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An analysis of impact on land pricing from High-Speed-Rail in Honshu area

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Abstract. Several decades of High-Speed Rail (HSR) in Japan have generated direct impacts on Japanese's life regarding reducing short time travel, enabling newly accessible areas, and increasing transport market. This paper discusses the indirect effects of HSR network in Honshu area based on urbanisation sustainability regarding land pricing impacts. This study conducts the quantitative analysis to measure the impact of Shinkansen network in the prefecture with and without HSR stations. The land price data is received since 1983. In this study, four case studies have been highlighted using ANOVA analysis to determine the correlation between each case. Besides, the Least Significant Different (LSD) analysis is used to compare the relationship on each pair later on. The research found that the big cities show no relation to land price with other towns due to the land prices in metropolitan areas had expensive before coming to HSR. And, the LSD analysis results show dramatically different on land price in both cases Osaka – Shimane, and Osaka – Tottori that represent high values of $|x_i-x_j|$ around 4,500 Yen/m^2. But, the comparisons of those cities with Kyoto represents slightly different on land value at 401.74 Yen/m^2.

1. Introduction

Recently, High-Speed Rail (HSR) plays an essential role in human life, social and economics. Since 1964, the HSR was firstly operated in Japan, and the trend of using HSR has been widely exploited in another 18 countries around the world. Added high technologies, overall parts of HSR system have been gradually developed particularly on its model for supporting customers' requirements regarding increasing conveniences, saving travel time, and enabling new areas [1]. The benefit of HSR was over the airline in China in term of high transportation capacity, travel speed and intercity travel demand. High demand on HSR system caused on reducing passenger on domestic China airline [2]. In Spain, the trend of using transportation between big cities has been changed from airplane to HSR [3].

In Japan, Shinkansen networks provided shorten the time in services, and increase passenger flow from the mainland (Honshu) and other Islands. HSR acts a catalyst to fasten on those areas together which firmly enhances the urban system in Japan. By following the aim to measure on the impact of HSR along the urbanisation sustainability within Honshu area is included in this study. The measurement of land prices and population density are represented. This study conducts the quantitative analysis base on the information from 8 Shinkansen lines in Honshu area consists of Hokuriku Shinkansen from JR West-East, Sanyo Shinkansen from JR West, Tokaido Shinkansen from

JR Central, Tohoku Shinkansen, Joetsu Shinkansen, Yamagata Shinkansen and Akita Shinkansen from JR East.

The paper address the following set of research questions:

- How the different on population dynamics in big and rural cities? Is it impacts from Shinkansen services?

- Has the Shinkansen network affected by land pricing in Honshu area, given the specific cases study? What is the impacts on land price in the area without Shinkansen systems?

- What is the implication to urban sciences?

The primary objectives of this research are to discuss the impact of HSR system along urbanisation sustainability precisely. This research is expected to be justified on the result whether HSR effect on population density and land prices or not. And, the finding will be a guideline to the urban developer for supporting new HSR projects.

An extremely investment of HSR infrastructure around the world reflects the benefits of economic growth in both regional and urban areas. China's HSR network becomes the most extensive networks in the world, which contains over 15,000 km of HSR track length [4]. The system not only enables Chinese travel within the country but also links China with its borders that directly enlarge markets. HSR network is expected to enhance GDP approximately 1-3%. The vast explanation of HSR network even has been happened in European countries that showed its network growth from 643 km in 1985 to 7,343 km in 2013 [4]. The data from EU Statistical Pocketbook illustrates the market share of HSR in almost European countries were increasing during 2000 – 2014 [5]. The HSR networks in European countries enables passenger conveniently travel across borders and stimulates economics as increasing productivity, growing labours and enlarging markets.

However, the successful of HSR projects require effective plans before investing in the new scheme for avoiding upcoming issues. The substantial investments are needed on HSR networks which aimed at the socio-economic benefit [6]. Various factors; however, i.e., the lack of study on HSR project, poor development and poor transportation policy may lead HSR project facing problems. The saturated infrastructure among European country that could not support the demand of both passenger and freight train; moreover, some railway line almost reaches their maximum capacity [7]. Another issue is a low number of passenger, the HSR networks in Spain faced with a weak demand of passenger near the corridor caused by the Government reduced ticket prices at least 11% [8].

This study aims to analyse the urbanisation sustainability impact of HSR regarding land pricing. The value of this study is the providing on reliable of long-term information that can be used as a guideline on new HSR projects and push their benefits to society. Those questions can be answered by comparing the collected data via ANOVA and LSD analysis and, combining with the literature reviews. This paper provides a review of Shinkansen network in Honshu areas (Section 2) that deeply summarisation on information of the Shinkansen services on each route in Honshu area; Direct and indirect effect on Japanese's life (Section 3); Analysis and discussion parts (Section 4), which contains both ANOVA and LSD analysis; and the conclusion (Section 5).

