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Chapter 4

Geographical Simulation Analysis of the High-Speed Railway in Malaysia

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Abstract: In this paper, we analyze the economic impact of the HSR between Singapore and Kuala Lumpur, and other potential sections, such as Singapore - Penang and Singapore – Bangkok. The analysis by IDE-GSM, a computable general equilibrium model based on spatial economics, has revealed that the section between Kuala Lumpur and Penang has the largest economic impact. We found that a reduction of NTB in the service sector within Singapore, Malaysia, and Thailand by 30% makes the economic impact 1.7 to 3.9 times larger for each country, compared with the HSR without NTB reduction. This paper has revealed that the economic impact of the HSR differs significantly by the combination of the sections, speed, frequency, and fare for the service, as well as NTB in the service sector. Thus, detailed simulation analyses are indispensable before the comprehensive plan of the HSR is fixed.

Keywords: Transit-oriented development, high-speed railway; urban planning; services
JEL Classification: R12, R13, R42

1. Introduction

On 5 September, 2018, the Singapore and Malaysian Governments formally agreed to postpone construction of the proposed high-speed rail (HSR) between Singapore and Kuala Lumpur until the end of May 2020. Due to this postponement, opening of the HSR operation is delayed to 1 January, 2031, instead of the original date, 31 December, 2026.

The economic viability of the Singapore-Kuala Lumpur HSR (SK-HSR, hereafter) was controversial, and became one of the political issues during the 14th General Election in Malaysia, held on 9 May, 2018. On the other hand, the HSR connecting Singapore, a city state with a population of 5.6 million, and Kuala Lumpur, the capital city of Malaysia with its population of 7.4 million including the surrounding urban areas, seems to offer one of the largest economic potential benefits among several HSR projects planned for Southeast Asia.

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In this paper, we try to evaluate the economic impact of the SK-HSR, and the other potential sections of the HSR, by utilizing IDE-GSM, a computational general equilibrium model based on spatial economics. By evaluating the economic impact, we can analyze the sensitivity of any economic gains according to the frequency and speed of the HSR.

This paper is structured as follows. First, we explain briefly about IDE-GSM, mentioning the model, data set, and the theory behind the model. Second, we introduce background information of the SK-HSR, and present some related literature on the economic impact of HSR projects in other countries. Third, we introduce various HSR scenarios that are analyzed in this paper according to the different sections, speeds and service frequency. Fourth, we show the estimated economic impact of various scenarios with our reasonable interpretation. The final section is the conclusion of this paper by combining the policy implications for the HSR's development.

2. Brief Introduction to IDE-GSM

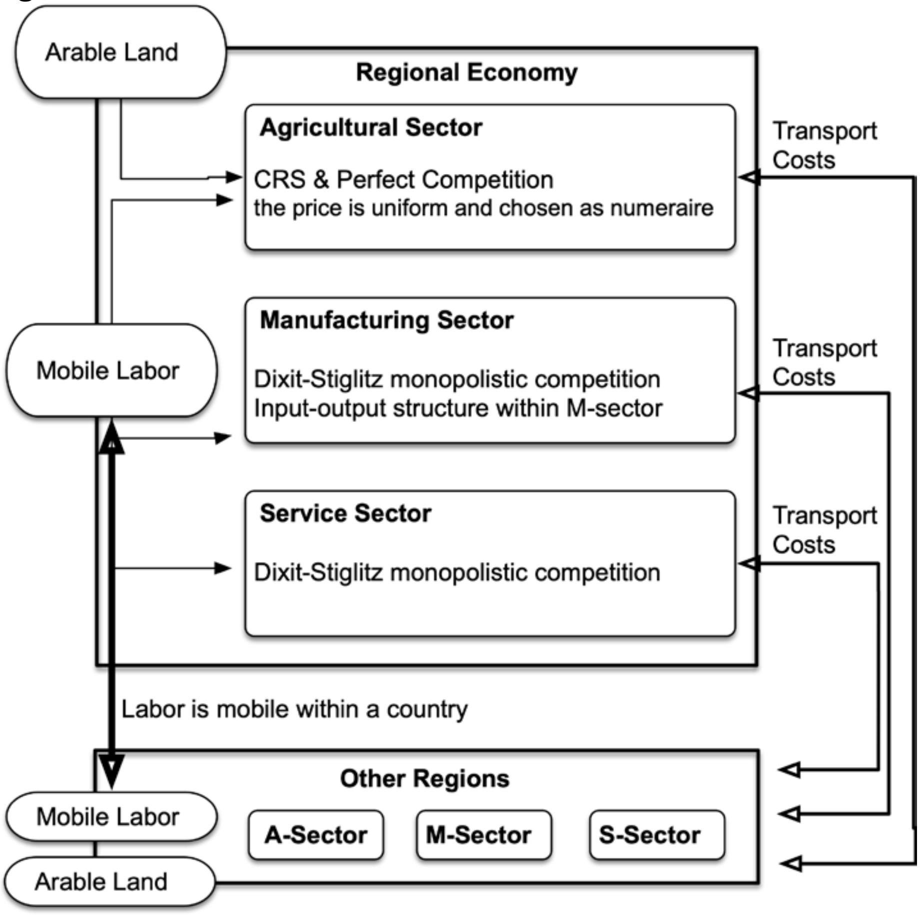
The Geographical Simulation Model developed by IDE-JETRO (IDE-GSM), is a variation of the computable general equilibrium (CGE) model based on spatial economics (Kumagai et al. 2013). The models based on spatial economics, either theoretical or empirical, tend to be complex and difficult to solve mathematically, and the spatial economic studies frequently use numerical simulation. The very basic model, the Core-Periphery (CP) model by Krugman (1991), shows the fundamental characteristics of the spatial economic model by a simple numerical simulation. The basic CP model is a two-location-two-goods model, setting one type of goods (typically assumed to be agricultural goods) as the numeraire, produced by a constant return to scale technology, which incurs zero transport costs, while the other goods produced by increasing return to scale technology (typically assumed to be manufactured goods), incur positive transport costs.

