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China-Kyrgyzstan railway meets IDE-GSM

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China-Kyrgyzstan railway meets IDE-GSM

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and K. Tsubota

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Abstract

The impact of connecting Kashgar, Trougart, Uzgen, and Karasuu and facilitating customs at the national border between China and Kyrgyzstan are examined by using IDE-GSM (Institute of Developing Economies, JETRO Geographical Simulation Model). We found that the railway connection has a positive impact in southern Kyrgyzstan and a negative impact in regions of northern Kyrgyzstan, neither of which are the capital city of Kyrgyzstan.

Keywords: economic geography, China, Kyrgyzstan

JEL classification: R12, R13, R42

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1. Introduction

As a project of the One Belt One Route Initiative, the construction of a new rail link from China to Uzbekistan via Kyrgyzstan is planned (Farchy and Kynge 2016). Our focus is on the link between Kashgar, China and Karasuu, Kyrgyzstan near Osh in the connection between Uzbekistan and China. This link is designed to provide a shortcut to send goods from Yiwu, China to Tehran, Iran, and transit fees for Kyrgyzstan. However, there was a voice such as "This [the proposed link] will divide the country, not unite it" (Foreign & Commonwealth Office, 2014). Since the link will pass only through Southern Kyrgyzstan, it may not provide positive benefits in Northern Kyrgyzstan. Thus, it is worth examining the impact of the new railroad on the economic activities in various regions of Kyrgyzstan.

For that purpose, we used an IDE–GSM (Institute of Developing Economies–Geographical Simulation Model) which is a simulation model based on Spatial Economics and New Economic Geography. Different from a cost-benefit analysis, the IDE–GSM calculates only the long-term benefits derived from the improvement of trade and transport facilitation measures via the dynamics of population and industries. In the model, the spatial configuration of economic activities is determined by the balance between the centrifugal and dispersion forces. The model contains positive feedback between supply and demand for consumption goods and intermediate goods as the centrifugal force, whereas regarding the dispersion force, the demand for consumption goods exists in remote areas in the model.

Since the IDE–GSM contains 2063 regions and 89 countries, the results we obtained were not only for Kyrgyzstan and China, but also on the neighboring countries. Furthermore, the transport costs for sending goods between regions in the IDE–GSM could be divided into transport costs, time costs, export tariff, import tariff, and non-tariff barriers. We also examined the impact of customs facilitation at the border between China and Kyrgyzstan, as additional policy measures may be needed to exploit the benefit from the railway construction.

The remainder of this paper is organized as follows. Section 2 introduces how we prepare for our analysis. Two scenarios and the results of their numerical analyses are explained in Section 3. Section 4 concludes the paper.

2. China-Kyrgyzstan-Uzbekistan Railway

The sentiment to construct the China–Kyrgyzstan–Uzbekistan Railway resulted in technical and environmental investigations to assess the development of the railroads between Bishkek, Oh/Djalala-Bad, and Kashgar (TRACECA 2003). Using the transport routes listed in Table 2.6 in United Nations (2012), it becomes clear that the railroad network is missing between Kashgar and Karasuu as shown in the center of Figure 3. Thus, it is natural to connect this discontinuity of railway networks as the next step.