2. An Overview of Shinkansen Network in Honshu Area

Honshu Island, which is the mainland in Japan, represents more than 60 percent of the whole population. The shape of Honshu Island is narrow that shows approximately 50 and 225 km in width and 1,303 km in length [9]. The trend of passenger using HSR is based on the travel distances that represents HSR gained higher market share than other modes of transportation at a distance 300-1,000 km and mostly get the highest at 69.1% at distance 500-700 km [1,10], and another source also defined an effective service of HSR within the distances 483 km – 692 km (Albert and Bel, 2012). Moreover, the density of population in Honshu Island represents mostly along the coast; therefore, the high-speed rail service has become competitive than other modes of transport [9].

Figure 1. The share of passenger transportation modes in Japan by distance (km)
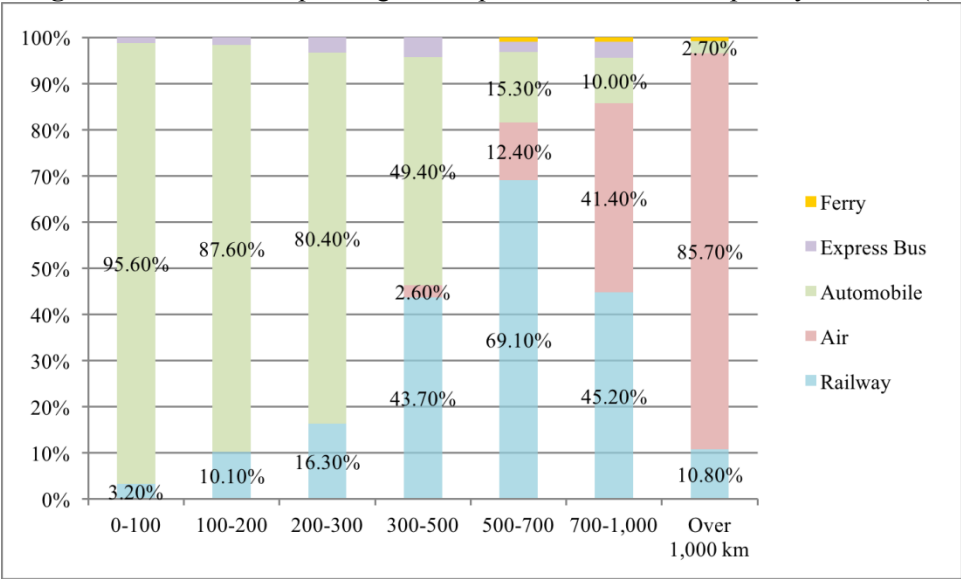
There is composed of three railway operators; of JR East, JR Central and JR west in Honshu area. Firstly, the JR East or East Japan Railway company has provided its HSR service in 2 routes, which is Hokuriku Shinkansen and Sanyo Shinkansen. The Hokuriku Shinkansen was entirely operated between Tokyo and Kanazawa in March 2015. The line was extended from the existing track between Tokyo and Nagano that serviced since 1997. However, the section between Tokyo and Takashi share tracks with Tohoku and Joetsu Shinkansen. The new section is separately operated by JR East (Nagano-Joetsu Myoko) and JR West (Joetsu Myoko - Kanazawa). The Sanyo Shinkansen is the second HSR line that services since 1972. The route of Sanyo Shinkansen started from Shin-Osaka to Okayama and, it was extended to Hakata in three years later. Secondly, the JR Central or Central Japan Railway Company has serviced HSR in route Tokyo and Osaka since 1964, which is the first HSR line in the world. Lastly, JR West or West Japan Railway Company mainly operated on the eastern and north-eastern parts of Honshu Island. There are five HSR consisted of Tohoku Shinkansen (route Morioka-Omiya), Joetsu (route Tokyo-Nigata), Yamagata (route Tokyo-Shinjo), Akita (route Tokyo-Akita), and Hokuriku Shinkansen (route Tokyo-Kanazawa), which is a collaborate line of JR East and JR West.

2. An Overview of Shinkansen Network in Honshu Area

Table 1. an overview of information of Shinkansen service from JR West, JR Central, and JR East