The beauty of the CP model, even extended from a two-location to the many-location version, is its simplicity with rich implications. IDE-GSM was started, as a branch of the CP model with many locations, except that the geography is not a "race track" but a realistic network of the cities in East Asia.

IDE-GSM has been developed as a variation of the CP model, with two main objectives, (1) To simulate the dynamics of the location of the populations and industries in East Asia over the long-term, and, (2) To analyze the economic impact of the trade and transport facilitation measures (TTFMs, hereafter). Such as development of the transport infrastructure and the reduction in time and money costs at national borders on the regional economies at the sub-national level. In our simulation model more than 3,000 regions are included. There are two types of production factors: labor and land. Labor is mobile within a country, but prohibited to migrate to other countries. Land is unevenly spread across all the regions and owned jointly by all the workers in each region.

Figure 1 shows the structure of IDE-GSM. All the products in the three sectors, agriculture/mining, manufacturing, and services, are tradable. Transport costs are supposed to be of the iceberg type; that is, if one unit of product is sent from one region to another, the unit with less than one portion arrives. Depending on the 'melted' portion, the supplier needs to set a higher price. The increase in price compared to the producer's price is regarded as the transport cost. Transport costs within the same region are considered negligible.

Figure 4-1: Structure of the Model

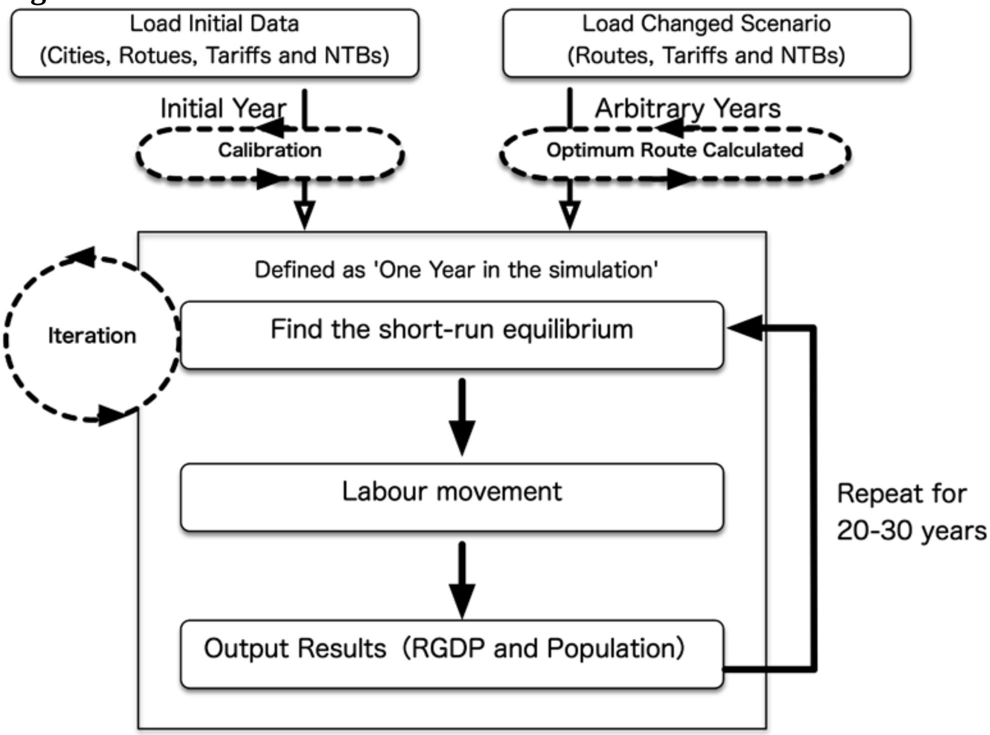


Source: The Authors.

The simulation procedure is shown in Figure 4-2. First, with a given distribution of labor and regional GDP by sector and region according to the actual data set, the short-run equilibrium is obtained by an iterative calculation. Observing the achieved short-run equilibrium, labor migrates among regions and industries according to the difference in real wages, i.e., the nominal wages adjusted by the price indices in each region. Labor moves to the sectors that offer higher real wage rates in the same region, and moves to the regions that offer higher real wages within the same country. After this migration dynamic, we obtain the new distribution of labor and economic activity. We define this one calculation cycle as one year in the simulation. With this new distribution and predicted national-level population growth given externally, the next short-run equilibrium is calculated for the following year, and we observe the migration dynamic again. These computations are repeated for 30 years from 2010 to 2040.

