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THE IMPACT OF HIGH SPEED RAIL ON LAND AND PROPERTY VALUES

A review of market monitoring evidence from eight countries

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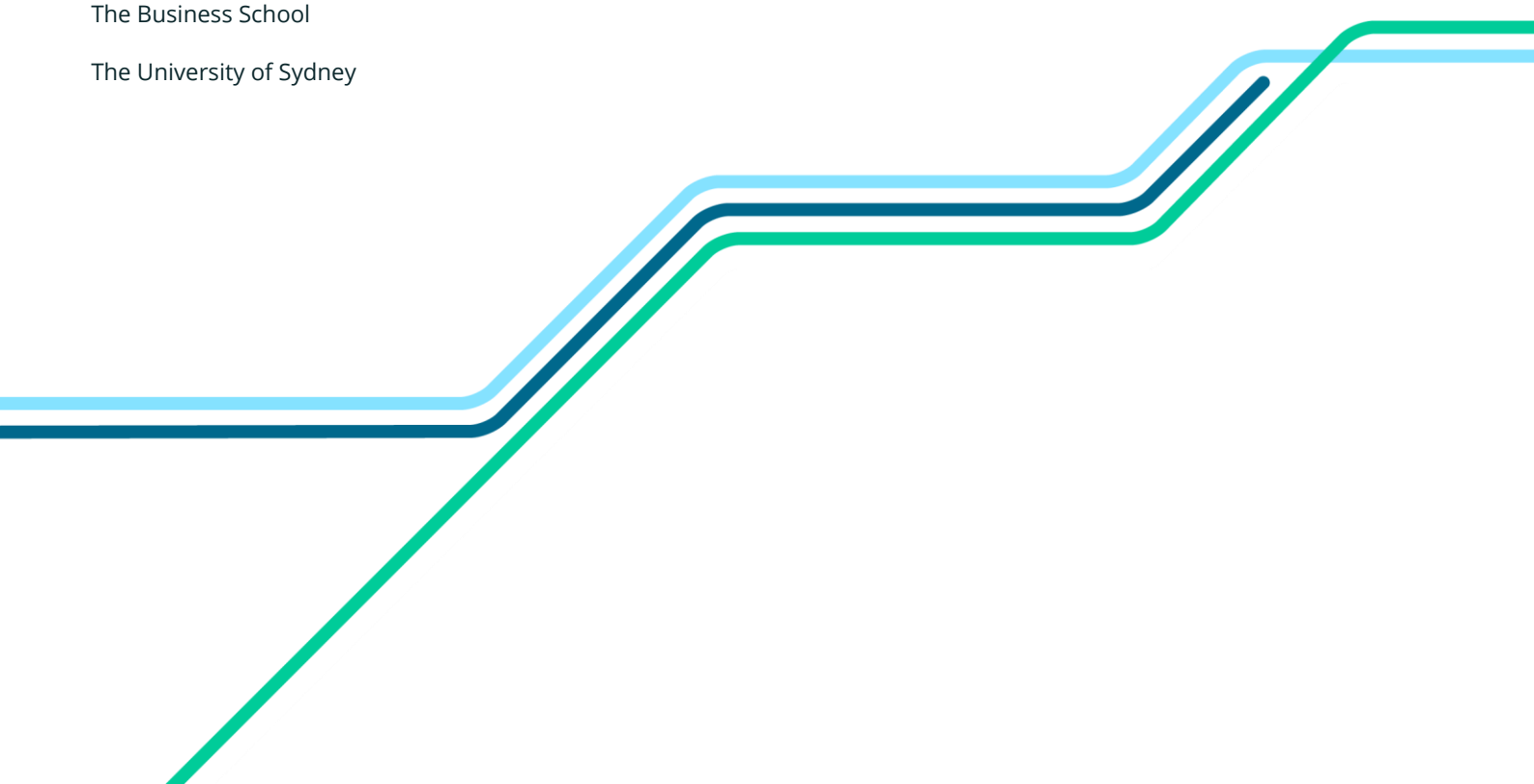

TABLE OF CONTENTS

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ABSTRACT

This paper reviews the impact of improved accessibility delivered through HSR on land and property values, where market monitoring evidence was collected from eight countries, using published sources. Our findings suggest that HSR does not always lead to (or is positively correlated with) the growth in property or land values in the short term (one to three years after the HSR project); and longer run evidence is not available. This conclusion is arrived at by comparing evidence across countries and within countries with multiple observations which is more robust than the normal approach involving a very small number of system case studies. We discuss reasons for the heterogeneous results which are observed and make key conclusions and recommendations for future HSR systems.