Train operators	Lines	Route	Number of Train / Day	Seat / Train	Seat / Day	Number of train in whole line services	Distance (km)	Number of Stop	Distance (km) / station	Max Speed (km/h)	Conventional Train Journey Time (mins)	HSR Journey Time (mins)	Time Change (mins)	Standard Ticket Price (Yen)	Price / Distance
JR West	Hokuriku Shinkansen	Tokyo - Kanazawa	63	934	58,842	34	345.4	18	19.19	260	240	148	92 (-38.33%)	13,600.00	39.37
		Kanazawa - Tokyo	64	934	59,776	35									
	Sanyo Shinkansen	Shin Osaka - Hakata	96	1,323	127,008	68	553.7	19	29.14	300	224	137	87 (-38.83%)	9,290.00	17
		Hakata - Shin Osaka	99	1,323	130,977	70								5,390.00	
JR Central	Tokaido Shinkansen	Tokyo - Osaka	154	1,323	203,742	125	552.6	17	32.51	285	587	142 (Nozomi)	447 (-76.15%)	14,450.00	26.15
		Osaka - Tokyo	149	1,323	197,127	122						180 (Hikari)	407 (-69.33%)	14,140.00	25.59
												240 (Kodama)	347 (-59.11%)		
JR East	Tohoku Shinkansen	Tokyo - Shin Hakodate Hokuto	140	731	102,340	16	713.7	26	27.45	320	242	143	99 (-40.90%)	16,840.00	23.60
		Shin Hakodate Hokuto - Tokyo	131	731	95,761	12									
	Joetsu Shinkansen	Tokyo - Niigata	79	816	64,464	45	333.9	13	25.68	240	-	120	-	10,570.00	31.66
		Niigata - Tokyo	80	816	65,280	44									
	Yamagata Shinkansen	Tokyo - Shinjo	32	402	12,864	12	421.4	16	26.34	130	203	149	54 (-26.60%)	12,870.00	30.54
		Shinjo - Tokyo	31	402	12,462	12									
	Akita Shinkansen	Tokyo - Akita	59	338	19,942	58	670.2	16	41.89	130	306	229	77 (-25.16%)	17,800.00	26.56
		Akita - Tokyo	53	338	17,914	53									

As shown in Table 1, the data is collected from reliable sources, i.e., financial reports and public data from Japanese government; moreover, an expert from the Railway Technical Research Institute (RTRI) helped to confirm an accurate data sources. The summarization of Shinkansen networks along eight HSR lines services has rigor, be comprehensive and up-to-date.

3. Direct and Indirect effects from Shinkansen networks

The benefits of HSR networks can define as direct and indirect effects on societies. The core concept of HSR was built up for increasing performances of the train regarding speed. The first era of rail transportation came with low velocity. After growing in passenger demand and expanding on economic around the world, the first HSR was taken place in Japan as the speed at least 150 km/hr, which was the fastest train in the world. The improvement of speed has continually occurred and, it recently presents on Shanghai Maglev that presents operating speed at 431 km/hr [12]. The essential idea of HSR bases on what speed that suitable for passenger able to journey [13]. The first design was agreed in the range 200 – 300 km/hr; however, HSR must contain speed at 250 km/hr or above. The changing on the rate provided distinct benefits regarding time series changed [14].

Socio-economic benefits are recognised as an indirect effect from HSR. According to growing on journey demand, the expectation to increase demand for tourists exposed in the area with HSR services. The transportation system is one of the critical factors that induces passenger making trips

[15]. It can be confirmed on the study of Litman that found the traffic volume was increased 10% in short-term in case of reducing travel time in the corridor by 20% [16, 17]. Therefore, the socio-economic conditions like population growth, and regional economy can be improved from the side effect of HSR.

3.1 Direct effects

3.1.1 Reduce travel time

Comparing with the services from a conventional railway, HSR drastically reduces the journey time between cities. The decreasing travel time is the most important effect from HSR due to the enormous saving time can attract passenger to use HSR services [18] in other words, HSR can change passengers' behaviour and attitude towards transportation mode. Within the journey distances at 300 – 1,000 km, HSR has gained the most market share rather than other modes of transportations. Many researchers pointed out that HSR comes with the high-frequency train in service, provides shorter time travel, connects between big cities, and served with comfortable services. Nevertheless, the journey time saving is the most influential factor reaching customers' expectation [19, 20, 21]. In the Honshu area, HSR network almost services on all prefectures. As shown in Table 1, the travel time of HSR presents at least 25% time saving compared with the conventional train within the same route. In case of JR West, the Sanyo Shinkansen gain reduce time at 38.83%. In fact, some trains directly run from Hakata to Tokyo that definitely provides convenience to passenger for saving travel time and avoiding time to change track. In case of JR central, the Tokkaido Shinkansen, which is the most popular line in Japan, provides three different levels of service depending on a number of stops. The fastest train called "Nozomi" save travel time 76.15% compared with the conventional line. For JR east, five HSR lines (including the Hokuriku Shinkansen) reduce time in the range 25.16% (Akita Shinkansen) to 40.90% (Tohoku Shinkansen) comparing with each conventional line.

3.2 Indirect effects

3.2.1 Property price or Land price

Many studies reveal the positive impact on property value around HSR station. A case study in Le Mans, France that the transactions of building and land were increased twice within three years after opening HSR; in the mean times, the land and accommodation price also doubles rose up [22]. In Taiwan; however, HSR accessibility shown no significant effects on property value and land price [23]. Therefore, the study on the impact of HSR on property value focused on further development. The comparisons on the land prices before and after opening HSR become a necessary part to find out the most influential factor, which affect property prices nearby HSR areas [24]. The results found from eight HSR stations in the European country that pointed out regional economy is the most crucial factor. Besides, the accessibility of transportation and the availability of public source also made a high impact on property value. Gargiulo and De Ciutiis benchmarked HSR stations within ten countries and, the result found that the location of the railway station is the most influential factors effect on property value [29].

