, side effects of improved external accessibility such as the loss of activities towards larger cities, can expand their catchment areas and need careful attention, because larger cities along the HSR corridor already possess high economic potential to attract new

enterprises due to the availability of well-educated residents, consolidated business clusters and robust legal and fiscal regimes. Therefore, enterprises in larger cities are likely to gain further through improved external accessibility.

Table 5. Impact on urban economic opportunities (%)

Impact on Urban Economic Opportunities	Small	Medium	Large
Reduces transport costs	29.2	18.2	37.5
Increase welfare potential	20.8	27.3	25
Facilitate transition to service economy	33.3	27.3	37.5
High economic potential	66.7	54.5	50
Attractive location for new companies	20.8	18.2	25
Well-educated residents	33.3	27.3	37.5
Consolidated business clusters	45.8	36.4	25
Attractive legal and fiscal regimes	16.7	27.3	37.5

Table 6 revealed that the proposed HSR is expected to significantly affect the property values of land around the station area. A station area refers to both permanently and temporarily inhabited areas of the city, which provides a connection to both material and immaterial flows. Enterprises expressed an increase in transactions of land and building sites, and also a surge in land and apartment prices and rentals (Chen & Haynes, 2015) in the station area after the operation of HSR. Residential property prices are likely to be affected marginally in the station area. High property values around station areas can stimulate land speculation and land hoarding by property developers. High land values can negatively influence overall development of the station area in long run due to land speculation.

Table 6. Effect on property development in the station area (%)

Property Development	Small	Medium	Large
Surge in property values of land	79.2	45.4	62.5
Increase transactions of land and building sites	58.3	81.8	37.5
Increase in land prices	62.5	54.5	25
Increase in apartment prices	45.8	27.3	25
Surge in residential property prices	33.3	54.5	12.5
Increase in rentals	50	18.2	37.5
Surge in land speculation	20.8	27.3	37.5
Land hording by property developers	37.5	36.4	25

Table 7 revealed that the operation of HSR is expected to create new urban images and boost the economic development of station areas. Besides potential business centers, HSR is likely to provide potential public spaces and

urban quality around station areas. The urban quality of HSR station areas is likely to be influenced by better urban design and development of cultural, recreational, educational and environmental facilities. Enterprises expressed that urban quality in station areas can be improved by better urban structure, modern architecture, functional diversity, and quality of public space.

Table 7. Urban quality of station areas (%)

Urban Quality in Station Areas	Small	Medium	Large
Improved urban structure	79.2	72.7	75
Modern and international architecture	66.7	54.5	50
Higher functional diversity	58.3	81.8	25
Better quality of public space	83.3	27.3	25

Table 8. Synergy between HSR and urban dynamics (%)

HSR and Urban Dynamics	Small	Medium	Large
Urban transformation			
Growth in service and high-tech enterprises	79.2	81.8	62.5
Reduce unemployment	54.2	45.4	37.5
Integrate young people in urban society	20.8	18.2	25
Rediscover urban value of neighborhoods	29.2	36.4	37.5
Improve urban dynamics	41.7	45.4	62.5
Attract service and leisure economy			
Offices	25	27.3	37.5
Services	29.2	54.5	50
Shops	20.8	27.3	25
Cultural establishments	41.7	36.4	37.5
Public facilities	16.7	18.2	25
Housing	37.5	27.3	12.5
High-quality open space	12.5	36.4	12.5
Creation of new facilities around station			
Offices	58.3	36.4	50
Entertainment and cultural venues	29.2	27.3	37.5
Congress and exhibition facilities	16.7	27.3	50
International head offices	12.5	18.2	62.5
Growth in new small-scale enterprises	62.5	54.5	37.5
Growth in tourist industry	29.2	36.4	50
Increase in employment	33.3	18.2	25

Table 8 revealed the expectation of enterprises regarding the synergy between HSR and urban dynamics in the HSR corridor. Enterprises expressed that the proposed HSR should be developed in synergy with the urban dynamics of cities in transition as well as metropolitan service cities. Urban development is highly dependent on transport infrastructure development for better accessibility to city centre, suburbs and the region. It also influenced the performance of existing and new transportation systems. The robust synergy between HSR and urban dynamics is likely to transform the urban economy via the development of service and high-tech enterprises including new small enterprises around the station area.