Keywords: High speed rail, accessibility, land and property value

INTRODUCTION

High speed rail (HSR) is often portrayed rather simply as rail that is faster than some minimum value. For many countries, HSR is a relative term, relative to the existing infrastructure. However, the speed that can be achieved will depend on the infrastructure provided and whether this is dedicated line or line that is upgraded (typically to continuous track) to run on conventional lines (Campos and de Rus 2009). This gives rise to a multiplicity of definitions: this paper is based on the definition used by the International Union of Railways (UIC) which comprehensively considers HSR from the perspective of high speed infrastructure, rolling stock and operations (UIC, www.uic.org/spip.php?article971).

HSR is the most expensive land-based transport infrastructure. For example, the construction cost per route kilometre of Taiwan's HSR is 39.5 million Euros at the 2005 price level (M€2005), 34.2 M€2005 for Korea and 25.5 M€2005 for Italy (de Rus 2009). Given such a high cost, it is expected that HSR would lead to significant benefits such as accessibility, time saving, and productivity, which in turn would have an impact on land values and property prices. The majority of empirical studies have investigated the wider economy impacts of transport infrastructure and are focused on highways, conventional rail and busway or bus rapid transit (BRT). In particular, studies focusing on the impact on land values have been concentrated on the impact of urban transport infrastructure. For example, Debrezion *et al.* (2007) review the impacts of conventional rail systems on land values and property prices; while Deng and Nelson (2010) focus on BRT systems.

This paper, documents and compares observed evidence on the impacts of HSR from the UK, France, Germany, Italy, Spain, China, Taiwan and Japan, i.e., eight out of 14 countries with HSR services in operation currently, mainly based on published sources. By comparing the growth rates in land and property values before and after the HSR project, our findings reveal that HSR has heterogeneous impacts on land and property values.

In the next section, the extent and growth of HSR is identified. This is followed by the theoretical foundations as to why HSR might give rise to land value changes. The paper then turns to review the eight HSR systems in different continents around

the world. The final sections investigate sources of potential differences, between HSR around the world before making key conclusions and recommendations.

BACKGROUND

High Speed Rail (HSR) was first introduced in Japan in 1964, in Europe first by France in 1981 and followed by other European countries (e.g., Germany and Spain). In Asian countries, Korea's HSR was opened in 2004; and China started its first HSR line between Qinhuangdao and Shenyang in 2003. HSR offers much faster speeds compared to normal rail.1 According to the International Union of Railways' (UIC) definition, the operating speed defining HSR is at least 200 kilometres per hour (km/h) for upgraded track and 250 km/h for new track. In addition to speed, UIC highlights some key advantages of HSR over normal rail, including commercial speed, high capacity, safety, frequency, reliability and comfort. UIC has compiled data on HSR lines (in operation, under construction and planned) with the most recent update (updated on 1 November 2011) given in Table 1, where the majority of lines have a speed of at least 250 km/h, with a few exceptions, mainly in China and Japan.

[1] HSR is introduced primarily for passenger travel; however a few HSR systems also carry freight. For instance, *La Poste* (French mail service) owns some special TGV trains for carrying postal freight. This review only considers high speed passenger rail.