Assisting in taking high benefits from HSR in both direct and indirect benefits for societies; the research suggests to use long-term data collection for profoundly and accuracy analysis. The research highlights on the collected data on land price which takes in large gaps for 34 years from 1983-2017.

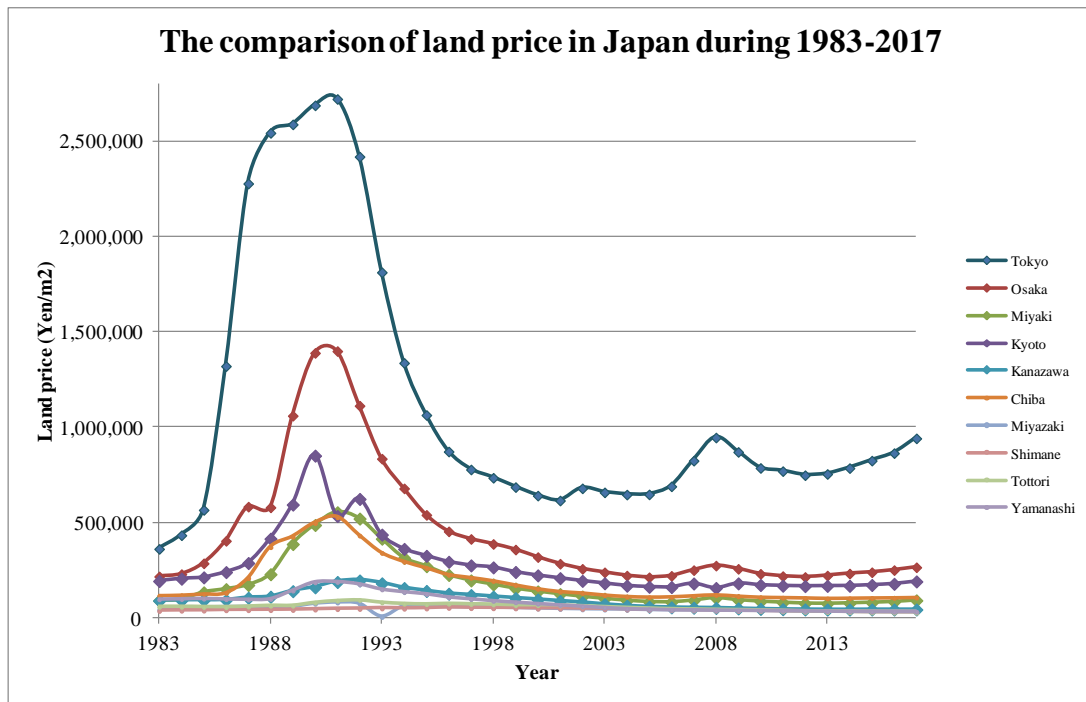**Figure 2.** The comparison of land price in Japan during 1983-2017

Figure 2 shows the comparisons of land prices in Japan during 1983-2017. The comparison can be classified into two groups of the areas with HSR and without HSR services. The overall trend steadily risen in 1985 due to it was Japan bubble crisis. The land price had dramatically increased within five years until 1985, which made a whole land price rate increase 16% [26]. The bubble burst in 1991 caused the trend of land price reached maturity point and sharply reversed direction. The economy of Japan recovered during 2002-2008, but it occurred small bubble burst again in 2006 as can be seen a little peak on across the land price in Tokyo. In the meantime, the ministry of finance provided new restriction against foreign investors aiming to limit the property prices. As a result, the real estate prices in Tokyo slightly dropped and turned into stable situation after 2010.

3.2.2 Gross Domestic Product (GDP)

Base on the starting era of building HSR track, the first project was developed within Tokaido line that operated between Tokyo and Shin-Osaka in 1964. The Sanyo Shinkansen line wholly performed in 1975 that linked Honshu Island to Hakata in Kyushu Island. In 1982, the Tohoku and Joetsu lines were utterly constructed caused by the HSR network was dramatically grown up to 1,324.8 km. After breaking from Japan National Railway (JNR) into Japan Railway Company in 1987, the Shinkansen network had been gradually expanded to 2,764 km in 2016. Comparing the total track (km) with the GDP lines, they also showed the relation between each other.

Investment in transportation is indicated to stimulate country's economics. Many research pointed out that there occurs a relationship between economic and transportation infrastructure. Litman examined how transportation generates efficiency and productivity commercial, especially for the business [28]. The essential facts are the transport system provides tangible benefits as cost saving, and improve the reliability of delivery services. The system allowed business to shortly access resources, services, and market, which generated high productivity.