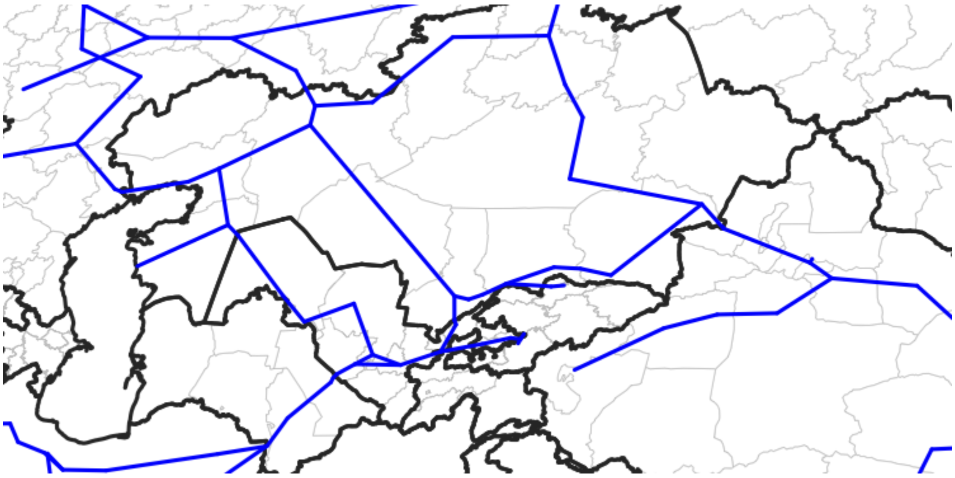

Figure 1 Railway networks in Central Asia

(Source) Authors

(Note) The blue lines in the figure show railways.

Data for the new railway used in this paper was borrowed from TRACECA (2003), which was added into the United Nations (2012) data to fix the transport route, distance, and time, and enlarge the existing dataset of IDE–GSM. That is, the route and distance connecting Kashgar, Trougart, Uzgen, and Karasuu in TRACECA (2003) were used. However, the speed was based on TRACECA (2003).

3. Economic impacts of the new railway

To analyze the economic impacts, we prepared a dataset from 2010 to run the IDE–GSM (See Appendix A) as the first step. Then, running a numerical analysis with the IDE–GSM, we obtained a dataset for the year 2030 assuming the absence of new infrastructure projects and custom facilitation. Finally, assuming the construction of the new railway and/or facilitating custom procedures in 2020, the IDE–GSM numerical analysis was performed and yielded a dataset for 2030 that reflected the impact of the new railway and/or custom facilitation. The economic impacts were measured using the data from the 2030 simulation obtained via the IDE–GSM by subtracting the data impacted by the construction of the new railways and/or custom facilitation from the data without such impacts. In other words, positive (negative) results indicated that the value obtained by numerical analysis with the new railway and/or custom facilitation was larger (smaller) than that without them.

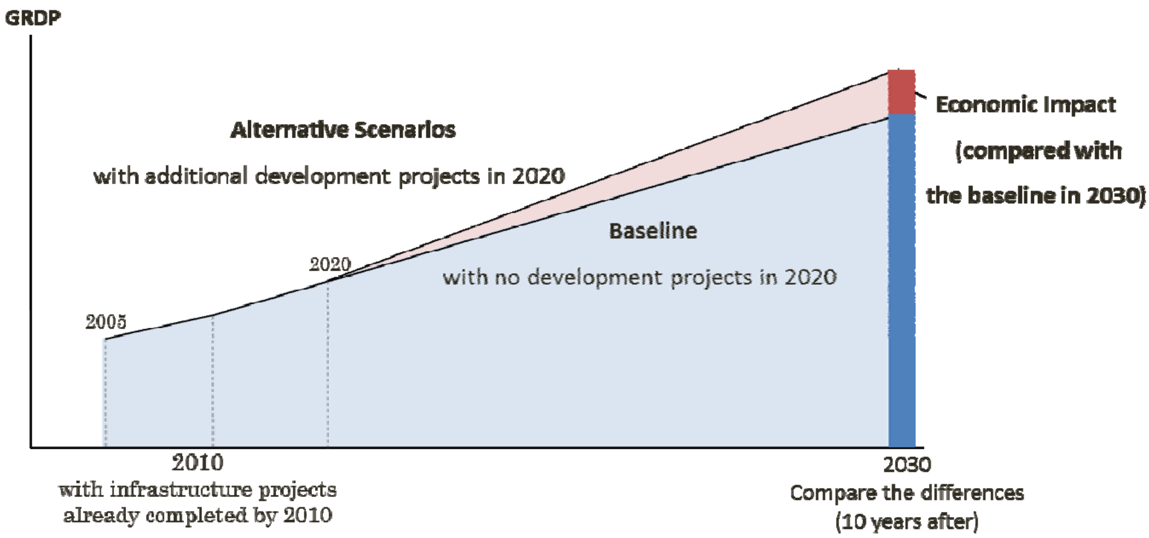

Figure 2 The approach used to estimate the Impacts in IDE–GSM
(Source) Authors

3.1 Scenario 1

The impact of connecting Kashgar, Trougart, Uzgen, and Karasuu by train without customs facilitation measures at the national border between China and Kyrgyzstan comprised scenario 1 in this subsection. The results of the numerical analysis are shown in Figures 3 and 4.