Table 1: HSR lines in the world (in operation, under construction and planned)

KM OF HIGH SPEED LINES IN THE WORLD				
	In operation	Under construction	Planned	Total country
Europe				
Belgium	209	0	0	209
France	1896	210	2616	4722
Germany	1285	378	670	2333
Italy	923	0	395	1318
The Netherlands	120	0	0	120
Poland	0	0	712	712
Portugal	0	0	1006	1006
Rusia	0	0	650	650
Spain	2056	1767	1702	5525
Sweden	0	0	750	750
Switzerland	35	72	0	107
United Kingdom	113	0	204	317
Total Europe	**6637**	**2427**	**8705**	**17769**
Asia				
China	6299	4339	2901	13539
Taiwan-China	345	0	0	345
India	0	0	495	495
Iran	0	0	475	475
Japan	2664	378	583	3625
Saudi Arabia	0	550	0	550
South Korea	412	186	49	647
Turkey	447	758	1219	2424
Total Asia	**10167**	**6211**	**5722**	**22100**
Other countries				
Morocco	0	200	480	680
Brazil	0	0	511	511
USA	362	0	900	1262
Total other countries	**362**	**200**	**1891**	**2453**
Total World	**17166**	**8838**	**16318**	**42322**

Updated 20111101

Source: Adapted from International Union of Railways (www.uic.org/spip.php?article573, accessed 1.12.2011)

Based on UIC's update, HSR is in operation in 14 countries, including *Europe*: Belgium, France, Germany, Italy, the Netherlands, Spain, Switzerland, United Kingdom (UK); *Asia*: China, Taiwan-China, Japan, South Korea and Turkey; and *North America*: United States of America (USA). China has the longest HSR network (i.e., 6,299 km), followed by Japan and Spain. In terms of commercial speed, two HSR lines in France operate at the highest speed of 320 km/hour (one running between Saint-Marcel-lès-Valence and Marseille, the other connecting Vaires-sur-Marne and Baudrecourt); while the majority of existing HSR systems operate at a speed between 250 km/h and 300 km/h.

THEORETICAL FOUNDATIONS

The land rent theory, developed by Alonso (1964) and Muth (1969), is the theoretical framework for the relationship between accessibility and land values. These theories purport that land rent (and therefore the underlying land values) reflects accessibility gradients with higher values of rent reflecting higher accessibility to goods and services.

In an urban context this suggests that locations with better accessibility have a higher rental value where rental value is the annualised capital value. New transport infrastructure, where it increases accessibility, will therefore increase rental value and hence land values. This will be the case for all forms of transport improvement. Empirical studies measure the increase in land values either through changes in improved land through property market prices or directly through unimproved land values.

Whilst there is significant debate in the transport planning literature about the definition of "accessibility", this paper adopts a definition where accessibility is the ease with which the land use and transport systems allow activities or destinations to be reached by individuals ((Morris et al. 1979, Handy and Niemeier 1997, Zhu and Liu 2004, Horner and Mefford 2005). The building of a High Speed Rail (HSR) leads to changes in accessibility for both industries and residents in properties within the catchment area of the new or changed infrastructure because some activities and destinations are nearer or can be reached more quickly or at lower cost or with a reduced generalised cost. Thus changes in accessibility can be seen to drive changes in land value, creating value uplift in the presence of enhanced transport infrastructure.

Whilst most of the studies focussing on the quantum of land value uplift have concentrated on the impact within urban areas, there are a number of studies which have considered transport infrastructure more generally. For example, Gospodini (2005) reviewed twelve cities across Europe which had implemented varying sized transport infrastructure projects and concluded that transport infrastructure projects can be the catalyst for land use change within areas but that the scale of the effect depends on a number of factors outside the control of the transport infrastructure itself. Large public transport projects serving large geographical areas have a bigger potential, the location of the transport investment had more impact if there was space for further development and a market pressure for particular types of development and the institutional framework and politics could encourage by providing a positive environment for change.

Accessibility drives land value changes and provides the opportunity for enhanced economic activity, which in turn offers the opportunity for land value uplift. The empirical evidence on this is mixed. This is partly because accessibility by definition is a relative term so that improved accessibility at one location may be at the expense of a competing location or if accessibility is already high, improvements to accessibility might only bring marginal change and therefore little impact. Enhanced accessibility brings activities closer together and this proximity generally leads to development, although this effect may not be as strong today as in the past since many services can be provided remotely e.g., information technology which allows industry to locate where labour is cheap. Improving accessibility effectively reduces transport costs and allows exploitation of economies of scale: Krugman (1991), for example, demonstrates how high transport costs leads to dispersed manufacturing

locations whereas lower transport costs concentrate the location of production. In turn, this concentration will have a knock-on effect on land values.

