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IDE DISCUSSION PAPER No. 700

Economic Impacts of High-Speed Rail between Kuala Lumpur and Singapore: An Application of IDE-GSM Satoru KUMAGAI¹, Ikumo ISONO² and Kazunobu HAYAKAWA³

March 2018

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Keywords: Simulation, new economic geography, Singapore, Malaysia

JEL classification: R12, R13, R42

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Economic Impacts of High-Speed Rail between Kuala Lumpur and Singapore: An Application of IDE-GSM

Satoru KUMAGAI, Ikumo ISONO and Kazunobu Hayakawa

Abstract

This paper examines the potential economic impacts of the Kuala Lumpur (KL) – Singapore High-speed railway (HSR) using a CGE model based on spatial economics, called IDE-GSM. The simulations covered three different scenarios: (1) Singapore–KL non-stop express service, (2) Johor–KL local service, and (3) Singapore–Johor shuttle service. Simulations were also performed to compare the economic impacts of the project on Singapore and the thirteen states of Malaysia. Our simulation analysis revealed that the economic impacts of HSR for Malaysia and Singapore in the best policy mix are USD 1.589 billion and USD 641 million a year for 2030, respectively. We also derived the following policy implications: (1) the specifications of express/local services need be very carefully planned to avoid a “tunnel” effect, (2) the policy to facilitate business transaction and travel between Singapore and Malaysia alongside the HSR development is important to unlock the potential benefits, (3) a policy to upgrade and/or relocate the manufacturing in Kelang Valley and Johor is necessary to avoid excessive de-industrialization, and (4) the supporting infrastructure for the HSR is also needed to unlock the full potential of the HSR.

Introduction

High-speed rail (HSR) is a key infrastructure that makes the transport of people much faster than traditional land transport such as rail and bus while the impacts to environment are much lower than air transport. In the 21st century, a number of countries have developed or have plans to develop HSR.

Kuala Lumpur– Singapore HSR (KL-SG HSR) is such a development project and connects Singapore, the most advanced city–country in ASEAN, and Kuala Lumpur (KL),

the capital city of Malaysia. In this paper, we try to evaluate the economic impacts of KL-SG HSR by utilizing the Institute of Developing Economies-Geographical Simulation Model (IDE-GSM), a computational general equilibrium model based on spatial economics (Kumagai et al. 2013; Isono et al. 2016). This model has a special importance to evaluate KL-SG HSR as it is regarded as one of the most potentially profitable HSR projects in the ASEAN region, considering the size of population and economic activities in the two terminal cities, KL and Singapore, and a distance of 350 km, which is suitable for HSR.

Although there are a few published studies on the economic evaluation of this project, this is the first academic paper that conducts a simulation analysis for several different scenarios. We evaluated if the different sets of stations have different economic impacts to each sub-national region and simulated the negative impacts of inefficient CIQ (customs immigration and quarantine) and congestion on HSR stations.

There are three main reasons to utilize IDE-GSM for this study. First, IDE-GSM uses province-level data that allow us to analyze different levels of impact by province. The province having an HSR station may have a positive impact while other provinces farther from the HSR may have negative impacts. At the same time, the model covers 30 countries/economies in Asia. Because KL-SG HSR connects Singapore and Malaysia, a CGE model with a single country setting is not suitable. Moreover, the direct impact on Singapore may have a ripple effect on Malaysia and other countries, and impacts on other countries may have another ripple effect on Malaysia as well. Considering integrating ASEAN through the ASEAN Economic Community, a multi-country model is more suitable to assess the economic impacts of large infrastructure projects. Second, the model is estimating economic impacts on overall economic activities rather than just the revenue of the railway operator or monetary equivalent of time saving. Third, IDE-GSM has new economic geography setting with eight sectors in the model and the model assumes HSR is used by service sector. Reducing transport cost mainly strengthens agglomeration force while congestion and rising wages may lead to the dispersion of the firms. The opening of HSR will change agglomeration forces and dispersion forces differently by industry. In this regard, IDE-GSM analysis can capture how HSR changes the industrial structure

of Singapore and Malaysia through enlargement of the agglomeration force of the service sector.

This paper is structured as follows: Section 1 briefly introduces the model beneath and the structure of IDE-GSM; Section 2 explains the background of KL-SG HSR and presents a few related literatures on the economic impacts of HSR; Section 3 presents different development scenarios for KL-SG HSR; Section 4 shows the calculated economic impacts of KL-SG HSR graphically and numerically; and Section 5 analyzes the simulation results and propose some policy implications. The last section concludes the paper with a future research agenda.

1. The Model

1.1 Basic Structure of IDE-GSM

Models based on spatial economics or new economic geography (NEG), either theoretical or empirical, tend to be complex and hard to solve mathematically; thus, NEG studies frequently use numerical simulation. The very basic model, the Core-Periphery (CP) model by Krugman (1991), also uses numerical solutions to show the fundamental characteristics of the NEG model. The basic CP model is a two-location/two-goods model, setting one good (typically assumed as agricultural goods) as numeraire, which is produced by a constant return to scale technology and incurring zero transport costs, whereas the other good is produced by an increasing return to scale technology (typically assumed as manufactured goods) and incurs positive transport costs.

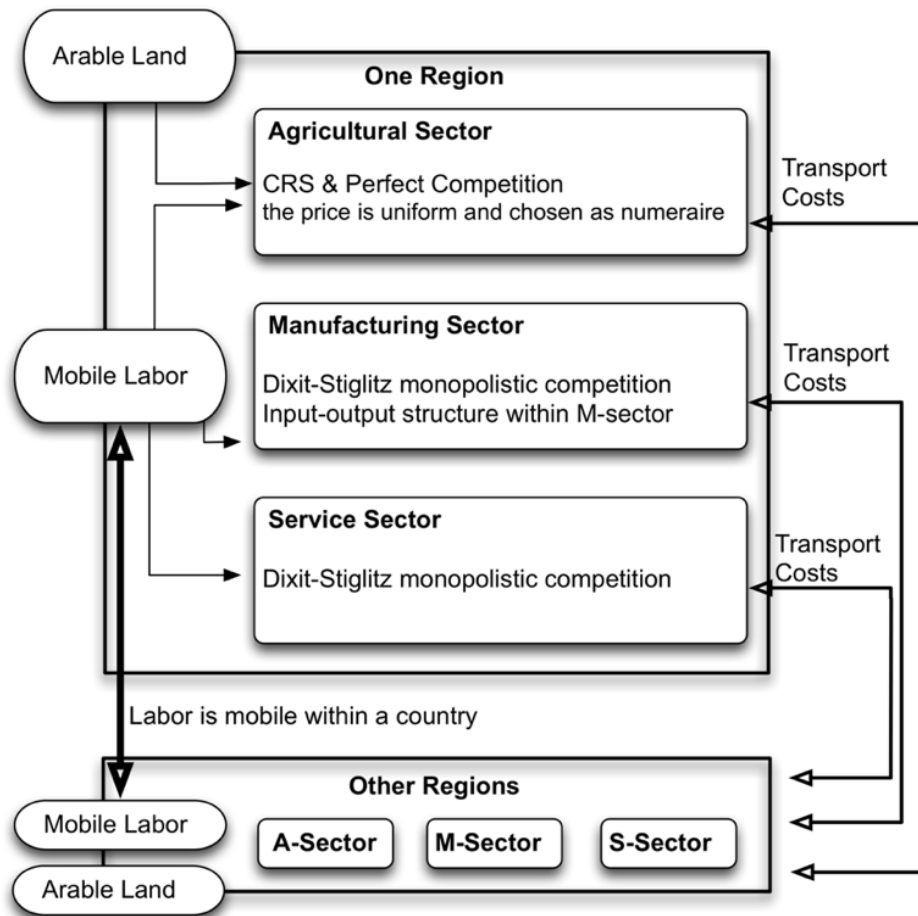
The beauty of the CP model in many locations is its simplicity, with rich implications applicable to the real-world setting. Indeed, IDE-GSM has started as a branch of the CP model in many locations, except that the geography is not the “race track,” but a realistic network of cities.