The region with the highest benefit was found to be the area in Kyrgyzstan near the national border between China and Kyrgyzstan. The positive impact was found only in Southern Kyrgyzstan. The numerical analysis showed that these areas would benefit both from an increase in population and real GDP. However, within Southern Kyrgyzstan, the GDP in Batken, which is located in the western part of Kyrgyzstan and in the area surrounded by Tajikistan, was found to be constant, and the population in Batken was shown to decrease. Thus, per capita, the GDP was found to increase slightly in these areas. The results for Chuy, which is located in the northern part of Kyrgyzstan near Kazakhstan along with the capital of Kyrgyzstan, Bishkek, were found to be almost the same as those for Batken. The drawbacks associated with building the new railway emerged only in Talas, which is located in the northwestern part of Kyrgyzstan near Kazakhstan, since both population and real GDP were shown to decrease. For Kyrgyzstan, this seems beneficial considering the fact that negative impacts are expected to emerge in only a single region out of seven. However, resources to effectively narrow this gap must be concentrated in Talas.

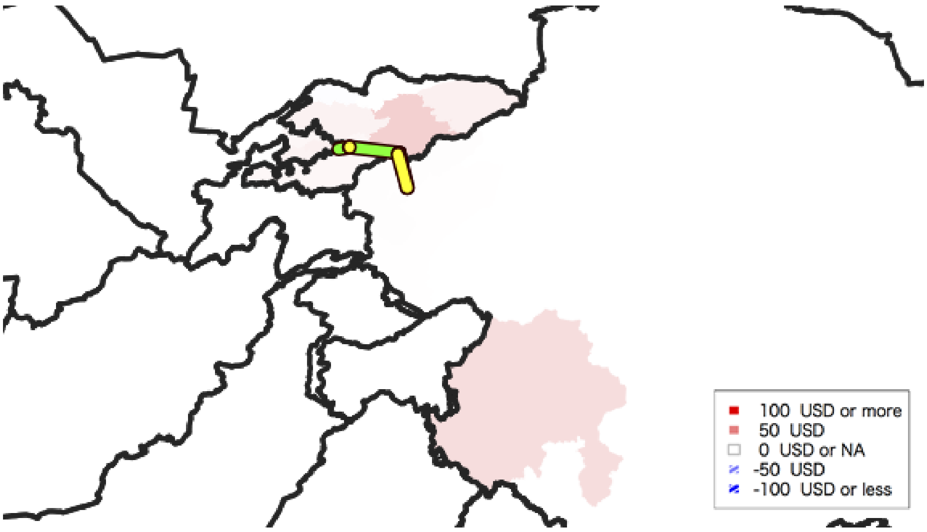

Figure 3 Scenario No. 1: Rise and fall of per capita GDP in a near view

(Source) Authors

(Note) The green and yellow line shows the railways connecting Kashgar, Trougart, Uzgen, and Karasuu.

In Figure 3, Kashgar is not represented by any color. However, the numerical analysis show that both the population and real GDP increased in such a way that the per capita GDP in Kashgar increased at a negligible rate. The positive impact was visible in Tibet near India, owing to the increase in population and real GDP.

In Figure 4, it can be seen that the impact of connecting Kashgar, Trougart, Uzgen, and Karasuu would be limited around the new railway project by measuring the impact on the scale in the legend of Figure 4.