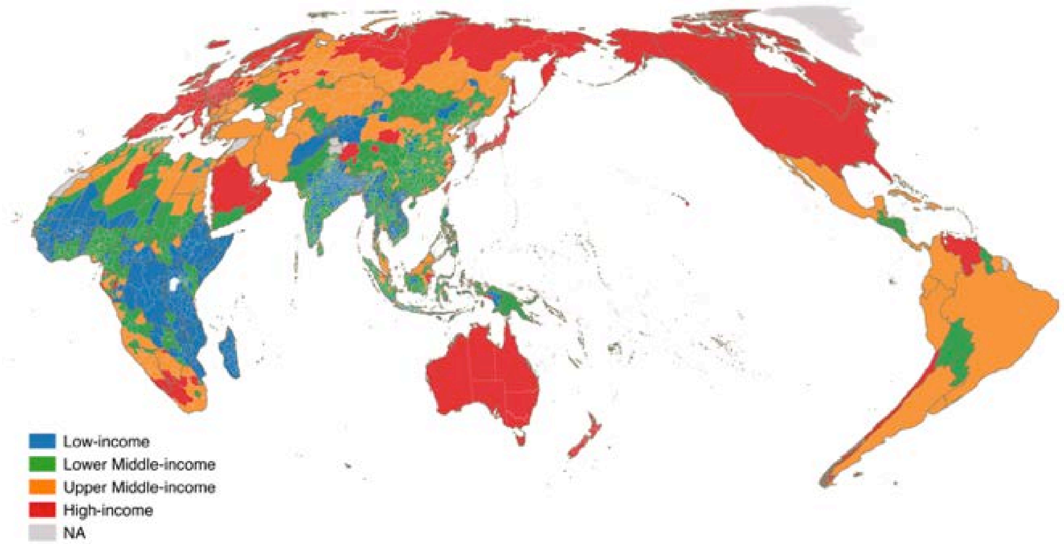
IDE-GSM depends on two data sets. One is the economic/population data set at the sub-national level, and the other is the data set of the transport networks. This is primarily based on official statistics, and sometimes by utilizing satellite imagery (Keola et.al. 2015) to derive the regional-level gross domestic product (RGDP) for the agricultural sector, mining sector, five manufacturing sectors, and the service sector for 2010. The five manufacturing sectors are food processing, garments and textiles, electronics, automotive, and other manufacturing. The population and land area for each region are compiled from official statistical sources. Figure 4-3 shows the RGDP per capita for each region in 2010, classified by the World Bank's income level thresholds.

Figure 4-2: Procedure for the Simulation



Source: The Authors.

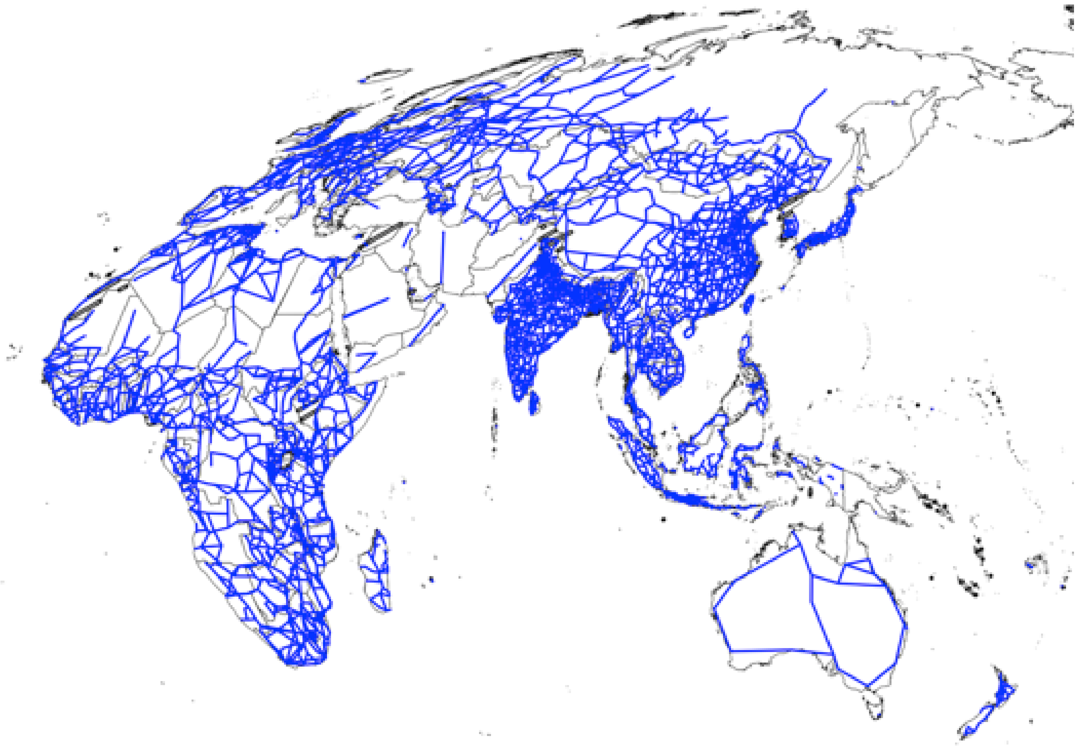
Figure 4-3: GRDP per capita in the world, 2010



Source: Dataset compiled for the IDE-GSM

For the transport network data, the number of routes included in the simulation is more than 14,000 (land: 10,000, sea: 1,300, air: 2,150 and railway: 900). The route data consists of the start city, end city, distance between the cities, the speed of the vehicle running on the route, etc. The land routes between cities are based mainly on the "Asian Highway" database of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), supplemented by the routes shown on various maps. The actual road distance between cities is used; if the road distance is not available, the distance between cities in a straight line is applicable. Figure 4-4 shows the land route networks incorporated with the IDE-GSM. Data on the air and sea routes was compiled mainly from Nihon Kaiun Shukaijo (1983), and the data set assembled by the team of the Logistics Institute - Asia Pacific (TLIAP), with a selection of 1,300 sea routes and 2,150 air routes included in the model. The railway data was adopted from various sources, such as maps and the official websites of the relevant railway companies.