HIGH SPEED RAIL SYSTEM AND THE IMPACT ON LAND VALUES

This section reviews eight High Speed Rail (HSR) systems around the world in sub-sections which relate to Europe, Asia and Japan. This forms the basis for the following section which considers the evidence for the heterogeneous impact of HSR on land values.

Europe

1. UK: High Speed 1 (HS1)

High Speed 1 (HS1), also known as the Channel Tunnel Rail Link (CTRL), is a 108 km (67 mile) HSR line running from London through Kent to the British end of the Channel Tunnel. Section 1 of HS1 commenced operations on 28 September 2003, from the Channel Tunnel to Fawkham Junction. Section 2 opened on 14 November 2007, from Kent to London.

Image: International service (by Eurostar) speed: 300 km/h Domestic service speed: 225 km/h

Cascetta *et al.* (2010) used HS1 as a case study to investigate HSR's impact on residential property values. A detailed analysis is conducted for the London Borough of Camden, where St. Pancras International Station is located (this HSR station was opened in 2007). Cascetta *et al.* found that the trend in the house prices in the borough of Camden was similar to the average trend for all of London before the arrival of the HS1 service; however after that, the house prices in Camden increased by 20 percent in 2007, compared to a 15 percent increase in London during the same period. In 2008, there was a 7 percent increase in Camden while no significant change was found for the whole city of London. Based on this evidence of the impact of HS1, Cascetta *et al.* concluded that HSR accessibility has a positive impact on property prices.

Pagliara *et al.* (2010) also analysed how HSR station accessibility influences residential property prices, using house transactions from 2001 to 2009 in the Camden borough of London around the St Pancras HSR station. Hedonic price models (see Rosen 1974) based on regression techniques are used to reveal potential impacts. In Pagliara *et al.* (2010), an area of 500

metres radius around St Pancras HSR station was been treated as the catchment area, and the changes within this catchment area were compared with changes in an area of 1,000 metres away from this station (serving as a control area). The key finding is that HSR station accessibility significantly benefits the property values in the catchment area, but not in the control area. Preston and Wall (2008) also conducted a descriptive statistical analysis on the impacts of HS1 in Ashford, and found that the opening of Ashford HSR station coincided with a six percent increase in employment and a three percent increase in house prices over and above that of the whole South East England.

2. France: Train à Grande Vitesse (TGV)

The TGV, France's high speed rail service, was developed during the 1970s, and the first TGV service was opened in 1981, i.e., LGV Sud-Est connecting Paris and Lyon. TGV trains are currently running on six domestic high speed rail tracks (Ligne à Grande Vitesse: LGV).

Commercial speed: 300 - 320 km/h

Located in the 10th arrondissement of Paris, the Gare de l'Est station is a HSR (TGV) station of Est-européenne HSR line (connecting Paris and Strasbourg). The Gare de l'Est station, originally built in 1849, was redeveloped to accommodate TGV trains in 2006. Gargiulo and de Ciutiis (2010) found that between 2006 and 2007 (the year that Est-Européenne was opened[2]), the average property values in the 10th arrondissement increased by 2.18 percent, compared to a 4 percent increase in all of Paris; and the average growth rate of property values in the 10th arrondissement is lower than the growth rate for the entire city of Paris (9 percent vs. 10 percent) between 2005 and 2006 (the year that the Gare de l'Est station was redeveloped for the HSR project). However before the opening of the redevelopment of the Gare de l'Est station and the opening of Est-européenne line (i.e., between 2000 and 2005), the annual growth rate of property values in the 10th arrondissement was higher than the growth rate for the entire city, with the largest difference in 2003/04 being over 5 percent higher, suggesting the capitalisation of accessibility into land values may have followed the announcement and building of the HSR and not

[2] Only the first section of Est-européenne is operating, which links Paris, Reims, Meuse and Lorainne; the second section, from Lorainne in Strasbourg, is expected to be completed by the end of 2014.

waited until the HSR was in operation. . Moreover, there is a decreasing trend in the annual growth rate of property values in the 10th arrondissement since the redevelopment the Gare de l'Est station for Est-européenne: 18 percent for 2004/05, 9 percent for 2005/06, and 2 percent for 2006/07.[3] Overall, the evidence seems to suggest that the HSR project (Est-Européenne) has a negative impact on property values, or at least it is negatively correlated with property values, with a stronger impact in the area around the HSR station (10th arrondissement) than in the entire city of Paris. This is consistent with studies focussing on urban transport infrastructure improvements where empirical evidence suggests that properties very close to enhanced infrastructure suffer negative externalities (noise, pollution etc) which more than outweigh accessibility benefits.