Table 9 is devoted to the expected impact of HSR on local tourism and recreational activities. This table revealed that the opening of HSR is likely to benefit the enterprises to arrange tourist itineraries easily due to the abundant supply of tickets, significantly reduce travel time, and provide clean and comfortable rides for shorter trips. However, high fares can restrict a number of travelers, but are preferred by executives and the younger generation compared to the older generation employees. Better accessibility to event cities is expected to increase the catchment area of small enterprises more compared to medium and large enterprises. This is likely to reduce the pressure of organizing fans to concerts due to their self participation in such events.

Table 9. Impact on local tourism and recreational activities (%)

Impact on Local Tourism and Recreations	Small	Medium	Large
Easier to arrange tourist itineraries	50	36.4	50
Shorten travel time	70.8	81.8	75
Clean and comfortable ride	87.5	63.3	87.5
Prefer by younger generation	62.5	27.3	25
Better accessibility to event cities	62.5	36.4	25
Enlarge catchment area of enterprises	70.8	45.4	37.5
Reduce pressure of organizing concerts	33.3	18.2	12.5
Increase hotel occupancy	12.5	18.2	12.5
Construction of new hotels	16.7	18.2	12.5

An HSR station area includes the zone of influence and development perimeter, which covers three development zones on the basis of accessibility and influence. The primary zone lies within five to ten minutes reach, a secondary zone can be reached within 15 minutes using complementary transport, and the tertiary development zone is more than 15 minutes travel time from the HSR station. Table 10 provided the expectation of enterprises regarding the indirect effects of HSR around station areas. Enterprises expected significantly high effects of the proposed HSR in the primary zone of the station area due to high savings in travel time and lesser use of complementary transport. High proximity to HSR network is expected to enhance its status as a location, which can attract more high-grade office and residential functions, increase land and real estate values and induce high and dense construction around the station area. Secondary zones can also attract some high-grade functional areas, however, the gains in property value and building density is expected to be lower compared to the primary zones of the proposed HSR station area, which may limit investment in these zones in the initial phase of HSR operation. Tertiary development zones are also likely to gain from improved accessibility, but are unlikely to experience direct development effects due to the introduction of the HSR line.

Table 10. Indirect effects of HSR around station area (%)

Effect around Station Area	Small	Medium	Large
Primary zone			
Maximum saving of travel time	58.3	81.8	75
Less use of complementary transport	25	36.4	12.5
Benefits of improved location status	20.8	27.3	12.5
Establishment of high-grade offices and residences	45.8	27.3	37.5
Surge in land and real estate values	37.5	63.3	50
Attractive construction	70.8	36.4	62.5
Secondary zones			
Establishment of high-grade functional areas	29.2	81.8	87.5
Lower gain in property value	29.2	54.5	62.5
Less investment	29.2	54.5	37.5
Tertiary development zones			
Improved accessibility	79.2	72.7	62.5
Less direct development	20.8	27.3	37.5

Manufacturing enterprises transport products through railways and highways. However, sales and procurement personnel are likely to switch to HSR for business trips. Table 11 revealed that service enterprises are likely to choose HSR due to significant reduction in travel time for meeting clients. Enterprises in culture and entertainment activities are likely to rely heavily on HSR to promote business development. Thus, many small and medium enterprises can switch from bus and car to HSR for inter-city travel.

Table 11. Impact on transport demand of enterprises (%)

Transport Demand of Enterprises	Small	Medium	Large
Facilitate business trips	83.3	63.3	62.5
Shorten travel time for meeting clients	83.3	72.7	75
Promote enterprise development	54.2	36.4	37.5

Table 12 provided the impact of proposed HSR on enterprise operations. Site selection of the enterprises is likely to be influenced by local policy, land price, transport accessibility, and logistics services, which varied by the type of enterprise. Site selection of large and medium enterprises is likely to be strongly influenced by local government's preferential policies, availability of sufficient land and transport accessibility. Operation of HSR is likely to influence relocation choices of enterprises in new economic zones. Small enterprises engaged in commercial trade services are likely to establish branch offices in mega-city Mumbai with HSR convenience of intra-city travel. HSR access is likely to strongly influence the site selection of enterprises. Therefore, there is need for more concerted land development

around HSR station to reap the opportunities to attract new enterprises. Most large enterprises expected that the opening of HSR is unlikely to strongly influence their basic enterprise operations, but likely to significantly influence the enterprise travel due to lower travel expenses, time savings, and high productivity.