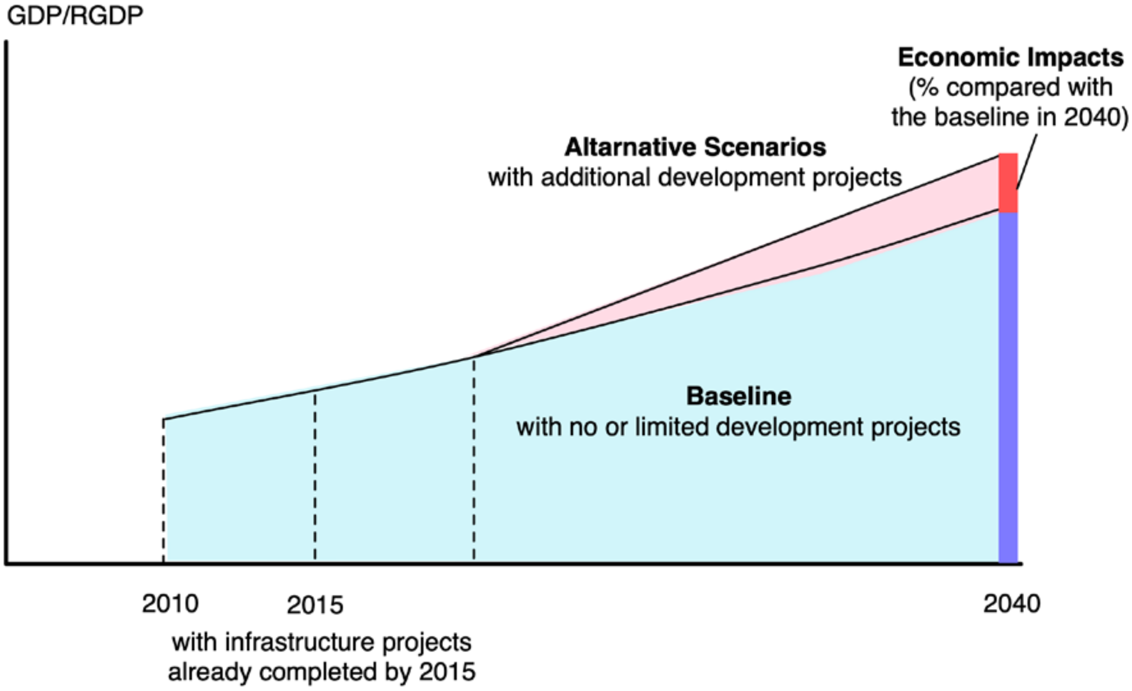
Figure 4-4: Land route network data for Eurasia, Africa, and Oceania



Source: Dataset compiled for the IDE-GSM

To calculate the economic impact of a specific TTFM, we take the difference from the baseline and the alternative scenario (Figure 4-5). The baseline scenario incorporates infrastructure projects completed by 2015. The alternative scenario assumes additional infrastructure development projects that are analyzed in the simulation. We compare and show the differences between the RGDPs for each sub-national region based on various alternative scenarios, against the RGDP for the same sub-national region in the baseline scenario for 2040. If a region under an alternative scenario has a higher (or lower) RGDP than that under the baseline scenario, we regard this surplus (or deficit) as a positive (or negative) economic impact of TTFM.

Figure 4-5: Evaluation of the Economic Impact by Sub-National Region



Source: The Authors.

In the baseline scenario, we assume a business-as-usual situation. The following assumptions are maintained in all the scenarios, including the baseline case, even if they are not explicitly cited in the following scenarios:

- The national population of each country is assumed to increase at the rate forecast by the United Nations Population Division until 2040.
- International labor migration is prohibited.
- Tariffs, non-tariff barriers, and service barriers change based on the FTA/economic partnership agreements (EPAs) currently in effect, and according to the phased-in tariff reduction schedule by the FTAs/EPAs and Hayakawa and Kimura (2015).
- We give different exogenous growth rates for the technological parameters for each country to replicate the GDP growth trend from 2010 to 2023, which is estimated and provided in the World Economic Outlook by the International Monetary Fund.
- After 2023, we gradually reduce the calibrated growth rate of the technological parameters to half over 20 years.

It should be noted that even if TTFMs negatively affect a regional economy under the simulation scenario, this does not necessarily mean that the region is worse off than the current situation. Most of the countries in Asia are expected to grow faster in the next few decades, and the negative economic impact will be offset by part of the gain from the expected economic growth. For any alternative scenario, we can change the settings related to the logistical infrastructure and/or other parameters pertaining to trade and production.

There are four different transport modes included in the IDE-GSM. The basic parameters for each transport mode are shown in Table 4-1. HSR is added as the fifth mode as a passenger-only train with higher speed and higher cost/km. Specifically, in the baseline setting, the average speed of the HSR service is set at 300km/h and the cost/ km is around 1USD/km, double that for conventional trains and about a quarter of the cost for air transport.

Table 4-1: Transport parameters by mode (Standardized per 20ft container)

	Truck	Rail	Sea	Air	HSR	
Cost/Km	1	0.5	0.24	4.52	1	US$/km
Avg. Speed	38.5	19.1	14.7	800	300	km/hour
Transit Time (Dom.)	0	2.7	3.3	2.2	0	Hours
Transit Time (Intl.)	13.2	13.2	15	12.8	0	Hours
Transit Cost (Dom.)	0	0	190	690	0	US$
Transit Cost (Intl.)	500	500	491	1276	0	US$

Source: The Authors.

We also set the waiting time at each HSR station. Setting a longer (shorter) waiting time at a station means a lower (higher) frequency of HSR service operation.

3. Background Information and Literature Review

From the Malaysian point of view, the SK-HSR was an entry point project to the Greater KL/Klang Valley region, a National Key Economic Area (NKEA) under the Economic Transformation Programme (ETP) by the Malaysian Government. The SK-HSR was initially planned to be built by 2026, and the relevant agreement between the governments of Malaysia and Singapore was announced in February 2013. The intermediate railway stations between the two terminals, Bandar Malaysia in Kuala Lumpur and Woodland in Singapore, are Seremban, Melaka, Muar, Batu Pahat, and Nusajaya. The HSR was planned to provide a travel time of 90 minutes between Kuala Lumpur and Singapore.