IDE-GSM was developed based on this CP model, with two main objectives: (1) to

simulate the dynamics of the locations of populations and industries in East Asia over the long-term and (2) to analyze the impact of specific transport and trade facilitation measures (TTFMs) on regional economies at sub-national levels. In our simulation model, there are more than 2,000 regions included along with two endowments: labor and land. Labor is mobile within a country, but is prohibited to migrate to other countries at this moment. Land is unequally spread in all regions and jointly owned by all the laborers of the region.

Figure 1 shows the structure of the model in IDE-GSM. All products in the three sectors 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 lost portion, the supplier sets a higher price. The increase in price compared with the producer's price is regarded as the transport cost. Transport costs within the same region are considered negligible.

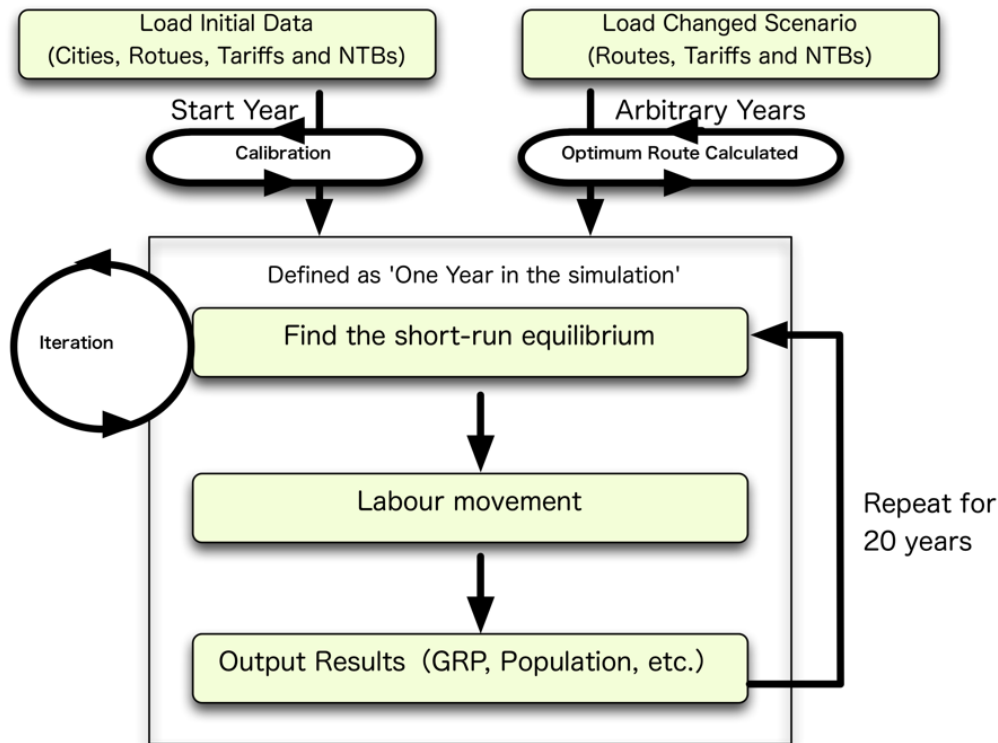
Figure 1: Structure of the Model



Source: Isono et al (2015)

The simulation procedures are shown in Figure 2. First, with given distributions of employment and regional GDP by sector and regions according to the actual data, a short-run equilibrium is obtained. Observing the achieved equilibrium, workers migrate among regions and industries according to differences in the real wages; workers move to the sectors that offer higher real wage rates in the same region and move to regions that offer higher real wages within the same country. Thus, we obtain a new distribution of workers and economic activities. With this new distribution and predicted population growth, the next short-run equilibrium is obtained for the following year and we observe migration again. These computations are repeated for typically 20 years, e.g., from 2010 to 2030.

Figure 2: Procedures of the Simulation



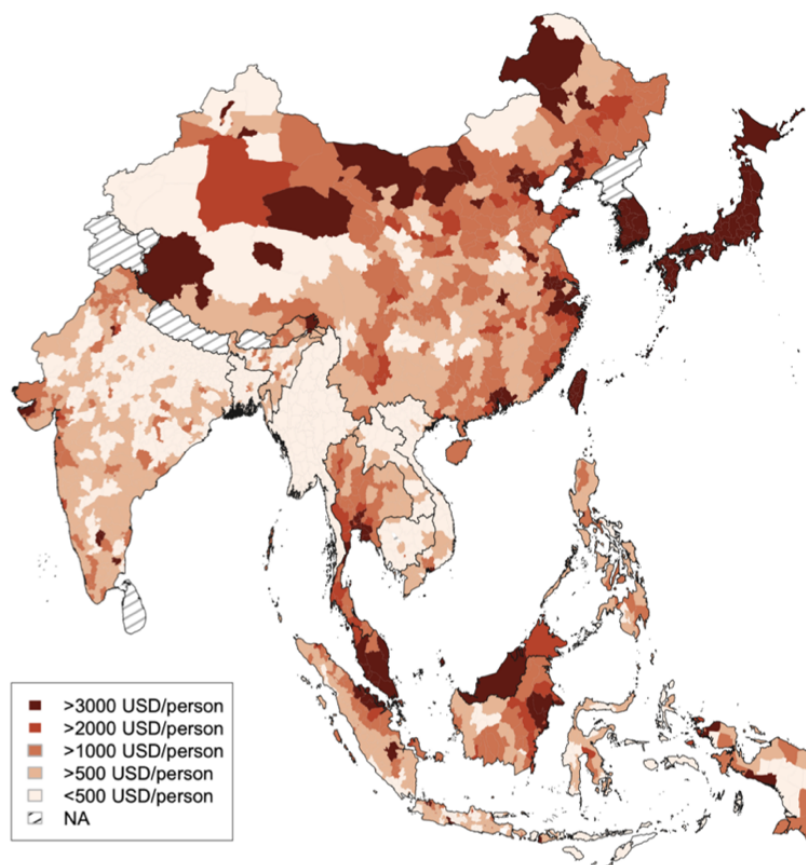
Source: Isono et al (2015)