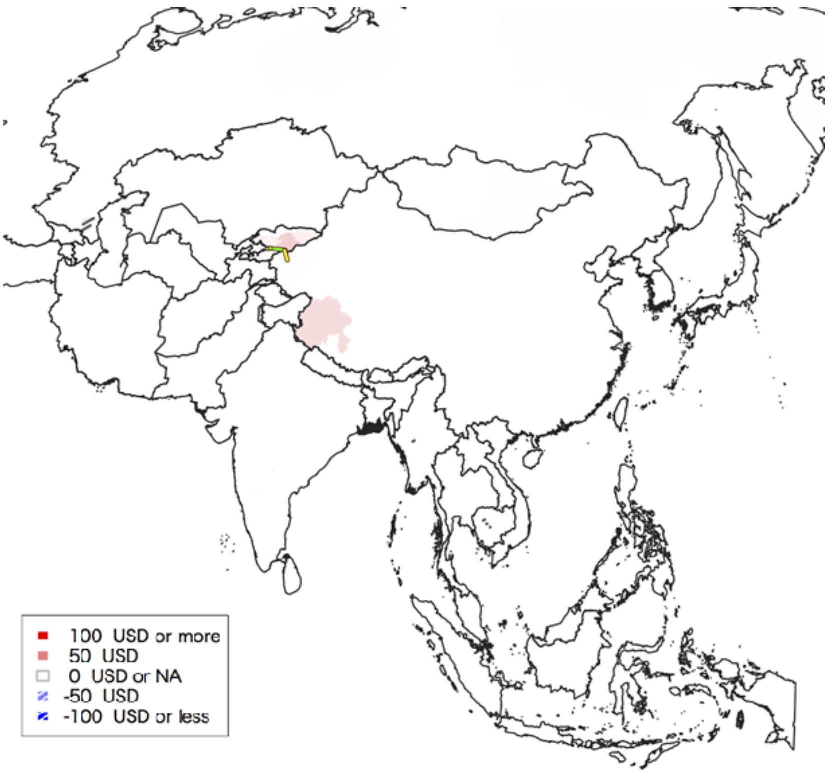

Figure 4 Scenario No. 1: Rise and fall of per capita GDP in a remote view

(Source) Authors

(Note) The green and yellow line shows the railways connecting Kashgar, Trougart, Uzgen and Karasuu.

3.2 Scenario 2

The impact of connecting Kashgar, Trougart, Uzgen, and Karasuu by train with custom facilitation measures at the national border between China and Kyrgyzstan was examined as scenario 2 in this subsection. The results of the numerical analysis are shown in Figures 5, 6 and 7.

Since the thresholds used to draw colors in Figure 5 and 6 were the same as those in Figure 3 and 4, it becomes clear that the contrast between the winners and the losers became clearer by facilitating custom additionally. Furthermore, Figure 5 shows that many regions would benefit from the positive impacts.