The distance between Singapore and KL is around 350km, a distance that is suitable for HSR operation, because it is relatiely far for car/bus transport, while is a bit near for air transport, considering the travel from/to airport and any waiting time there. The distance of 350km is the same as that for the Tokyo-Nagoya Tokaido Shinkansen (HSR) route in Japan.

It is noteworthy to introduce the economic impact of the first HSR in the world, the Tokaido Shinkansen, which was completed in 1964, the year Tokyo hosted the Olympic Games. The Tokaido Shinkansen connects the three largest cities in Japan, Tokyo, Nagoya, and Osaka, with a maximum speed of 210 km/h, almost double that for conventional trains running at a maximum speed of 110km/h. The travel time between Tokyo and Osaka (553 km) has been drastically shortened by the HSR, from 6 hours 30 minutes (as of 1960) to 3 hours and 10 minutes.

There have been several studies made concerning the economic impact of the Tokaido Shinkansen. Usami et al. (2013) have estimated that the impact using a CGE model achieved a positive economic impact in 1970 of JPY 617.8 billion (USD 5.6 billion). This increased to JPY4158.9 billion (USD 37.8 billion) by 2005, four decades after the service started.

In the 1960s, Japan experienced the highest economic growth in its modern history, and the Tokaido Shinkansen is regarded as one of the catalysts. The population of the Tokyo Metropolitan Area is 17.9 million, and in the Osaka area the population is 12.2 million. Nagoya, which is located in-between, has a population of 7.3 million (Nawata 2008). Because the economic impact created by the Tokaido Shinkansen seems to be the largest ever in the world for this kind of infrastructure, it is natural that the economic impact of the SK-HSR would be on a much smaller scale than the impact by the Tokaido Shinkansen. Even the estimated economic impact of the Liner Chuo Shinkansen (MILT 2007), connecting Tokyo and Nagoya in 2027, and Nagoya and Osaka section in 2045 by a maglev train running at over 500 km/h, is expected to be JPY 960 billion (USD 8.7 billion) by 2047, a quarter of the economic impact of the Tokaido Shinkansen.

We also conducted a simulation analysis on the Hokuriku Shinkansen, connecting Tokyo–Takasaki–Kanazawa (450km) in 3 hours, and completed in 2015. The GDP of Tokyo in 2010 was 4.5 times larger than that of Singapore and, of the three prefectures around Kanazawa, it is 1.5 times larger than Selangor and KL. The estimated economic impact by 2030 is USD 1.1 billion. This number is a comparative benchmark for the economic impact by the SK-HSR.

4. The HSR Scenarios

Here, in order to estimate the economic impact of the SK-HSR and other potential sections, we include the following scenarios.

4.1 Different Sections

SGKL: Simulating the international service between Singapore and Kuala Lumpur, with an intermediate stop at Iskandar, Johor. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process.

SGPN: Simulating the international service between Singapore and Butterworth, Penang, with intermediate stops at Iskandar, Johor, and Kuala Lumpur. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process.

SGBK: Simulating the international service between Singapore and Bangkok, with an intermediate stop at Iskandar, Kuala Lumpur, Butterworth, and Hat Yai, Thailand. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process.

4.2 Different Speeds

S200: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be 2 hours. There is a 30-minute wait at the CIQ process. The speed of HSR service is 200km/h.

S250: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The speed of HSR service is 250km/h.

S300: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The speed of HSR service is 300km/h.

S350: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The speed of HSR service is 350km/h.

4.3 Different Service Frequency

F0.5: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 30 minutes. There is a 30-minute wait at the CIQ process.

F1: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 1 hour. There is a 30-minute wait at the CIQ process.

F2: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process.

F4: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 4 hours. There is a 30-minute wait at the CIQ process.

4.4 Different Fares

LF: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The fare is USD0.5/km, on a par with conventional trains.

BF: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The fare is USD1.0/km on a par with car transport.

MF: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The fare is USD2.0/km, double that for car transport, and half the air fare.

HF: Simulating the Singapore-Bangkok HSR. The frequency of the service is assumed to be every 2 hours. There is a 30-minute wait at the CIQ process. The fare is USD4.0/km, on a par with the air fare.

4.5 HSR with NTB reduction

In this scenario, we estimate the economic impact of the Singapore – Bangkok HSR with a reduction in NTB by the service sector among three countries of 30% by 2031. The speed, frequency, and fare of the service are the same as in the baseline scenario.

5. Simulation Results

5.1 Different Sections

The estimated economic impact from the SK-HSR in 2040 is shown in Table 4-2. The largest economic impact is for Malaysia, 1.27 billion USD per year, compared with the baseline GDP, followed by that for Singapore, 212 million USD. For Thailand, a small negative impact is observed because of the relocation of some industries from Thailand to Malaysia and Singapore.

The positive economic impact for Malaysia is mainly observed in the service sector, while some level of negative economic impact is observed by the manufacturing sector. On the other hand, some economic impact for Singapore is observed by both service and manufacturing sectors. We interpret this as follows. First, the HSR service makes the service sector in Malaysia comparatively more advantageous against the manufacturing sector in Malaysia. Then, some part of the decline in production by the Malaysian manufacturing sector will be captured by the manufacturing sector in Singapore.

Table 4-2: Economic impact by the SGKL HSR (2040, million USD)

Country	Agriculture	Automotive	E&E	Textile	Food Proc.	Oth. Mfg.	Services	Mining	Real GDP
Malaysia	-3	-6	-121	-5	-4	-66	1,476	-1	1,269
Singapore	0	25	60	0	4	79	44	0	212
Thailand	-7	-21	-35	-21	-5	-46	-17	0	-154
Total	-10	-2	-96	-26	-6	-33	1,502	-2	1,327

Source: The Authors.