Figure 3. The comparisons between the amount of passenger, HSR Track, and GDP [27]
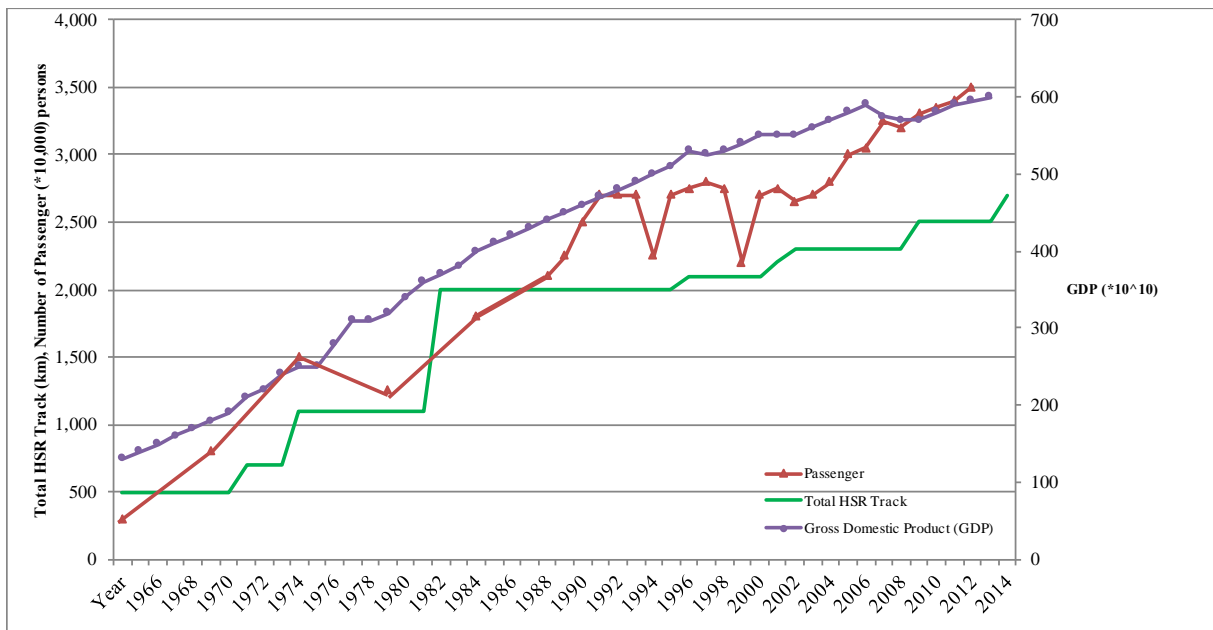
4. Results and Discussion

The analysis in this study is expected to clarify and highlight the differentiation on the effects of HSR services; in other words, it can be answered the research question: Has the Shinkansen network effected on land pricing in Honshu area? And, what are the impacts on land price in the area without Shinkansen systems? The reliable land price information is used from Tochidai (2017) and, the analysis is designed along four cases study by comparing one prefecture with HSR service with two prefectures without HSR services [29]. The criteria to match prefectures is selected the nearby areas to avoid other factors as follows;

4.1 One-way ANOVA analysis on land pricing

One way-ANOVA analysis is applied to this research to measure the relationship between each sample within the group. The null hypothesis (H_0) is a stated for following general assumption that there is no relation in mean (μ) within the case study. In this case, The H_0 means the Shinkansen network has no impacted on the land price caused by those means are equally represented. On the other hand, the alternative hypothesis (H_1) is implied that the means are not all equal. Based on this study, the acceptance of H_1 is interpreted as the Shinkansen network has effected on land price.

4.1.1 Case I: Miyagi - Chiba, and Yamanashi

The ANOVA test for the case I is to identify whether the Shinkansen network impacts on land price or not. The test statistic for testing are followed;

H_0: $\mu_{Miyagi} = \mu_{Chiba} = \mu_{Yamanashi}$

H_1: The means are not all equal

F-Test for $\alpha = 0.1$

Table 2. The result of one-way ANOVA test for Case I: Miyagi - Chiba, and Yamanashi

SUMMARY

Groups	Count	Sum	Average	Variance
Sendai	35	6315490	180442.6	1.88E+10
Chiba	35	6768054	193373	1.53E+10
Yamanashi	35	2926077	83602.2	2.22E+09

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.52E+11	2	1.26E+11	10.39974	7.76E-05	2.355356
Within Groups	1.24E+12	102	1.21E+10			
Total	1.49E+12	104				

The ANOVA analysis shows the value of $F_{(calculation)} = 10.3997$ where the $F_{(0.1,2,102)} = 2.3611$; in other words, $F_{(calculation)} > F_{(table\ \alpha\ =\ 0.1)}$. Therefore, this scenario will reject H_0 which can interpret as the mean of at least one group of samples is the difference; in other words, there shows different impact from Shinkansen network on land price among Miyagi, Chiba, and Yamanashi prefectures.