Primarily based on official statistics, we derive the 2010 gross regional product (GRP) for the agriculture, mining, services, and five manufacturing sectors. The five manufacturing sectors are food processing, garments and textiles, electronics, automotive, and other manufacturing. Population and area of arable land for each region are compiled from official statistical sources. Figure 3 shows the GRP per capita for each region in 2010.

The number of routes included in the simulation is more than 10,000 (land: 6,500; sea: 950; air: 2,050; and railway: 450). The route data comprise 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. The actual road distances between cities are used: if the road distances are not available, then the distances between cities in a straight line are employed.

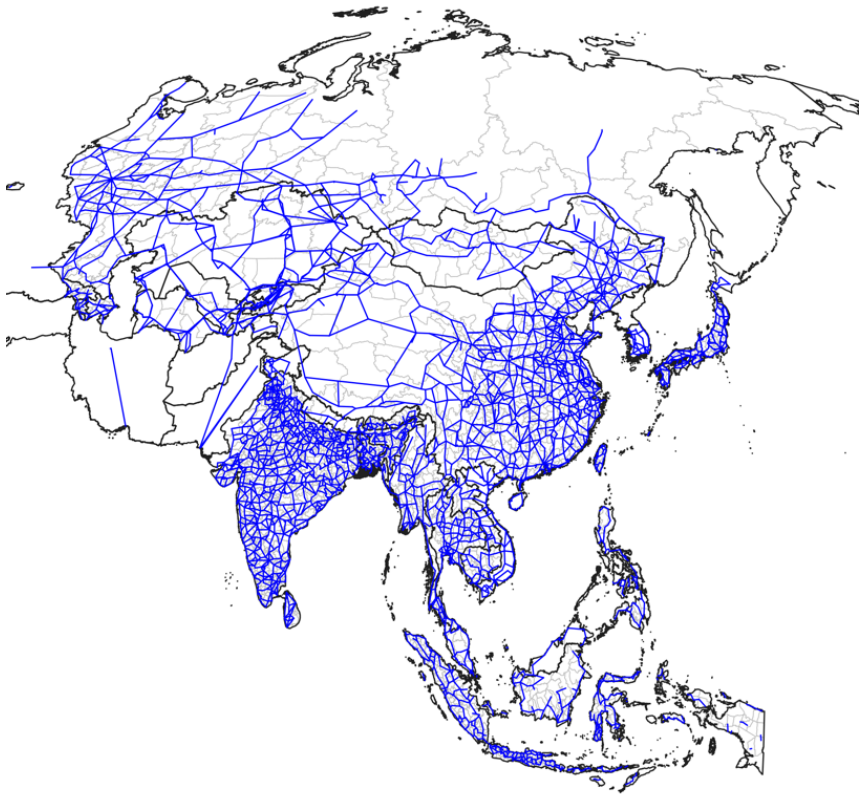
Figure 4 shows the land route networks incorporated in IDE-GSM. The data on air and sea routes are compiled from Nihon Kaiun Shukaijo (1983) and the dataset assembled by the team of the Logistics Institute-Asia Pacific, and 950 sea routes and 2,050 air routes are selectively included in the model. The railway data is adopted from various sources such as maps and the official websites of railway companies.

Figure 3: GRP per Capita in East Asia, 2010



Source: Figure 3, Isono et al (2015)

Figure 4: Land Route Network Data in the IDE-GSM

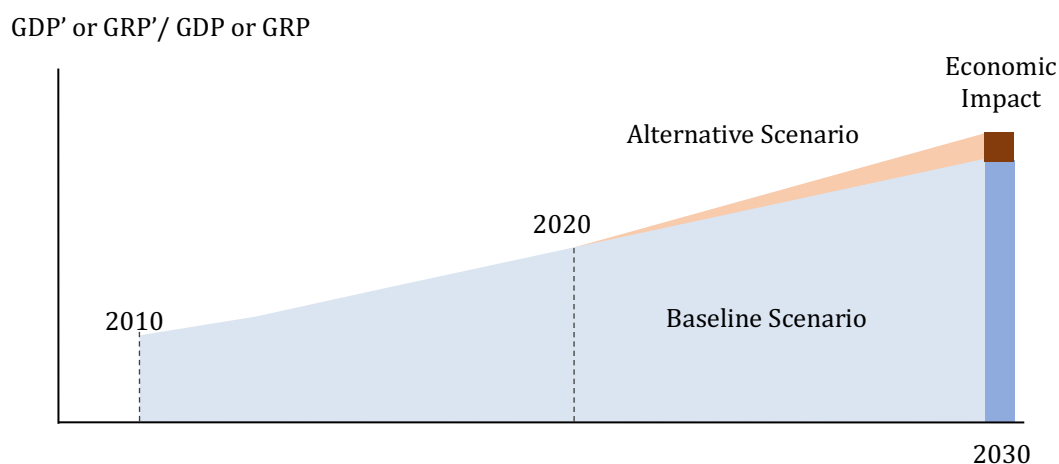


Source: Authors

1.2 Calculating economic impacts

To calculate the economic impacts, we take the differences in the baseline and alternative scenarios (Figure 5). The baseline scenario assumes minimal additional infrastructure development after 2010. The alternative scenario assumes the completion of corridors in 2020 and beyond. We compare and show the differences between GDP (for countries) or GRP (for sub-national regions) based on alternative scenarios, against GDP (for countries) or GRP (for sub-national regions) of baseline scenarios for the year 2030. If a country/region under alternative scenarios has a higher (lower) GDP/GRP than under the baseline scenario, then we regard this surplus (deficit) as a positive (negative) economic impact of the corridor's development.

Figure 5: Evaluation of Economic Impacts by Countries or Sub-national Regions



Source: Adapted from Isono and Ishido (2016)

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

- The national population of each country is assumed to increase at the rate forecast by the United Nations Population Division until 2030.
- International labor migration is prohibited.
- Tariffs, non-tariff barriers, and services barriers change based on 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 calibrate the GDP growth trend from 2010 to 2020, which is estimated and provided by the International Monetary Fund.