Table 12. Impact on enterprise operations (%)

Impacts on Business Operations	Small	Medium	Large
Site selection of enterprises			
Local policy	62.5	90.9	100
Land price	70.8	72.7	100
Transport accessibility	66.7	90.9	87.5
Logistics services	87.5	63.3	62.5
Decision-making of enterprise operations			
Influence basic enterprise operations	58.3	72.7	25
Influence enterprise travel	62.5	72.7	87.5
Facilitate human resource allocation	45.8	36.4	37.5
Broaden enterprise catchment areas	58.3	45.4	62.5
Faster enterprise responses	33.3	63.3	37.5
Establish a branch office	20.8	54.5	25
Facilitate employment of expert	12.5	45.4	25
Expand training business	12.5	27.3	12.5
Improve investment of non-local enterprises	25	27.3	12.5
Bring new enterprise opportunities	41.7	54.5	62.5
Promote local enterprise	37.5	54.5	37.5

Most small and medium enterprises expected that the HSR is likely to facilitate the allocation of human resources and expand their catchment areas. Shorter travel time between cities is likely to help staff of small enterprises to cover neighboring cities more easily and their businesses can be expanded to achieve regional scale economy and faster enterprise responses. Most of the medium enterprises are likely to open a branch office in Mumbai with greater inter-city integration. The operation of HSR is also likely to increase the employment of expert trainers, expand training activities, increase participation in trade exhibitions, improve investment in non-local enterprises, and expand new opportunities to promote local enterprises. Therefore, the introduction of HSR is expected to positively influence operations of most enterprises, which is likely to be stronger for service enterprises.

6.4 *Spatial impacts of HSR*

Table 13 provided the expectation of the enterprises regarding the impact of HSR on spatial development. It is expected that introduction of HSR is likely to change the absolute and relative accessibility of different cities, which can increase mobility opportunities (García Mejuto, 2017; Wang et al., 2020), enable business people and tourists to travel

longer distances. HSR-induced relative accessibility can influence the choice of location for housing and place of work for individuals and office sites for businesses and result in regional spatial redistribution.

Table 13. Impact of HSR on spatial development (%)

Spatial Development Effects	Small	Medium	Large
Increase mobility opportunities	62.5	81.8	87.5
Enable longer business travel	29.2	90.9	62.5
Facilitate tourists to travel longer distances	66.7	54.5	37.5
Choice of location	20.8	27.3	12.5
Housing	16.7	45.4	50
Place of work	12.5	45.4	37.5
Office sites	12.5	27.3	25

Table 14 provided the expectation of the enterprises on the redistribution and relocation effects of the opening of HSR corridors. It is expected that the cities along HSR corridor are likely to experience stronger redistribution of social, economic and spatial elements in terms of population, employment, real estate prices, gross value addition, and gross disposable household income. Dominant cities along the HSR corridor are expected to become more competitive after the opening of the line and improve their location advantages. HSR is likely to create new opportunities to conduct business in larger central cities, attract some business activities such as professionals' meetings, mid-level business, consultancy and tourism to the intermediate cities.

Table 14. Impact of HSR on redistribution and relocation (%)

Redistribution and Relocation Impact	Small	Medium	Large
Population growth	87.5	72.7	62.5
Employment levels	79.2	54.4	37.5
Real estate market values	41.7	63.3	75
Gross Value Added	45.8	36.4	50
Gross Disposable Household Income	62.5	54.5	25
Dominant cities to become more competitive	37.5	27.3	12.5
Improve location advantages	54.2	36.4	25
Attract business activity to intermediate cities	20.8	36.4	37.5
Meetings of metropolitan professionals	16.7	18.2	25
Mid-level business	12.5	27.3	25
Technical consultancy firms	8.3	18.2	37.5
Urban tourism	16.7	27.3	12,5

Table 15 revealed the expected impact of HSR on creating an extended functional region. The proposed HSR corridor is likely to connect Mumbai and Ahmedabad metropolitan areas by linking a chain of small cities, which may create an integrated corridor economy. In short-term, HSR is expected to integrate the goods and services market, along with labor, commercial, interpersonal and leisure activities, while it is expected to relocate the households and firms along its corridor in medium-term. The proposed HSR corridor is likely to create a completely new location pattern with high travel volumes along with new travel patterns after the opening of a new line, which can improve the effectiveness of regional labor markets via reduce information decay and easier labor migration.