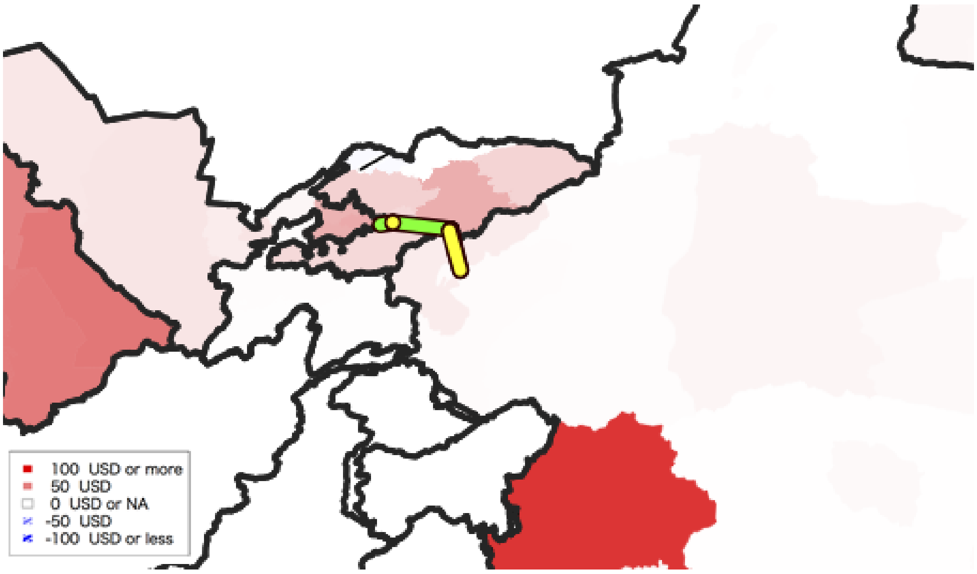

Figure 5 Scenario No. 2: Rise and fall of per capita GDP in a near view

(Source) Authors

(Note) The green and yellow line shows the railways connecting Kashgar, Trougart, Uzgen, and Karasuu.

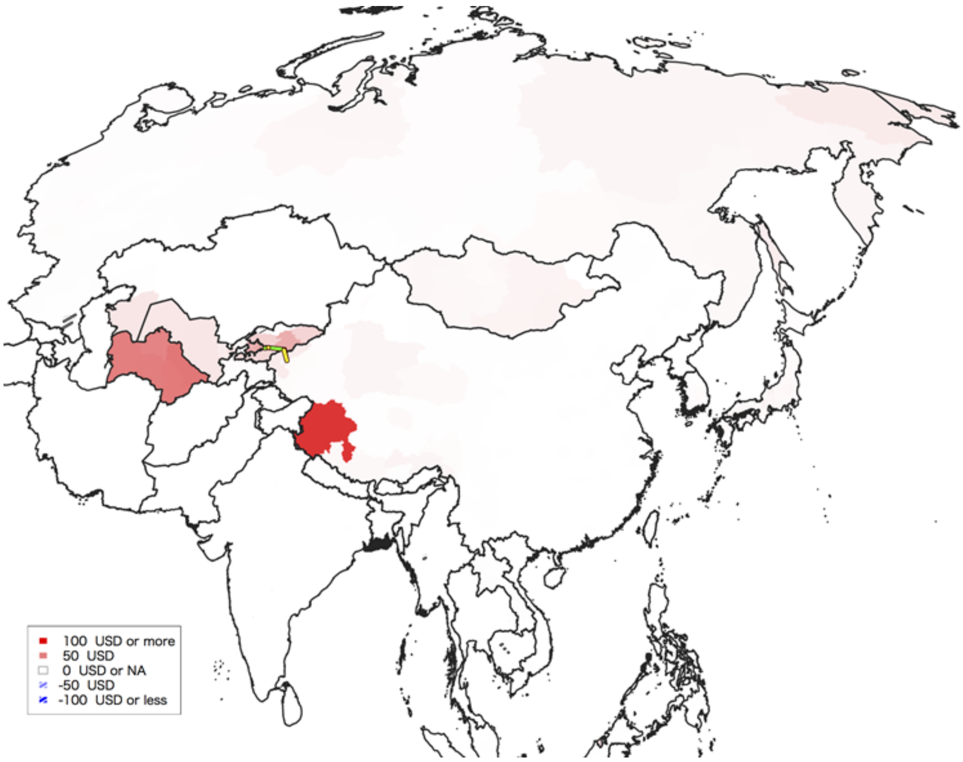

Figure 6 Scenario No. 2: Rise and fall of per capita GDP in a remote view

(Source) Authors

(Note) The green and yellow line shows the railways connecting Kashgar, Trougart, Uzgen, and Karasuu.

A larger area is impacted as a result of migration and trade. Positive impacts can be seen in Uzbekistan, Turkmenistan, southwestern of Kazakhstan, and almost all of Russia and Mongolia in Figure 6, whereas negative impacts can be observed in regions near the Caspian Sea in Russia in Figure 6.

The positive and negative impacts are clearly depicted in Figure 7 by narrowing threshold values of the per capita GDP used to determine the colors in the figure. The positive impacts covered a larger area in China and Russia, and even in regions of South Korea and Japan. However, the scale of such impacts was not found to be large and there was hardly any impact in Kazakhstan and South Asia. The negative impacts were shown to exist in the eastern part of Mongolia, the western part of Nepal, and not only the area near Caspian Sea, but also the area facing the Barents Sea in Russia.