Figure 4-6 shows the geographical distribution of the economic impact for each region in the three countries in 2040. The regions colored red have a positive impact, while the regions colored blue show a negative impact from the HSR service between Singapore and Kuala Lumpur. For Malaysia, the regions without HSR stations, such as Malacca and Negri Sembilan, and the regions that are far away from the HSR line, such as Pahang and Terengganu as well as Sabah and Sarawak, will be affected negatively. Such negative impact is caused by relocation of the population and industry from these regions to the regions with locational advantages due to the HSR.

The estimated economic impact by the HSR between Singapore and Penang is shown in Table 4-3. For Malaysia, the economic impact is 4.6 times larger than that by the HSR service between Singapore and Kuala Lumpur. This means that the economic impact from the Kuala Lumpur - Penang section is larger than that for the Kuala Lumpur - Johor section. This is plausible if the economic relationship between Kuala Lumpur and Penang is stronger than that between Kuala Lumpur and Johor. Indeed, the number of passengers between Kuala Lumpur Airport and Penang Airport in 2016 was 2.09 million, while that between Kuala Lumpur and Johor was 789,000 (Ministry of Transport, Malaysia 2017), although the population of Penang State is about half that of Johor State.

Table 4-3: Economic impact by the SGPN HSR (2040, million USD)

Country	Agriculture	Automotive	E&E	Textile	Food Proc.	Oth. Mfg.	Services	Mining	Real GDP
Malaysia	-5	-16	-142	-5	-11	-121	6,017	-2	5,714
Singapore	0	34	82	0	5	108	58	0	288
Thailand	-10	-41	-57	-34	-15	-85	36	-1	-208
Total	-15	-23	-117	-39	-21	-98	6,110	-3	5,794

Source: Authors.

Figure 4-7 shows the geographical distribution of the economic impact in each region in the three countries in 2040. For Malaysia, the northern states such as Penang, Kedah, and Peris, as well as Kelantan in the east coast, will see a benefit when the HSR service is extended to Penang.

The estimated economic impact for the HSR service between Singapore and Bangkok is shown in Table 4-4. The economic impact for Malaysia will declines slightly, while the economic impact for Singapore and Thailand is much larger than that seen by the previous two scenarios.

The economic impact for Malaysia and Thailand is mainly observed by the service sector, while the manufacturing sector in both countries have some negative impact from the HSR service. Again, some positive impact by the manufacturing sector in Singapore is observed, because some part of the declining production by the manufacturing sector in Malaysia and Thailand will be captured by the manufacturing sector in Singapore.

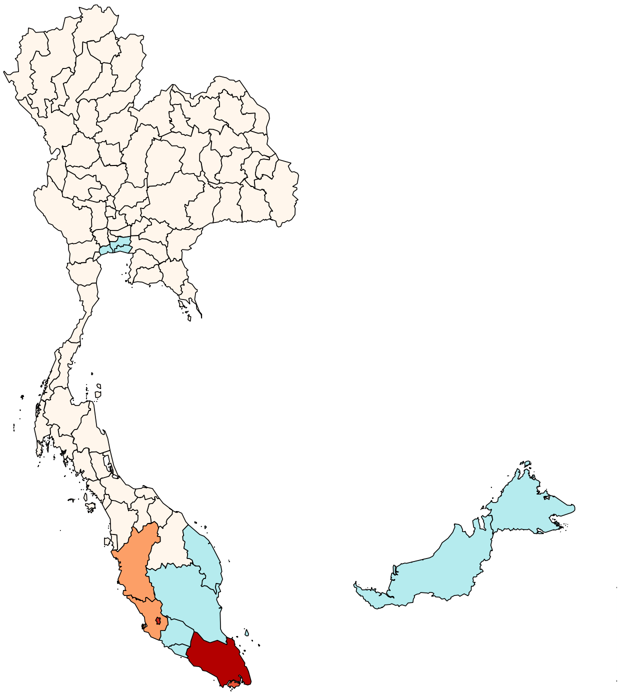
Table 4-4: Economic impact by the SGBK HSR (2040, million USD)

Country	Agriculture	Automotive	E&E	Textile	Food Proc.	Oth. Mfg.	Services	Mining	Real GDP
Malaysia	-14	2	-292	-13	20	-147	6,042	-6	5,592
Singapore	-1	139	333	1	20	446	264	0	1,202
Thailand	-47	-145	-214	-141	-62	-359	2,454	-3	1,481
Total	-62	-4	-173	-153	-22	-60	8,760	-9	8,276

Source: The Authors.

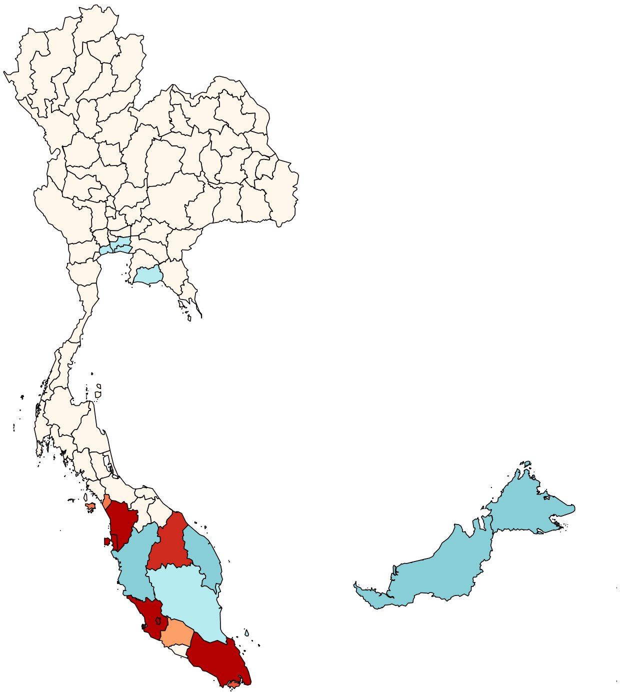
Figure 4-8 shows the geographical distribution of the economic impact for each region in the three countries in 2040. For Thailand, some positive economic impact is observed in Bangkok and the southern regions, such as Songkhla, Nakhon Si Thammarat, and Yala. Some small negative impact is observed in some other regions such as Samut Sakhon, Phuket, and Surat Thani.