Table 15. Impact of HSR on creating an extended functional region (%)

Short-Term and Medium-Term Gains	Small	Medium	Large
Short-term gains			
Integrate the goods and services market	91.7	72.7	87.5
Integrate labor, commercial, and leisure activities	70.8	54.5	62.5
Medium-term gains			
Relocate households and firms along its corridor	54.2	36.1	25
Larger travel volumes	70.8	45.4	50
Change in travel patterns	33.3	27.3	62.5
Facilitate effectiveness of regional labour markets	20.8	27.3	37.5

HSR improves regional accessibility as well as door-to-door accessibility. HSR accelerates local markets and regional economy due to huge investment to be met from spillover effect such as surge in tax revenues and enhanced firms' outcomes for which security and necessary facilities are needed for transit passengers in station areas. HSR development increases land prices around station area. The agglomeration gains can be bolstered in the cities along the HSR routes. New enterprises can be moved from nearby urban centers to reap agglomeration advantages. The distant urban centers from the HSR routes can concentrate on different economic activities compared to the cities along the HSR lines. In case of far distant cities from the HSR lines, firms' movement can be restricted and agglomeration gains could be low due to increased transportation cost, which compel the firms to diversify trading activities in local areas such as realty, finance, insurance, restaurants, retail enterprises, and tourism, leisure, and entertainment services.

6.5 *Opportunities and challenges of HSR development*

Table 16 revealed that the proposed HSR corridor is expected to provide a robust opportunity for the urban industry to upgrade and transform cities along the line. HSR development is likely to attract headquarters and R&D centres of multinational corporations (MNCs) in megacities along the proposed corridor. The availability of talented manpower and public institutions in cities connected with the proposed corridor may facilitate further development of existing high technology and knowledge-intensive manufacturing and can provide other connected cities to establish such industries and expand their markets. In brief, concerted efforts should be made to tap human capital resources and prepare robust urban policy and planning to maximize the outcomes of the proposed HSR development.

Table 16 also provided the expressed potential implications and planning challenges of direct and indirect impacts of HSR development. Enterprises opined that HSR is likely to be a very expensive transport mode for passengers and may be out of reach of the income of most people. Other direct challenges include poor accessibility to the stations due to inadequate public transport between station areas and city centers, which require the construction of highways to connect the HSR stations and the city centre so that passengers can save their travel time using public transport.

Therefore, poor public transport connectivity is likely to be a major challenge in improving HSR accessibility and enhancing the overall attractiveness of HSR, which can be improved by developing an integrated urban transport system.

Table 16. Opportunities and Challenges of HSR development (%)

Opportunities and Challenges	Small	Medium	Large
Opportunities			
Upgradation and transformation of urban industry	58.3	72.7	75
Establishment of headquarters and R&D centres of MNCs	37.5	81.8	62.7
Transformation to technology and knowledge-intensive manufacturing	66.7	54.5	37.5
Expansion of existing technology and knowledge-intensive activities	41.7	36.4	87.5
Attraction and expansion of markets	70.8	27.3	25
Challenges			
Very expensive transport mode	58.3	18.2	37.5
Relatively high prices of HSR	54.2	27.3	25
Poor public transport connectivity to station	41.7	45.4	50
Uncertainty in synergy between HSR and urban transformation	62.5	72.7	62.5
Competition between different layers of governments	41.7	45.4	37.5
Assuring qualitative growth of high-end service and leisure functions	33.3	27.3	37.5

HSR development is likely to face potential implications and planning challenges of indirect effects. It is expected that cities connected to HSR will likely perform better than the unconnected cities, which can be addressed by redistribution of tourism, business and the knowledge economy along the HSR line, otherwise, cities with high-quality resources will become more attractive places to visit and conduct business. Cities with robust knowledge-intensive sectors such as Anand and Vadodra and well-developed tourism, such as Sabarmati and Shirdi will gain more from the introduction of HSR, whereas smaller cities without such potential will likely face severe challenges in development process. Therefore, planners and policy-makers must consider these challenges to avoid the over-estimation or underestimation of the development opportunities in the proposed HSR corridor. Enterprises opined that HSR development has immense potential to reconstruct the urban spatial system and achieve qualitative urbanization and can transform a manufacturing-centered economy into a services-centered urban economy.

Addressing the synergy between HSR development and the strategy of urban transformation is essential. There is a high level of competition between different layers of governments for urban development. Local urban administration is responsible for the governance of local development and prosperity. The proposed HSR is considered as an opportunity by the enterprises to address the challenges to stimulate the urban economy and attract high-end services and leisure functions in the HSR station area. Besides, assuring qualitative growth of high-end services and leisure functions is also considered as a major challenge to maximize the likely benefits of proposed HSR development. Therefore, the planning challenges of HSR development should be addressed through integrated transport development to realize the potential impacts of HSR.