In the central district of Strasbourg, where the other end of the Est-Européenne HSR station is located, the annual growth rate has shown no significant change before and after the construction of Strasbourg TGV station; with the growth rate of property values in its central district similar to the growth rate of entire Strasbourg during the same period.

LGV Nord, a HSR service between Paris and Channel Tunnel, was opened in 1994. The TGV station LGV Nord for Paris is also located in the 10th arrondissement. Between 1994 and 1995, the average price of properties in 10th arrondissement decreased by 13 percent (vs. a 7 percent decrease for Paris), which showed a much deeper drop compared to 1993/94 (i.e., -4 percent) and 1992/93 (-0.5 percent) in 10th arrondissement. Similar to the Gare de l'Est station, this TGV station also seems negatively correlated with growth in property prices.

With regard to the earliest TGV service in France (TGV Southeast between Paris and Lyon, opened in 1981), Haynes (1997) found that the new TGV station in Le Creusot had almost no local economic impact in terms of new jobs, firms or commercial expansion. However the Lyon Part-Dieu station had a significant effect in terms of a 43 percent increase in the immediate area land values. Haynes (1997) also concluded that LGV Atlantique (another TGV service between Paris and Le Mans, opened in 1989) is a major contributor to the rapid increase in Le Mans's land values (unimproved and improved), up 100 percent in three years; while in Nantes, rents around its TGV station are 20 percent higher.

[3] Although the annual growth rate for the entire city of Paris also reduced during the same period, which is higher compared to the growth rate for the 10th arrondissement, where the HSR station is located.

3. Spain: Alta Velocidad Española (AVE)

The AVE is the HSR service in Spain. AVE trains run on a network of dedicated high speed rail track. The first line was opened in 1992, connecting the cities of Madrid and Seville. Spain has 11 HSR lines in operation, with a total network length of 2,056 kilometres.

Commercial speed: 200 – 300 km/h

In 1992, Spain's first HSR line (Madrid-Seville AVE) was opened. Among the five HSR stations of Madrid-Seville AVE, one is located in Ciudad Real. de Rus and Inglada (1997) concluded that in addition to significant time savings and newly generated traffic, the high speed rail project also stimulated property prices in Ciudad Real. An evaluation study by Fariña et al. (2000) confirmed that the area near the AVE station in Ciudad Real had the highest growth in property prices (132,000 Spanish pesetas[4] per square metre), coinciding with the opening of the AVE link.

[4] Spanish peseta was replaced by euro in 2002. The exchange rate was 1 euro = 166.386 pesetas.

4. High Speed Rail in Italy

High speed rail in Italy connects all the major Italian cities. Italy's first HSR service operated in 1978, running between Florence and Roma. Now the total length of its HSR network reaches 923 kilometres.

Commercial speed: 250 – 300 km/h

The first section of the Turin-Milan HSR line was opened in 2006, connecting Turin and Novara with a length of 94 kilometres. The second section between Novara and Milan was opened in 2009 with a length of 55 kilometres. In Turin, a new station (Porta Susa HSR station) was built for this HSR line, which is located in Cit Turin. Gargiulo and de Ciutiis (2010) compared the average property values in the area of Cit Turin with the entire city of Turin, using property prices from 2000 to 2006. Before 2006, the average property value of Cit Turin was lower when compared to the average value of the entire city. However after the opening of Turin-Milan HSR line in April 2006, the property value in Cit Turin surpassed the average value of the city. Between 2005 and 2006, the average value of properties in Cit Turin jumped by over 30 percent, significant higher than the growth rate for the whole city (9.5 percent), which is opposite to the growth before the opening of Turin-Milan HSR line, for example, 9 percent for Cit Turin and 12 percent for the whole city between 2004 and 2005. These statistics suggest that there is a positive relationship between property values and the arrival of HSR service in Turin, and its impact on the area around the HSR station (i.e., Cit Turin) is stronger.