Figure 4-6: Economic impact by the SGKL HSR (2040, million USD)



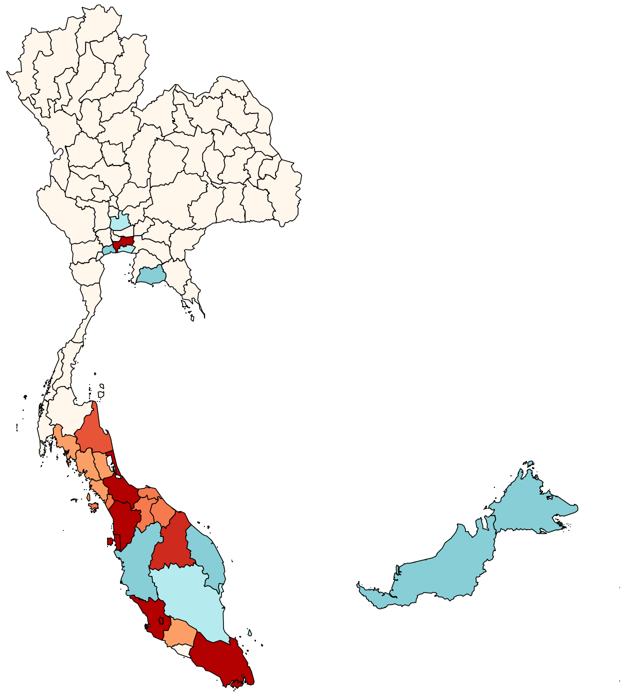
Source: The Authors.

Figure 4-7: Economic impact by the SGPN HSR (2040, million USD)



Source: The Authors.

Figure 4-8: Economic impact by the SGBK HSR (2040, million USD)

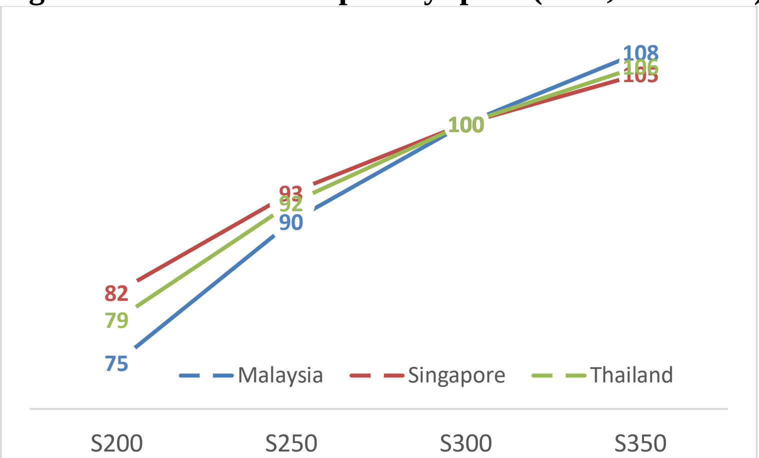


Source: The Authors.

5.2 Different Speeds

The estimated economic impact for different service speeds is shown in Figure 4-9 The economic impact of the scenario in which the HSR runs at 300km/h(S300) is set as 100. The faster the service, the larger is the economic impact. Among the three countries, the economic impact for Malaysia is the most sensitive to changes in the speed of the HSR service.

Figure 4-9: Economic impact by speed (2040, S300=100)

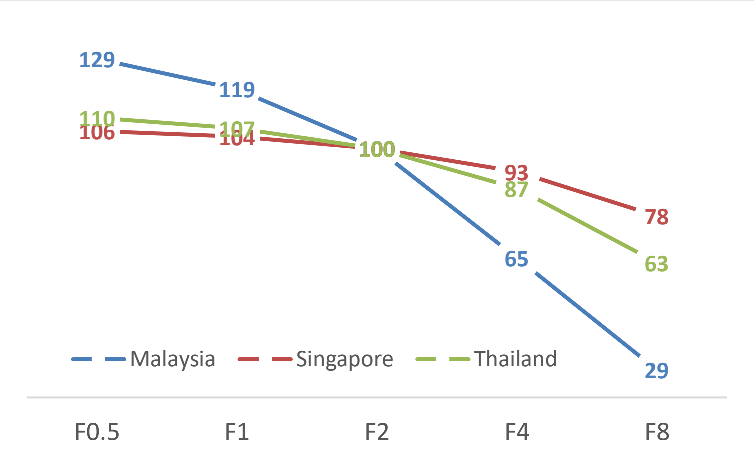


Source: The Authors.

5.3 Different Frequency

The estimated economic impact according to a different service frequency is shown in Figure 4-10. The economic impact of the scenario in which the frequency of the service is one train every two hours is set as 100. The more frequent the service, the larger is the economic impact. Among the three countries, the economic impact for Malaysia is the most sensitive to a change in the service frequency. This sensitivity is interpreted as the HSR service in Malaysia faces stiff competition from the airlines and the highway bus services.