7. Conclusion and policy implications

HSR project is likely to create significant socio-economic and spatial impacts and increase the development potential of station areas and connected larger cities than intermediate and small cities along the corridor. The proposed HSR station area development has immense potential to generate significant enterprise growth between Mumbai-Ahmedabad corridor and the linked cities served. It can considerably affect business traffic and work patterns of enterprises due to improved accessibility and likely surge in business travel demand between the two mega cities and cities connected to the corridor. However, business operations are more likely to be concentrated in major cities from the local surrounding areas. Land and property values are expected to significantly surge after the operation of HSR, which are unlikely to benefit business activities. The tourism industry is likely to gain significantly after HSR operation specifically in already established religious tourist destinations, which will lead to a considerable surge in hotels and other tourist services. Urban transformation and development are likely to be experienced around HSR station areas. Primary and secondary zones around station areas are expected to experience different impacts of HSR development project. Improved transportation may ease access to certain occupations, increase employment opportunities, improve productivity and influence the relocation of enterprises significantly.

HSR could play a more significant role for enterprises to implement a strategy of business expansion through improved access to skilled manpower resources and better transport accessibility. Therefore, HSR has strong potential to expand labor market and improve the mobilization of talented manpower. It is expected that expansion of the market can enable enterprises to improve their scale and productivity due to reduced salary and increased access to talented human capital resources. HSR can positively impact major cities compared to more peripheral areas of the corridor economy. Therefore, to achieve inclusive and sustainable growth, it is essential to promote quality transport infrastructure investment for equitable growth of the corridor economy. HSR can attract advanced services enterprises compared to manufacturing companies in station areas and may benefit business tourism, and cultural events and conferences. However, the expected reduction in hotel stays can reduce tourist expenditure and consumption of hotel services significantly. HSR can improve accessibility between the cities but disarticulates the space between these cities, thereby unlikely to increase inter-territorial cohesion and integration and may promote territorial polarization.

The strong interconnection between different means of public transport is essential for the quality of the proposed HSR service by ensuring moderate competition with other means of transport. There is a need to improve the interconnection between big cities and the accessibility of small and medium cities. Improvement in interregional accessibility should be ensured to integrate intermediate cities along the HSR corridor to improve the interconnection of markets. There is an urgent need to improve accessibility to the HSR station area to deal with expected traffic jams. It is necessary to improve station area accessibility by developing public transport and car parks for greater effects of the HSR project. The cooperation of all stakeholders, appropriate institutions, and coherence with the strategies of firms and labor market are needed. There is also a need to evolve strategies for the development of enterprises and tourism, property markets and station area development.

8. Research contribution

The study found that the HSR is desirable travel options for long-distance travel due to improved travel safety and quality of travel, time savings, and development of amenities in station areas and concentration of more service oriented activities along HSR routes. Besides direct impacts on transport capacity, HSR generates indirect effects or spillover effects, like surge in land prices and rentals, realty development and employment creation, new hotels and recreational avenues, and thus revenue collection. The spillover effects of HSR significantly influence economic growth in the future, for instance, a spike in land values increases business confidence and a surge in realty prices positively impacts bank lending as the businesses use the land as collateral to banks for new finance. Therefore, the study has offered significant policy implications to improve the quality of MAHSR, robust connectivity between agglomerations and peri-urban or sub-urban areas along the HSR routes, increasing interregional accessibility and markets and the need for strong collaboration of relevant players including firms and labour markets.

9. Limitations and future research

In this ex-ante case study, the qualitative analysis has been based on the perceptions of the targeted population, because scant information was available, which compelled the researcher to depend on the expectation, experience, and opinions of the targeted population. This is considered as a major limitation of the study, but not a barrier. The perceptions and expectations of the targeted population are paramount, which the researcher has analyzed in the initial stage of the HSR development project. Nevertheless, this ex-ante case study has been a modest attempt to analyze the intended objectives with limited extant information and offered significant policy options. Additionally, the soundness of qualitative analysis can be a limitation as it becomes outdated faster. However, the authenticity of qualitative analysis can be stronger than strict quantitative analysis. The perceptions of the targeted population can persist longer and provide valuable initial insights for policy options and can supplement the quantitative analysis. Therefore, future research can focus on comparing the results of the ex-ante impact analysis with ex-post quantitative impact study to ascertain the extent of achievement of the HSR development.

Conflict of interest

The author declares that there is no conflict of interest regarding the publication of this paper.

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