It should be noted that even if trade and transport facilitation measures negatively impact a region's economy according to 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 impacts offset

a part of the gains from the expected economic growth. For any alternative scenario, we change the settings relating to the logistics infrastructure and/or other parameters pertaining to trade and production.

1.3 HSR in IDE-GSM

There are four different transport modes included in IDE-GSM. The basic parameters are as shown in Table 1. Here HSR is added as the fifth mode, specified as a passenger-only train with higher speed and higher cost/km. The average speed of HSR is set as 200–300 km/h and the cost/km is around 2 USD/km, which is double the road transport cost and around half of air transport cost.

Table 1: Transport Parameters by Mode (standardized per 20 ft container)

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

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

2. Background Information and Literature Review of HSR Impact Analyses

From the Malaysian point of view, KL-SG HSR is an entry point project to the Greater KL/Klang Valley, a National Key Economic Area under the Economic Transformation Programme by the Malaysian government. The KL-SG HSR is planned to be built by 2026, and the agreement between the governments of Malaysia and Singapore was announced in February 2013. The railway stations currently specified include KL, Seremban, Melaka, Muar, Batu Pahat, Nusajaya, and Singapore. The KL-SG HSR will provide a travel time of 90 minutes between KL and Singapore.

The call for tenders to appoint an assets company for the project started in December 2017 and it is reported that Japan and China are showing an interest in this project. The distance between Singapore and KL is around 350 km, which is suitable for HSR because it is far for car/bus transport while near for air transport, considering the travel from/to airport and waiting time. Indeed, the distance of 350 km is the same as from Tokyo to Nagoya on the Tokaido Shinkansen (HSR) in Japan.

It will be noteworthy to introduce the economic impacts of the first HSR in the world, Tokaido Shinkansen, which was completed in 1964, the year Tokyo hosted the Olympic Games. Tokaido Shinkansen connects the three largest cities in Japan, Tokyo, Nagoya, and Osaka, with the maximum speed of 210 km/h, approximately twice as fast as the ordinary express train, running at the 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 min (as of 1960) to 3 hours and 10 min.

There are several studies on the economic impacts of the Tokaido Shinkansen. Usami et al. (2013) estimated the impacts by a computational general equilibrium (CGE) model and showed the positive economic impact in 1970 was JPY 617.8 billion (USD 5.6

billion), which expanded to JPY 4,158.9 billion (USD 37.8 billion) by 2005, four decades after its completion.

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

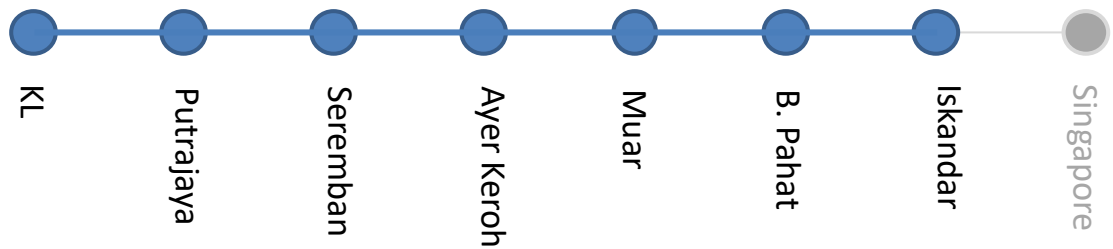
We also conducted a simulation analysis on Hokuriku Shinkansen, connecting Tokyo–Takasaki–Kanazawa (450 km) in 3 hours, completed in 2015. The GDP of Tokyo in 2010 is 4.5 times larger than Singapore and, of the three prefectures around Kanazawa, is 1.5 times larger than Selangor and KL. The estimated economic impacts in 2030 are USD 1.1 billion.

3. Scenarios

To estimate the economic impacts of KL-SG HSR by service type, we include the following scenarios.

SC1: Simulate the domestic service between KL and Iskandar, Johor, with five intermediate stops as in Figure 6. The waiting time at each station is 30 minutes.

Figure 6: KL-SG HSR Domestic Services (SC1)



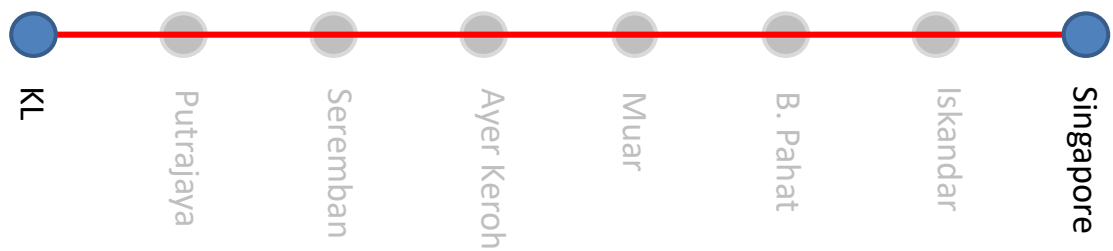
SC2: Simulate the shuttle service between Singapore and Iskandar, Johor, as in Figure 7. The waiting time at each station is 30 minutes. There is a 30-minute wait for the CIQ process.

Figure 7: KL-SG HSR Shuttle Service between Singapore and Iskandar (SC2)



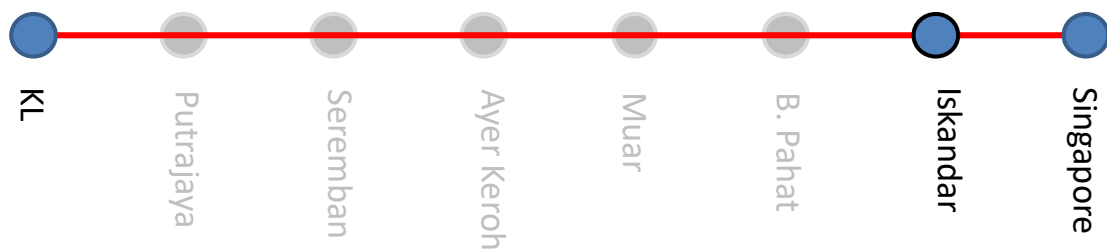
SC3A: Simulate the express service between KL and Singapore at 300 km/h with no intermediate stops as in Figure 8. The waiting time at each is 30 minutes. There is a 30-minute wait for the CIQ process.

Figure 8: KL-SG HSR Express Service between KL and Singapore (SC3A)



SC3B: Simulate the express service between KL and Iskandar, Johor, at 270 km/h with an intermediate stop at Iskandar, Johor, as in Figure 9. The waiting time at each station is 30 minutes. There is a 30-minute wait for the CIQ process.