4.1.2 Case II: Tokyo – Chiba, and Yamanashi

The ANOVA test for case II is to identify whether the Shinkansen network impacts on land price or not. The test statistic for testing are followed;

H_0: $\mu_{Tokyo} = \mu_{Chiba} = \mu_{Yamanashi}$

H_1: The means are not all equal

F-Test for $\alpha = 0.1$

Table 3. The result of one-way ANOVA test for Case II: Tokyo – Chiba, and Yamanashi

SUMMARY

Groups	Count	Sum	Average	Variance
Tokyo	35	38957846	1113081	5.05E+11
Chiba	35	6768054	193373	1.53E+10
Yamanashi	35	2926077	83602.2	2.22E+09

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	2.24E+13	2	1.12E+13	64.24665	8.77E-19	2.355356
Within Groups	1.78E+13	102	1.74E+11			
Total	4.01E+13	104				

The ANOVA analysis shows the value of $F_{(calculation)} = 64.2466$ where the $F_{(0.1,2,102)} = 2.3611$; in other words, $F_{(calculation)} > F_{(table\ \alpha = 0.1)}$. Therefore, this scenario will reject H_0 which can interpret as the mean of at least one group of samples is the difference; in other words, there shows different impact from Shinkansen network on land price among Tokyo, Chiba, and Yamanashi prefectures.

4.1.3 Case III: Kyoto – Shimane, and Tottori

The ANOVA test for case III is to identify whether the Shinkansen network impacts on land price or not. The test statistic for testing are followed;

H_0: $\mu_{Kyoto} = \mu_{Shimane} = \mu_{Tottori}$

H_1: The means are not all equal

F-Test for $\alpha = 0.1$

Table 4. The result of one-way ANOVA test for Case III: Kyoto – Shimane, and Tottori

SUMMARY

Groups	Count	Sum	Average	Variance
Kyoto	35	9626326	275037.9	2.56E+10
Shimane	35	1503396	42954.17	49771541
Tottori	35	2025354	57867.26	3.41E+08

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.18E+12	2	5.91E+11	68.19563	1.57E-19	2.355356
Within Groups	8.83E+11	102	8.66E+09			
Total	2.06E+12	104				

The ANOVA analysis shows the value of $F_{(calculation)} = 68.1956$ where the $F_{(0.1,2,102)} = 2.3611$; in other words, $F_{(calculation)} > F_{(table\ \alpha = 0.1)}$. Therefore, this scenario will reject H_0 which can interpret as the mean of at least one group of samples is the difference; in other words, there shows different impact from Shinkansen network on land price among Kyoto, Shimane and Tottori prefectures.

4.1.4 Case IV: Osaka – Shimane, and Tottori

The ANOVA test for case IV is to identify whether the Shinkansen network impacts on land price or not. The test statistic for testing are followed;

H_0: $\mu_{Osaka} = \mu_{Shimane} = \mu_{Tottori}$

H_1: The means are not all equal

F-Test for $\alpha = 0.1$

Table 5. The result of one-way ANOVA test for Case IV: Osaka – Shimane, and Tottori

SUMMARY

Groups	Count	Sum	Average	Variance
Kyoto	35	9626326	275037.9	2.56E+10
Shimane	35	1503396	42954.17	49771541
Tottori	35	2025354	57867.26	3.41E+08

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.18E+12	2	5.91E+11	68.19563	1.57E-19	2.355356
Within Groups	8.83E+11	102	8.66E+09			
Total	2.06E+12	104				

The ANOVA analysis shows the value of $F_{(calculation)} = 68.1956$ where the $F_{(0.1, 2, 102)} = 2.3611$; in other words, $F_{(calculation)} > F_{(table\ \alpha = 0.1)}$. Therefore, this scenario will reject H_0 which can interpret as the mean of at least one group of samples is the difference; in other words, there shows different impact from Shinkansen network on land price among Osaka, Shimane and Tottori prefectures.

As the results of four cases study reject H_0, it cannot interpret whether Shinkansen network effect on land price or not. The next stage to find the correlation between two prefectures is applied Least Significant Different (LSD) as shown in section 4.2.

4.2 Least Significant Different (LSD) Analysis

Fisher developed Least significant different analysis (LSD) in 1935 [30]. It is aimed to justify all possible pair-wise comparisons of means comprising a factor after analysing of ANOVA, and its results showed at least one group differs from other. The outcomes can genuinely identify the similarity or dissimilarity between each pair of the sample in a case study. It can justify how the impact of HSR on population dynamic and land price in the area with and without HSR station.

$$\text{LSD} = t_{\frac{\propto}{2}}, \text{n-k} \ \sqrt{MSW} \times \sqrt{\frac{1}{n1} + \frac{1}{n2}} \tag{1}$$

In cases of $n_1 = n_2$, the equation (1) can be derived to new form as represents in equation (2)

$$\text{LSD} = t_{\frac{\propto}{2}}, \text{n-k} \times \sqrt{\frac{2MSW}{n1}} \tag{2}$$

Which; t = the critical value for the α level obtained from the t distribution, MSW= mean square with in group, n = number of sample, k = number of groups, n_i = number of sample in group i.

4.2.1 LSD analysis on land price

As follow section 4.2, the results of LSD analysis on four cases study shows in Table 6 below.