In Milan however, the Turin-Milan HSR line seems to have a different impact. The Milan central station for this HSR service is located in Zone 2 of Milan (out of its city centre). Before the opening of the Turin-Milan line in 2006, the annual growth rate of property prices in the area around the Milan central station was higher than the growth rate for the city as a whole. However between 2005 and 2006, a lower growth rate was witnessed in the area around the HSR station. Moreover, the annual growth rate showed a decreasing trend for the area around the HSR station and all of Milan: 10.5 percent and 9.5 percent respectively in 2002/03, 8.5 percent and 7.7 percent respectively in 2004/05, and 4.1 percent and 4.8 percent respectively in 2002/03. These figures suggest the opposite impact of the arrival of HSR in Milan, compared to what occurred in Turin. Rome has a story similar to Milan; its property prices grew more slowly after the opening of Rome-Naples HSR (the 2005/06 growth rate: 5.1 percent for the area around the new HSR station and 5.8 percent for Rome vs. the 2004/05 growth rate 6.5 percent for the area around the HSR station and 6.7 percent for Rome). While in Naples, after the opening of Rome-Naples HSR, the

annual growth rate surged for the area around the Naples central station (HSR) (2004/05: 2.8 percent, 2005/06: 15.5 percent); but decreased for the whole city of Naples (2004/05: 16.1 percent, 2005/06: 10.8 percent). In contrast, there were no significant variations in the growth of property prices in Florence before or after starting the construction of the new Belfiore station for the Florence-Bologna HSR service in opened in 2006. For both the area around the station and Florence as a whole experienced growth in property prices of around 5 percent for 2004/05 and 2005/06.

5. Germany: Intercity-Express (ICE)

The ICE is a HSR system running in Germany and neighbouring countries (e.g., Belgium and Switzerland). Within Germany, the network length of ICE in operation is 1,285 kilometres.

Commercial speed: 230 – 300 km/h

In order to better link Berlin to Germany's rail network, two stations in Berlin were extensively rebuilt in the early 1990s: 'Gesundbrunnen' in the north and Südkreuz in the south. Both stations are also used as the terminals for ICE stations. Ahlfeldt (2010) analysed a large number of transactions of developed properties in Berlin between 1993 and 2008, and found that intercity rail accessibility has had a marginal impact on property prices, both within the immediate station neighbourhoods and at the whole city level. Based on his finding, he concluded that there are only localised effects on location productivity and household utility. Ahlfeldt questioned the justification for committing substantial public funds to rail redevelopment projects.

Asia

1. China: China Railway High-speed (CRH)

China's first HSR line (Qinhuangdao - Shenyang) was introduced in 2003. The Ministry of Railways of China reported the daily ridership has a shown consistent increases: 237,000 in 2007 and 349,000 in 2008 to 492,000 in 2009 and 796,000 in 2010. China has the longest HSR network in the world.

Commercial speed: 160 – 250 km/h

China's HSR system is rapidly growing, with plans to reach 30,000 kilometres, connect 250 cities and transport 4 billion passengers annually by 2020. A recent study by Morgan Stanley (2011) pointed out that HSR has a significant positive impact on the increase of property values in general, and properties along a railway network are 8-20 percent more expensive.

2. Taiwan: Taiwan High Speed Rail (THSR)

The THSR line runs between Taipei and Kaohsiung. The 345-km Taipei-Kaohsiung HSR line opened in 2007 and significantly reduced the travel time between the Taipei and Kaohsiung metropolitan areas from four hours to one and half hours.

Commercial speed: 300 km/h

Taiwan High Speed Rail has eight HSR stations, one of which is Tainan station, located at Guiren in Tainan County (outside Tainan metropolitan area). Andersson *et al.* (2010) applied hedonic price techniques to investigate the impact of HSR station accessibility on property prices in the Tainan metropolitan area. In their models, candidate explanatory variables include: distance to Tainan CBD, distance to Tainan's HSR station and distance to freeway interchange, and distance to the Tainan Science-based Industrial Park, which measure accessibility; road width, commercial or residential zone (dummy variable: 1 or 0), mean household income, and percentage of colleague-educated in district, which represent neighbourhood attributes; floor area, lot size, age, height, shop or dwelling use (dummy variable: 1 or 0), and located at street frontage or not (dummy variable: 1 or 0), which are structural attributes of a property. No significant impact of HSR accessibility was found on residential property prices in the Tainan metropolitan area.