Figure 4-10: Economic impact according to service frequency (2040, F2=100)

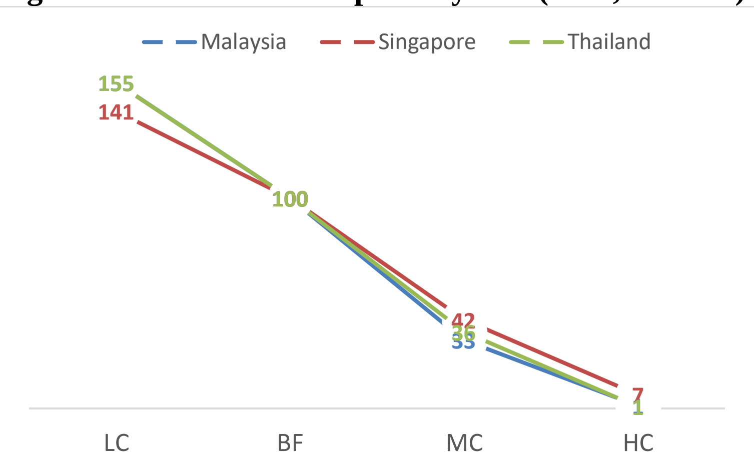


Source: Authors.

5.4 Different Fares

The estimated economic impact for different fares of HSR services are shown in Figure 4-11. The economic impacts of the scenario in which the fare is about the double of ordinary trains (BF) is set to 100. The more expensive the fare is, the smaller the economic impact is. If the fare is equal to airlines, the economic impact becomes almost nothing. The sensitivity of the economic impacts to the level of fare is not very different each other among the three countries.

Figure 4-11: Economic Impacts by fare (2040, BF=100)



Source: Authors.

5.5 HSR with NTB reduction

The estimated economic impact of the Singapore – Bangkok HSR, combined with a reduction of NTB in the service sector by three countries of 30% by 2031 is shown in Table 4-5. The economic impact for Malaysia, Singapore and Thailand is 1.7 times, 2.6 times, and 3.9 times respectively, compared to HSR without NTB reduction. The economic impact id widely observed not only by the service sector but also observed by the manufacturing and agricultural sectors in these three countries.

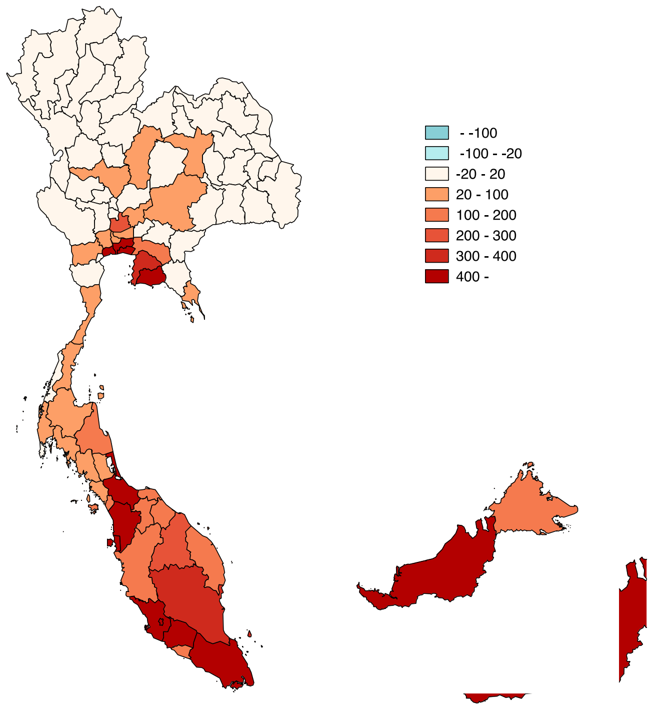
Table 4-5: Economic impact by the SGBK HSR with NTB reduction (2040, million USD)

Country	Agriculture	Automotive	E&E	Textile	Food Proc.	Oth. Mfg.	Services	Mining	Real GDP
Malaysia	543	-1	48	556	174	4,036	4,208	0	9,564
Singapore	9	318	1,122	6	34	726	912	1	3,127
Thailand	845	-448	-364	568	-77	3,118	2,193	-3	5,834
Total	1,397	-131	807	1,130	131	7,880	7,313	-2	18,525

Source: Authors.

Figure 4-12 shows the geographical distribution of the economic impact for each region in the three countries in 2040. No region will have a negative impact, while a large number of regions in the three countries will achieve a positive impact in this scenario.

Figure 4-12: Economic impact by the SGBK HSR with NTB reduction (2040, million USD)



Source: The Authors.

Summary

In this paper, we analyze the economic impact of the HSR service between Singapore and Kuala Lumpur, and other potential sections, such as Singapore - Penang and Singapore – Bangkok. Among the potential sections of the HSR, the section between Kuala Lumpur and Penang seems to have the largest economic impact.

We also analyze the sensitivity of the economic impact to the speed, frequency and fare for the HSR service. All three factors will significantly affect to the economic impact by the HSR service. Among them, an overpriced fare for the HSR service will be fatal to its economic viability considering the competition from the regional airlines. Sensitivity of the economic impact to changes in the speed of the HSR service seems to diminish as the speed increases. On the other hand, sensitivity of the economic impact to changes in the frequency of the service differs section by section.

We also show that a reduction of NTB in the service sector in the three countries by 30% makes the economic impact 1.7 to 3.9 times larger compared with the HSR without NTB reduction. This result indicates that NTB by the service sector in generally high, and this may prevent the full potential of the HSR service being achieved. It is highly recommended that construction of an international HSR should be accompanied with an agreement among the related countries to facilitate economic transactions.

All in all, this paper reveals that the economic impact by the HSR service differs significantly according to the combination of the sections, speed, frequency and fare for the service, as well as NTB in the service sector. Thus, a detailed simulation analysis is indispensable before the comprehensive plan for the HSR is finalized. The IDE-GSM is a suitable model to apply for this purpose.

Last but not least, we need to consider the competition between the HSR and the LCC (low-cost carrier) airlines nowadays, and conventional trains operating at relatively higher speeds (such as the ETS services between Kuala Lumpur and Penang). This issue should be addressed by a future study.

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