Figure 9: KL-SG HSR Express Service between KL and Singapore with a Stop at Iskandar (SC3B)



Other derivative scenarios are as follow:

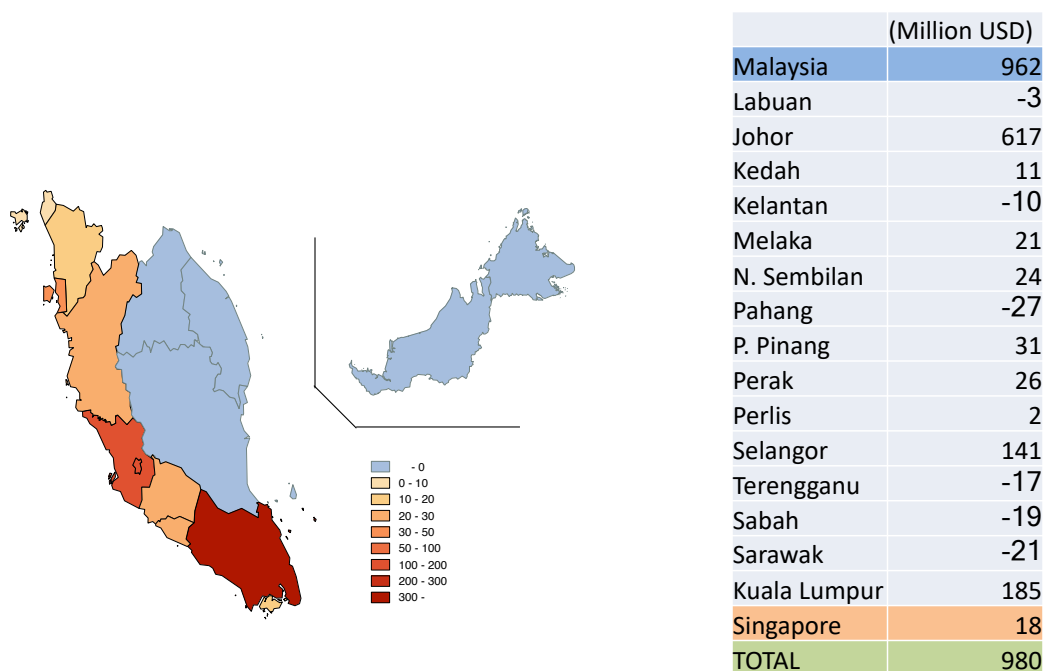
- SC All-A: SC1+SC2+SC3A
- SC All-B: SC1+SC2+SC3B
- SC All-A, bad CIQ: SC All-A but CIQ takes 1 hour
- SC All-A congestion: SC All-A but all access road to the stations are congested (takes 4 times longer than baseline)
- SC All-A Half-NTB: SC All-A and reduction in the bilateral NTB of service sector by 50%

4. Simulation Results

Figure 10 shows the economic impacts of the HSR domestic services in 2030. The states along the west coast of Malaysia and Singapore tend to gain from the HSR domestic

services, whereas three states along the east coast and Sabah and Sarawak lose some of their GDP, although the amount is small. The total economic impact is USD 962 million/year for Malaysia. The top gainer state is Johor (USD 617 million) followed by KL (USD 185 million) and Selangor (USD 141 million). It is natural that the impact to Singapore is very small (USD 18 million) because SC1 simulates only domestic services.

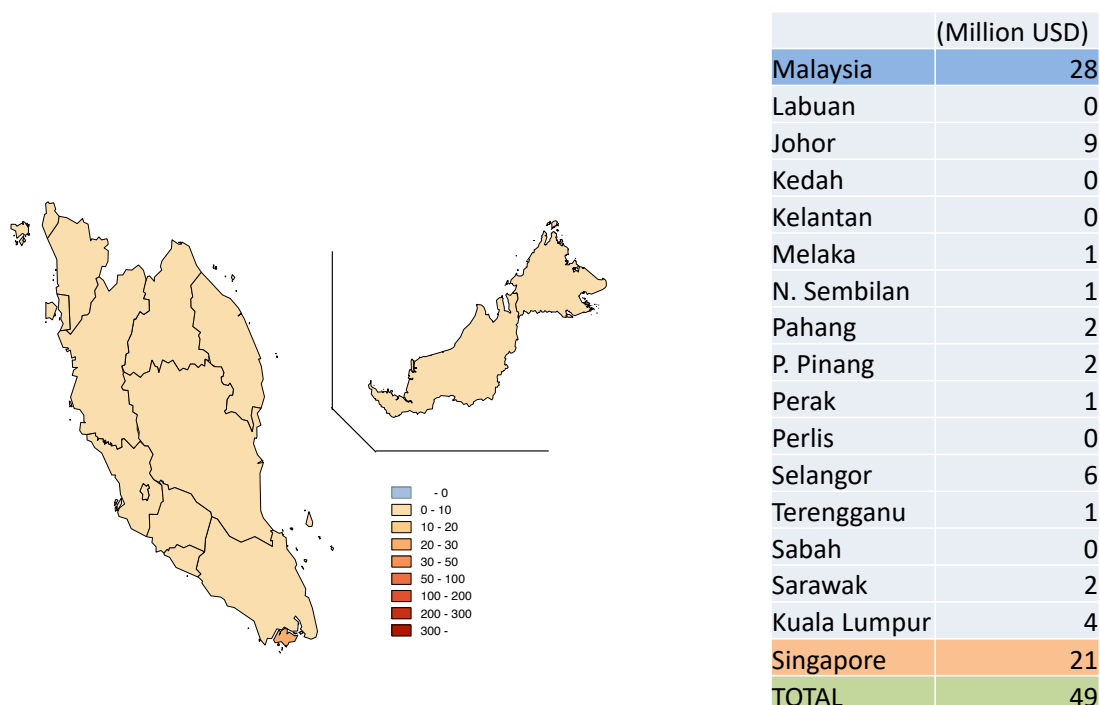
Figure 10: Economic Impacts of SC1 (2030, compared with baseline)



(source) Estimated by IDE-GSM

Figure 11 shows the economic impacts of the HSR shuttle services between Singapore and Iskandar in 2030. The economic impacts are generally small. The top gainer is Singapore (USD 21 million) followed by Johor (USD 9 million). This small impact is caused by low frequency in SC2 and the distance from Johor Bharu and Iskandar makes it an unattractive alternative to the Causeway.