3. Japan: Shinkansen

The Shinkansen is a network of HSR lines in Japan. The first Shinkansen line (the Tokaido Shinkansen) commenced in 1964, connecting Tokyo and Shin Osaka.

Commercial speed: 240 - 300 km/h

Nakamura and Ueda (1989 cited in Haynes 1997) analysed the impact of the Shinkansen on regional development. They found that Shinkansen accessibility stimulated employment growth and per capita income in regions with Shinkansen stations, and land values in commercial areas with Shinkansen accessibility rose by 67 percent. Tomoyoshi Omuro, a property analyst (cited by Morgan Stanley 2011), concluded that the Shinkansen system helped the urbanization of regional cities and local economies, and led to land price appreciation during the 1970s and 1980s. A recent survey, conducted by the Ministry of Internal Affairs and Communications, Japan, has also showed the positive impact on property prices of a recently-built Shinkansen (the Kyushu Shinkansen between Fukuoka and Kagoshima in Kyushu), where values of commercial and residential properties along the Kyushu Shinkansen line increased, in contrast to over 3 percent decrease at the national level (http://www.fukuoka-now.com/en/news/show/5132, accessed 15/02/2012).

HETEROGENEOUS IMPACTS OF HSR ON LAND VALUES AND PROPERTY PRICES

The impacts shown as the difference in land/property value growth rate before and after the HSR project are summarised Table 2, using the observed evidence from eight countries. For China and Japan, the impacts are obtained along a HSR route, not based on a specific area around the HSR station. For the other six countries, the impacts are based on the areas around a HSR station, with the exception of Taiwan, where the HSR station's impact is on the entire Tainan metropolitan area.

Table 2: Immediate impacts of HSR on land values and property prices

UK:	London (+), Ashford (+)
France:	Paris (-), Strasbourg (0), Le Creusot (0), Lyon (+), Nantes (+), Le Mans (+)
Spain:	Ciudad Real (+)
Italy:	Milan (-), Rome (-), Florence (0), Naples (+), Turin (+)
Germany:	Berlin (0)
Taiwan:	Tainan (0)
China (+)	
Japan (+)	

Notes: +: positively correlated; - : negatively; 0: marginally

The evidence shows that the HSR projects have heterogeneous impacts on land values between and within countries. In China, Japan, Spain (one case study) and the UK (two case studies), the HSR projects are positively correlated with property prices, showing land value uplift. Berlin (Germany) and Tainan (Taiwan) have not observed significant changes in property prices. France and Italy have more than three case studies, which reveal that even within a country the impacts of HSR could be varied. For example, in France, the HSR seems ti negatively impact properties prices around Paris' HSR stations; while positively influencing land values in Lyon and Le Mans; but with marginal impacts on properties around the HSR stations in Strasbourg and Le Creusot. Similar evidence was also found in Italy. The heterogeneous impacts shown for HSR mirror the highly variable impacts observed for urban transport systems within cities. As with the intra-urban area studies, differences are observed in the timing of uplift where it exists with some occurring post announcement and before operation. There is also evidence that land close to terminals may suffer negatively, perhaps through negative externalities which offset the benefits of enhanced accessibility. The methodologies of the HSR studies are also very varied with some differences likely to be due to this. Given these findings, the key conclusion is that: ***HSR does not always lead to (or is positively correlated with) growth in property or land values.***