Table 6. The summarisation of LSD analysis on land price at confidence level 90%

| Case Study	Comparison	LSD	$|x_i-x_j|$	Results
Case I: Miyagi - Chiba, and Yamanashi	Miyagi-Chiba	3.9966	863.4974	$\mu_{\text{Miyagi}} \neq \mu_{\text{Chiba}}$
	Miyagi-Yamanashi		127.6061	$\mu_{\text{Miyagi}} \neq \mu_{\text{Yamanashi}}$
	Chiba-Yamanashi		991.1035	$\mu_{\text{Chiba}} \neq \mu_{\text{Yamanashi}}$
Case II: Tokyo - Chiba, and Yamanashi	Tokyo-Chiba	42.7825	4,673.4686	$\mu_{\text{Tokyo}} \neq \mu_{\text{Chiba}}$
	Tokyo-Yamanashi		5,664.5721	$\mu_{\text{Tokyo}} \neq \mu_{\text{Yamanashi}}$
	Chiba-Yamanashi		991.1035	$\mu_{\text{Chiba}} \neq \mu_{\text{Yamanashi}}$
Case III: Kyoto - Shimane, and Tottori	Kyoto-Shimane	2.2482	463.1589	$\mu_{\text{Kyoto}} \neq \mu_{\text{Shimane}}$
	Kyoto-Tottori		401.7454	$\mu_{\text{Kyoto}} \neq \mu_{\text{Tottori}}$
	Shimane-Tottori		61.4136	$\mu_{\text{Shimane}} \neq \mu_{\text{Tottori}}$
Case IV: Osaka - Shimane and Tottori	Osaka-Shimane	2.2997	4,531.0119	$\mu_{\text{Osaka}} \neq \mu_{\text{Shimane}}$
	Osaka-Tottori		4,469.5983	$\mu_{\text{Osaka}} \neq \mu_{\text{Tottori}}$
	Shimane-Tottori		61.4136	$\mu_{\text{Shimane}} \neq \mu_{\text{Tottori}}$

In conclusion, the comparison between the area with HSR station and without HSR station shows that there is no relation to land prices within these groups on LSD analysis. The majority cities, i.e., Miyagi, Tokyo, Osaka, and Kyoto are selected as the area with HSR station. As shown in Figure 2, Tokyo displayed significantly higher price than other areas. As supported by Noguchi and Poterba's research that pointed out the land price in Tokyo and Osaka were obviously different. The land price in those areas cost approximately 90% of housing prices [10]. The research revealed the land prices in three regions within Tokyo that showed an average land price of 91% over the total building cost. On the other hand, other big prefectures like Osaka, Nagoya, and Hiroshima represented at 87.2%, 74.7%, and 65.9% respectively; moreover, in the rural areas such as Akita, Toyama and Miyazaki showed only 36.2%, 47.6% and 40.6% over the total cost respectively. The research found that the big cities show no relation to land price with other towns due to the land prices in metropolitan areas had expensive before coming to HSR.

Land price in Japan customarily related to the GDP, which growth around 2% during 1955 to 1985. But, the bubble crisis in mid of 1980 caused fluctuations in land prices. As seen in Figure 3, the bubble burst crisis made impacts cross over Japan but, the changing of land prices was dramatically different depending on each area. An average land price in Tokyo was changed from 568,015 Yen/m^2 in 1985 to 1,322,067 Yen/m^2 in the next year, which was risen over 132%; in the meantime, Osaka and Kyoto were changed at 40.92% and 12.88% respectively (MLIT, 2017). One part of Noguchi and Poterba (1994)'s research focused on the accommodation prices in Tokyo during 1984-1989 [10]. The finding illustrated that the housing prices in Tokyo were dropped down apart from distance from city centre. Those are evidence supported the outcome of this research that the land prices in big cities have not been affected by HSR.

The case study I and II, Chiba and Yamanashi prefectures are areas without HSR nearby Tokyo; the results represented there was no relation between each prefecture. Apart from those reasons above, Chiba is the cities for industries and economy. The area is located in the coastal zone; therefore, this area turned to the hub for industries, commerce and other business functions. As the cities of manufacturing, the land price of Chiba was in the top ten highest land prices in Japan; however, the rate was nine-time lower than Tokyo prefecture within a similar year. Similarly, with the Yamanashi prefecture, the average land prices have shown three times smaller than Tokyo even they are neighbour cities. It was only Kofu city has naturally higher prices than other cities since the JR Chou line operates between Tokyo and Kofu; moreover, the land price was impacted sharply in the area nearby the train station [32]. The finding on this paper also related with the previous study that the results of LSD analysis shows both Chiba and Yamanashi are no relation on land prices with Tokyo and Miyagi as represented on the dramatically different values between LSD and $|x_i-x_j|$ in Table 6.

In case study III and IV, the Shimane and Tottori are selected as the area without HSR services comparing with the closest big cities as Kyoto and Osaka. The finding on this study show there is no relation to land price within any prefectures. Both Shimane and Tottori is neighbour prefecture located in the Chugobu part. The Sanyo Shinkansen is the main HSR line in Chugobu, which links Hyogo and Fukuoka through Chugobu area; however, the line is not passed on Shimane and Tottori prefectures. The average land prices of both regions have obviously shown lower than the rest areas.