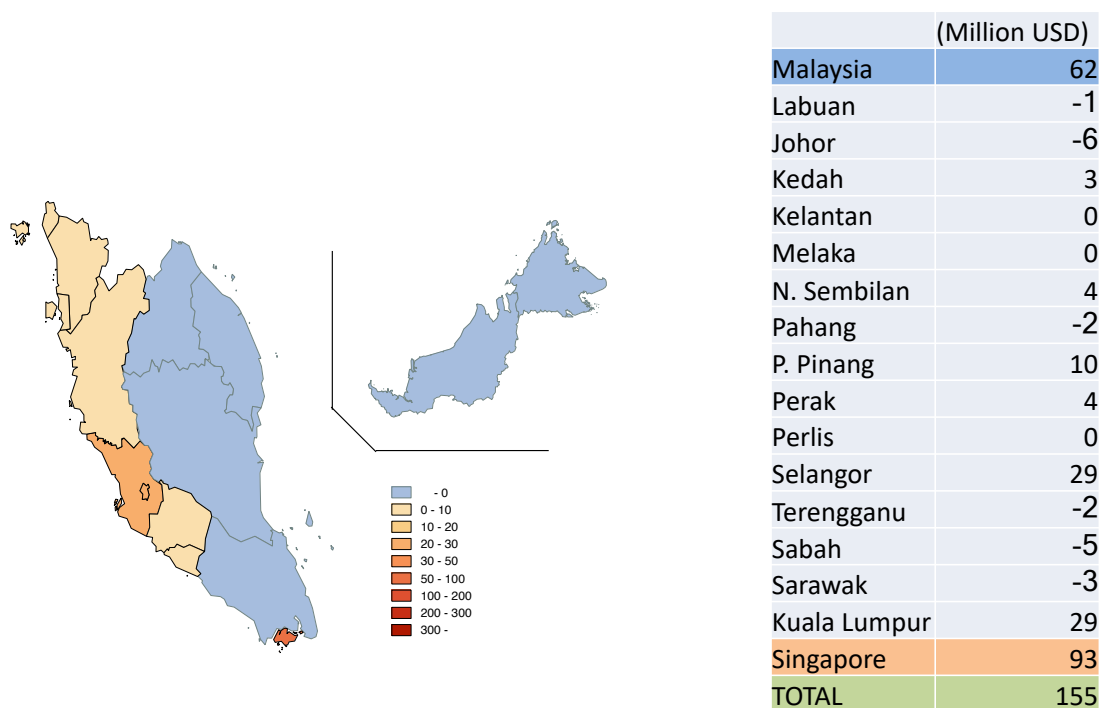
Figure 11: Economic Impacts of SC2 (2030, compared with baseline)



(source) Estimated by IDE-GSM

Figure 12 shows the economic impacts of the HSR express services, directly connecting KL and Singapore in 2030. The states along the west coast of Malaysia and Singapore tend to gain from the HSR domestic services, whereas Johor and three states along the east coast and Sabah and Sarawak lose some of their GDP, although the amount is small. The total economic impact is USD 62 million for Malaysia while the impact for Singapore is USD 93 million. The top gainer states are KL (USD 29 million) and Selangor (USD 29 million). It is understandable that the impact to Johor is small but negative due to the direct connection between KL and Singapore making Kelang Valley more attractive than Johor, hence triggering the migration of people and companies from Johor to Kelang Valley.

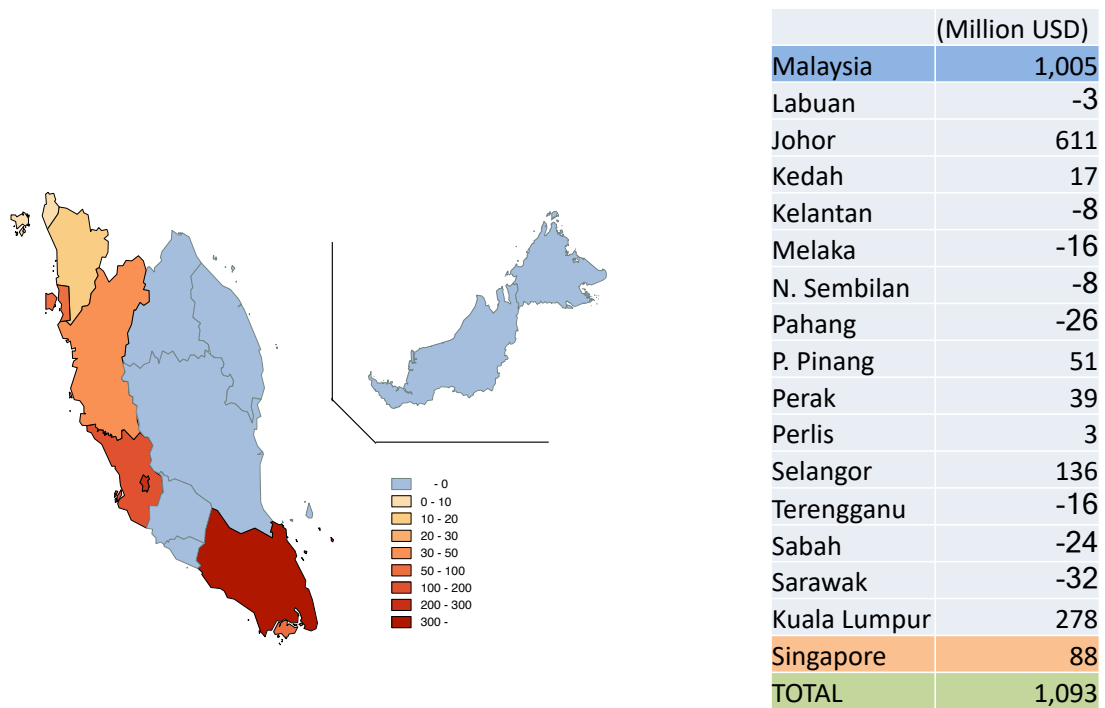
Figure 12: Economic Impacts of SC3A (2030, compared with baseline)



(source) Estimated by IDE-GSM

Figure 13 shows the economic impacts of the HSR express services with an intermediate stop at Iskandar, Johor, in 2030. The states along the west coast of Malaysia and Singapore tend to gain from the HSR domestic services, whereas Malacca, N. Sembilan, and three states along the east coast and Sabah and Sarawak lose some of their GDP, although the amount is small. The total economic impact is USD 1.0 billion for Malaysia while the impact for Singapore is USD 88 million. The top gainer state is Johor (USD 611 million) followed by KL (USD 278 million) and Selangor (USD 136 million). It is reasonable that the impacts to Malacca and N. Sembilan are small but negative because the states that have HSR stops become more attractive than states that have no HSR stops.