Cities in Table 2 can be divided into two categories: *large* including London, Paris, Lyon, Berlin, Milan and Rome, and the rest belong to *small or (relatively small).* Among the six large cities, Paris, Milan and Rome were associated with slower growth or

more negative growth in property prices after the opening of HSR services in Paris and Milan and the construction of Rome's HSR station. Given that the HSR stations in Paris and Rome are located within or close to the centres of these big cities, where accessibility was already very high as well as high property prices; some negative externalities of HSR (e.g., noise) might outweigh its benefits. However, properties in the areas around London's and Lyon's HSR stations increased their prices after introducing the HSR lines. In Milan, the HSR station is not in the city centre and negative land value premiums may well be associated with a lack of improvement to accessibility. The reviewed London's HSR station is located in Camden, which was characterised by low image with higher crime and poverty. The opening of this HSR station in 2007 signalled improvement of the neighbourhood to include significant redevelopment which has attracted investors and consequently stimulated house prices by 20 percent in 2007, and 7 percent in 2008. Lyon's HSR station was built to support the new Part-Dieu urban neighbourhood project, which aimed to establish Part-Dieu (3rd arrondissement of Lyon) as another city centre for Lyon. Along with the HSR station, one of the largest shopping centres in France, a major government office complex, and the tallest skyscraper in the region were also built. Hence, the significant increase (i.e., a 43 percent increase in the immediate area land values) was not solely contributed by the HSR project, but a series of projects that have led to increased business, commercial activities and travel demand in Part-Dieu, which now has become one of the largest business districts in France.

For *small* cities, the prices of properties around the HSR stations tend to increase after opening HSR services (e.g., Ashford, Nantes, Le Mans, Ciudad Real, Naples and Turin), with property value uplift mainly due to improved accessibility. These *small* cities in general have greater potential to grow and develop as compared to cities which are already large scale. For these cities, the implementation of HSR lines has sent a very strong growth signal, attracting inward investment and consequently stimulating property values. There are three exceptions: Strasbourg, Le Creusot and Florence, where HSR appears to have had a marginal impact.[5] For Strasbourg and Florence, the impacts on property prices around the stations were observed before and after the construction of HSR stations. The conclusions may be varied depending on when the studies were carried out before/after the opening of HSR lines as the time points chosen for analysis can make a difference (McMillen and McDonald 2004). In Le Creusot, its isolated station location and poor road access to the HSR station are two major reasons for its limited impact on property values (see Haynes 1997). In order to deliver the full benefits of a HSR project, the HSR station needs to be easily accessed, that is, integrated with other modes of transport to allow for door-to-door service (see Hensher and Li forthcoming for similar evidence for bus rapid transit). Given these findings, the key conclusion is that: ***the impact on property or land values is highly variable with smaller cities appearing to achieve positive premiums more than larger cities***.

[5] The Taiwan study looks at the impact on the entire Tainan metropolitan area, not the area around its HSR station. Therefore, it is not counted.

CONCLUSIONS

This paper has reviewed the impact of HSR accessibility on land and property values, using evidence from eight countries. Among the 15 cities where the impacts on the areas around the HSR stations were investigated, eight cities reported that land/property values were positively linked with the opening of HSR; however three cities show the opposite evidence, while four cities have no significant variations in property values. These findings reveal that HSR has heterogeneous impacts on land/property values at least in the short term (by comparing the growth rates before and after the HSR project: one year after the project for most reviewed cities and up to three years for Le Mans). This is an important conclusion given it is derived from evidence from a large number of observations (within and across countries).

Where and how to build the HSR stations is crucial to its impact on land and property values. Our analyses suggest that HSR is more likely to have a positive impact on land/property values when a HSR station is built in the area with a greater potential to grow and where the HSR project is well embedded in the growth or redevelopment strategy, along with other key components including office buildings and shopping centres. Lyon is a good example, where the HSR was only one component of the project that planned to develop Part-Dieu into another city centre for Lyon and this led to the land value around its HSR station (Part-Dieu) increasing by over 40 percent. Moreover, the HSR station has to be supported by good transport infrastructure such as roads and other modes of public transport to access the HSR service. As an example, Le Creusot's HSR station is difficult to access, and its presence had no significant impact on property values. Therefore, for achieving an attractive value for money outcome, the HSR project has to be carefully planned, treated as part of public transport system, and incorporated into the growth strategy.

With regard to future research on evaluating HSR's wider economy impacts, we encourage more studies to monitor and analyse the longer term impacts of HSR projects. Existing studies focus on the short-run impacts. Another research avenue is to investigate the causality of HSR on land and property values, not just correlation. This would need to control for the influence of other factors such as the degree of land use mix, new shopping centres and business building in the area so as to understanding the real consequence of HSR.

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