Figure 2. The top five expensive land price zone in (a) Shimane prefecture and (b) Tottori prefecture [29]
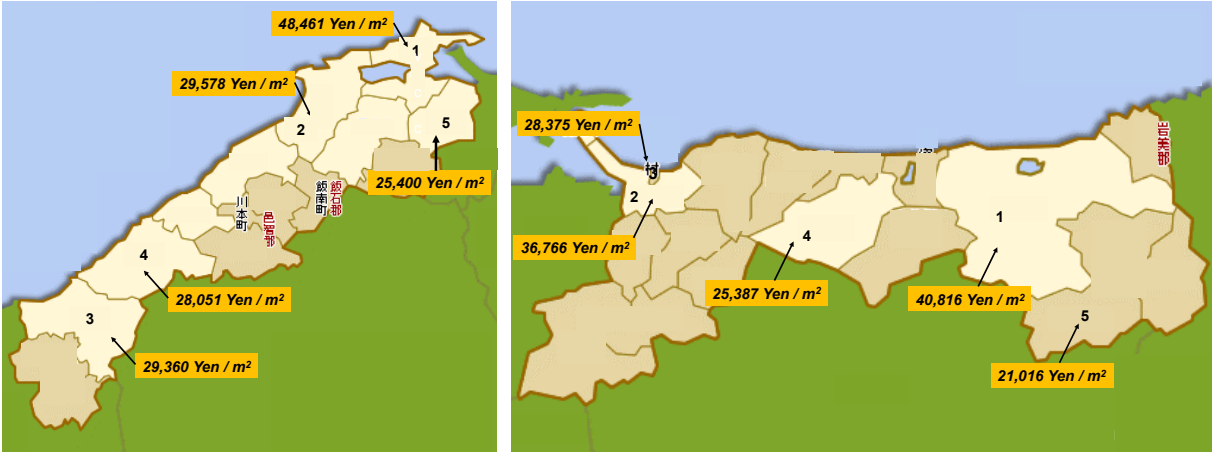
In case of Shimane prefecture, it stated the lowest land value in Japan since 1990 due to its lack of facilities such as schools and hospital [33]. The Japanese government solved this issue by developing that area to economic and population distribution zone that could reduce imbalances on land price issues. After that, the manufacturing has been supported to establish at Shimane prefecture due to the

easy accessibility by port caused by Shimane recently contains with the large volume of production. Tottori prefecture, another case study, combines natural and industrial areas that compose with wide ranges of manufacturing, i.e., electronics, medical, drug. The comparisons between the average land price between Shimane and Tottori in 2017 showed at 30,285 and 29,512 Yen/m^2 respectively [29]. The high land value in Shimane is almost seaside area, as shown in Figure 4(a), Matsue (the area number 1), which is the capital of Shimane prefecture, composes of various attractions, i.e., Matsue castle, Izumo Taisha; in other words, it is an economic area on this prefecture caused by an average price was nearly twice higher than other cities. Similarly, the capital of Tottori prefecture showed the highest land prices over the surrounded areas. One key factor is two leading universities, Tottori sand dunes, and other attractions located within this area. The LSD analysis results show dramatically different on land price in both cases Osaka – Shimane, and Osaka – Tottori that represent high values of |xi-xj| around 4,500 Yen/m^2. But, the comparisons of those cities with Kyoto represents slightly different on land value at 401.74 Yen/m^2.

5. Conclusion

According to several decades of Shinkansen services in Honshu area, it has generated both direct and indirect positive impacts on Japanese society. As follow direct impacts, HSR naturally offered to shorten travel time and to enlarge the gaps between cities caused by newly accessible areas are easily reached. On this point, HSR has been judged as the best catalysed for improving urban areas. Positive impacts from HSR also can continually generate indirect effects on Japanese society as increasing land price, stimulating population dynamics and making country economics; however, these were still obscurely on the point that has HSR generated an impact with urbanisation.

The two stages analysis in this study focus on deeply analyse the indirect impacts regarding land pricing and population dynamics. The land pricing in Japan has growth rely on GDP but, it vastly impacted due to the crisis that made the trend of land price reached over 130% rather than the typical situation.

The result of land pricing analysis in each case studies pointed out that HSR has effected on the land prices but, it depends on each prefecture. The research found that HSR obviously impacts in rural more than urban areas. In a country, an obviously different from the average land price illustrated the prefectures with HSR station take advantage over the counties without HSR station. Besides, the areas surrounded HSR stations has been turned to economics zones. In an urban area, on the other hand, HSR has shown slightly impact on majority cities (i.e., Tokyo) due to the metropolitan cities may grow up by other factors such as new business, and other facilities.

The analysis along two stages of this research found that HSR has impacts on urbanisation in Japan but, the volume of effect relies on characteristics of the prefecture. Among ambiguous answers of has HSR impacted on Japanese society, the research can affirm that the Shinkansen network obviously reflects its benefit on the rural than urban areas.

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