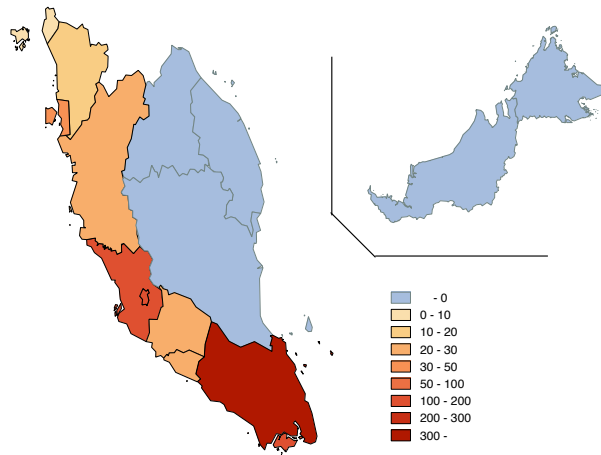
Figure 13: Economic Impacts of SC3B (2030, compared with baseline)



(source) Estimated by IDE-GSM

Figure 14 shows the economic impacts of the HSR, combining domestic services (SC1), shuttle services (SC2), and express services (SC3A) in 2030. The states along the west coast of Malaysia and Singapore gain from the HSR while three states along the east coast and Sabah and Sarawak lose some of their GDP although the amount is small. The total economic impact is USD 1.0 billion for Malaysia while the impact for Singapore is USD 114 million. The top gainer state is Johor (USD 621 million) followed by KL (USD 194 million) and Selangor (USD 156 million). By combining the three services, the economic impacts seem to spread widely to the state along the west coast.

Figure 14: Economic Impacts of ALL-A (2030, compared with baseline)

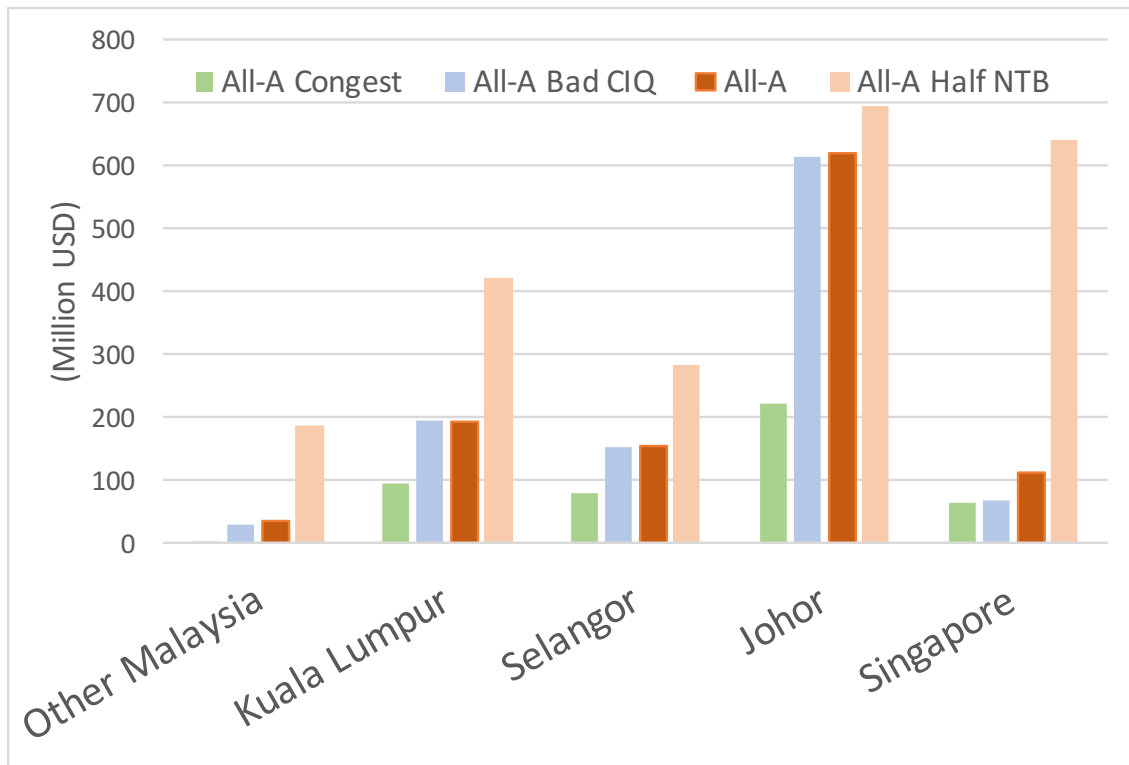


	(Million USD)
Malaysia	1,006
Labuan	-3
Johor	621
Kedah	12
Kelantan	-11
Melaka	24
N. Sembilan	28
Pahang	-25
P. Pinang	36
Perak	27
Perlis	2
Selangor	156
Terengganu	-16
Sabah	-22
Sarawak	-20
Kuala Lumpur	194
Singapore	114
TOTAL	1,120

(source) Estimated by IDE-GSM

Figure 15 shows the economic impacts of other derivative scenarios by region. We estimated the impacts of different scenarios derived from SC All-A. Compared with All-A scenario, the “congestion” scenario reduces the economic impacts for KL and Singapore in half and that for Johor by one-third. A “bad CIQ” scenario also makes the economic impacts smaller for Singapore but not much for Malaysia. In the “Half-NTB” scenario, the economic impacts are doubled for KL and are six times larger for Singapore.

Figure 15: Economic Impacts of Other Scenarios (2030, compared with baseline)



(source) Estimated by IDE-GSM

Table 2 shows the economic impacts of All-A Half-NTB scenario by state and industry. The industry most benefited from this scenario in Malaysia is the service sector (USD 1,906 million). The electronics sector and other manufacturing sectors are negatively affected in the scenario. For Singapore, the sector that benefits most in this scenario is the other manufacturing sector (USD 236 million) followed by services (USD 234 million) and the electronics sector (USD 109 million).

Table 2: Economic Impacts of All-A Half-NTB Scenario by Industry (2030, compared with baseline)

Region	Agri.	Auto	EE	Textile	Food	Oth. Mfg.	Services	Mining	Total
Labuan	0	0	0	0	0	-1	0	0	-1
Johor	0	-1	-27	-4	0	-18	746	0	695
Kedah	0	-1	-6	0	0	-4	33	0	23
Kelantan	0	0	0	0	0	-1	-7	0	-8
Melaka	0	-2	-9	0	1	-2	51	0	38
N. Sembilan	0	0	-6	-1	1	-5	58	0	46
Pahang	-1	0	-1	0	0	-9	11	0	0
P.Pinang	0	-1	-60	-2	1	-6	104	0	36
Perak	-1	0	-5	-1	0	-6	60	0	48
Perlis	0	0	0	0	0	-1	5	0	4
Selangor	-1	-12	-43	-2	4	-30	369	0	284
Terengganu	0	0	0	0	0	-6	4	0	-2
Sabah	-4	0	0	0	-1	-3	-1	0	-8
Sarawak	-1	0	-2	0	0	-17	30	0	11
Kuala Lumpur	0	-2	-8	-1	0	-8	442	1	423
Malaysia	-9	-19	-167	-11	6	-115	1,906	-1	1,589
Singapore	0	46	109	1	15	236	234	0	641

(source) Estimated by IDE-GSM

5. Analysis and Policy Implications

The analysis by IDE-GSM revealed some important implications for KL-SG HSR development. First, the regions that have no stations tend to be negatively affected by HSR development. If the HSR express service stops at KL and Singapore, then Johor is negatively affected by the development. If the HSRs stop at KL, Singapore and Johor, then Malacca and N. Sembilan are negatively affected. This result seems to be consistent with a theoretical prediction in spatial economic literatures. To address this issue, the specification of express/local services need be very carefully planned.

Second, the simulation results revealed that Malaysia is benefited from HSR domestic services more than the express service with Singapore. This seems to be counter-intuitive at first, but it is consistent with the fact that services are traded mostly within a country

and international trade in services is limited. The non-tariff barriers for the service sector are very high compared with the manufacturing sector. In this paper, we have reduced the NTBs for services between Malaysia and Singapore by half and calculate a 60% and 5.6 times higher economic impact for Malaysia and Singapore, respectively. Thus, we need consider the policy to facilitate business transaction and travel between two countries alongside of the HSR development.

Third, the impacts of HSR differ significantly for each industry in each country. For Malaysia, the service sector gains a lot while the manufacturing sectors lose their GDP by the HSR development. This can be interpreted as a stronger service sector making the manufacturing sectors comparatively uncompetitive. Some of the loss in the Malaysian manufacturing sector seems to be substituted by the manufacturing sectors in Singapore (first round impacts). Then, the overall spill-over effects from a higher GDP in both countries benefit the service sector in Singapore (second round impacts). Thus, Malaysia may need to care about an excessive de-industrialization in Kelang Valley and Johor by a booming service sector when KL-SG HSR commences operation in 2026.

Fourth, supporting infrastructure for the HSR is also needed to unlock its full potential. Especially, smooth access to and from city centers to HSR stations is crucial. Congestion and/or poor access around HSR stations may reduce the economic impacts of the HSR by 64% and 38% for Malaysia and Singapore, respectively, as shown in

Table 2. In addition, a smooth CIQ is also important. An increase in CIQ time from 15 min to 1 hour reduces the economic impacts by 9% and 34% for Malaysia and Singapore, respectively.

6. Conclusion

In this paper, we tried to identify the economic impacts from the development of KL-SG

HSR for different settings. Our simulation analysis revealed that the economic impacts of HSR for Malaysia and Singapore in the best policy mix are USD 1.589 billion and USD 641 million per year in 2030, respectively. We also derived the following policy implications such as (1) the specification of express/local services need be very carefully planned, to avoid a “tunnel” effect; (2) the policy to facilitate business transactions and travel between Singapore and Malaysia alongside the HSR development is important to unlock the potential benefits; (3) some policy to upgrade and/or relocate the manufacturing in Kelang Valley and Johor is necessary to avoid excessive de-industrialization; and (4) supporting infrastructure for the HSR is also needed to unlock the full potential of the HSR.

We demonstrated the usefulness and importance of simulation tools like IDE-GSM in transport infrastructure development planning. Although the results of the simulation analysis depend on some assumptions and parameters, interactive policy making based on a scientific evaluation tool is essential to ensure robust planning in international infrastructure development projects.

References

- Bosker, M., Brakman, S., Garretsen, H., Schramm, M., 2010. Adding geography to the new economic geography: bridging the gap between theory and empirics. *Journal of Economic Geography*, 10(6), 793-823.
- Cormen, T.H., Leiserson, C.E., Rivest, R.L., Clifford, S., 2001. Introduction to Algorithms, MIT Press.
- Fingleton, Bernard. 2006. The new economic geography versus urban economics: an evaluation using local wage rates in Great Britain. *Oxford Economic Papers* 58. 501-530.
- Fujita, M. and Mori, T. 2005. Frontiers of the New Economic Geography. *Journal of Public Economic Theory* 5, 279-304.
- Head, K., and Mayer, T. 2000. Non-Europe: the magnitude and causes of market fragmentation in the EU. *Weltwirtschaftliches Archiv*, 136(2), 284-314.

- Hummels, D., 1999. Toward a geography of trade costs. GTAP Working Paper No. 17.
- Isono, I., Kumagai, S., Hayakawa, K., Keola, S., Tsubota, K., Gokan, T. 2016. Comparing the economic impacts of Asian integration by computational simulation analysis, IDE-Discussion Paper No. 567.
- Isono, I., and Ishido, H. 2016. Service liberalization in Lao PDR (No. 559). Institute of Developing Economies, Japan External Trade Organization (JETRO).
- JETRO. 2013. *Zai-Azia-Oseania Nikkei Kigyo Gittai Chosa* (<http://www.jetro.go.jp/jfile/report/07001539/0700153901a.pdf>)
- Krugman, P. 1991. Increasing Returns and Economic Geography, *Journal of Political Economy*, 99, 483-99.
- Krugman, P. 1993, On the number and location of cities. *European Economic Review*, 37(2), 293-298.
- Kumagai, S., K. Hayakawa, I. Isono, S. Keola and K. Tsubota. 2013. Geographical Simulation Analysis for Logistics Enhancement in Asia. *Economic Modelling* 34, 145–153.
- Kumagai, S., and Isono, I. 2011. Economic Impacts of Enhanced ASEAN-India Connectivity: Simulation Results from IDE/ERIA-GSM. *ASEAN-India Connectivity: The Comprehensive Asia Development Plan, Phase II*.
- MILT. 2007. tai kouka bunseki tou no chousa kekka ni tuite(<http://www.mlit.go.jp/common/000144961.pdf>)
- Nawata, Yasumitsu 2008. Sengo Nihon no Jinkou Idou to Keizai Seichou, *Keizai no Prism*, Sangiin, 54, 20-37.
- Nihon Kaiun Shukaijo. 1983. *Distance Tables for World Shipping (Eighth edition)*. Nihon Kaiun Shukaijo.
- Puga, D. 1999. The rise and fall of regional inequality. *European Economic Review* 43, 303-334.
- Straits Times. 2017. Singapore-KL high-speed rail: An interactive guide (<http://graphics.straitstimes.com/STI/STIMEDIA/Interactives/2016/12/singapore-kl-high-speed-rail-line/index.html>)
- Stelder, D., 2005. Where do cities form? A geographical agglomeration model for Europe. *Journal of Regional Science*, 45(4), 657-679.
- Teixeira, A. C. 2006. Transport policies in light of the new economic geography: The

Portuguese experience. *Regional Science and Urban Economics* 36, 450-46

Usami S., Okuda. T, Hayashi Y and H. Kato. 2014. Post-evaluation of the long-term impact on the regional economy of Tokaido Shinkansen (http://www.jsrsai.jp/Annual_Meeting/PROG_50/ResumeD/rD04-1.pdf)