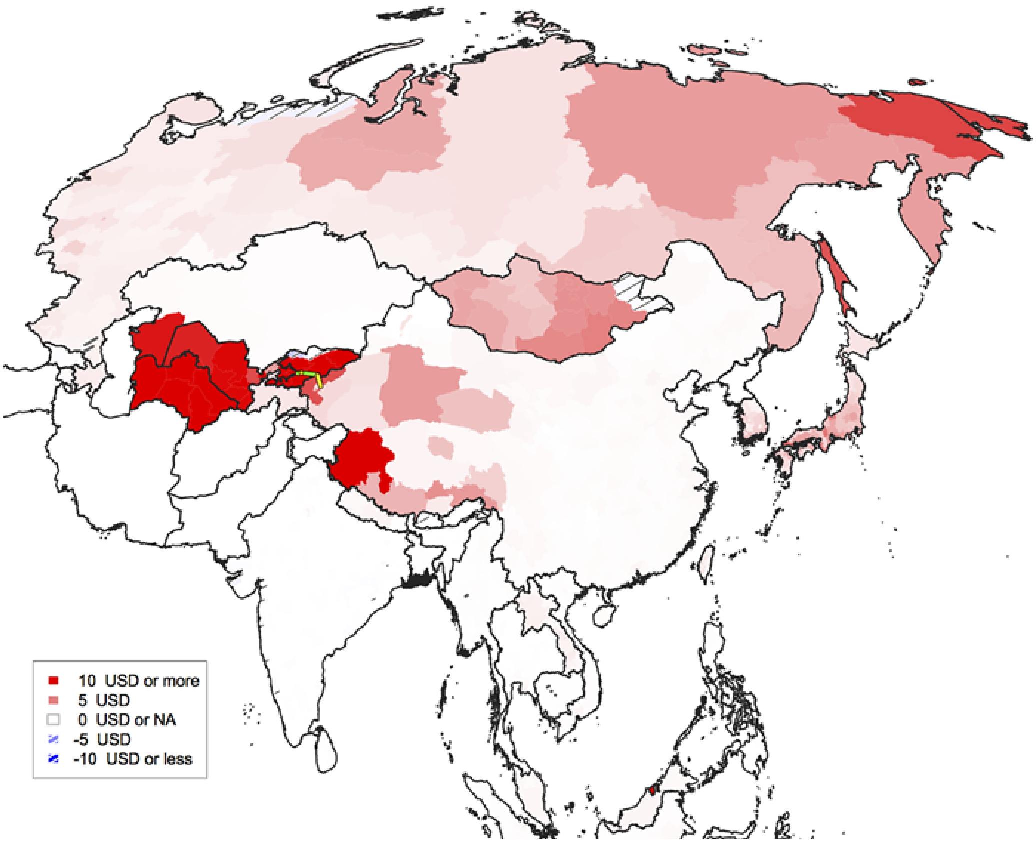

Figure 7 Scenario No. 2: Rise and fall of per capita GDP in a remote view

(Source) Authors

(Note) The green and yellow line shows the railways connecting Kashgar, Trougart, Uzgen, and Karasuu. The different scales are used to draw maps in Figure 6 and Figure 7.

4. Conclusion

We examined the impact of connecting Kashgar, Trougart, Uzgen, and Karasuu and facilitating customs at the national border between China and Kyrgyzstan.

We found that the railway connection was projected to have a positive impact in southern Kyrgyzstan and a negative impact in regions of northern Kyrgyzstan, neither of which are the capital city of Kyrgyzstan. The contrast between the regions where the per capita GDP was found to increase and decrease became clear when customs facilitation were included in the analysis. Furthermore, we found that most countries in Central Asia, as well as China, almost all regions of Russia, and Mongolia would benefit from both a new railway and customs facilitation, although the scale of such benefits would be small.

Since the region predicted to suffer from the new railway only included one region in Krygzstan out of seven, transferring resources from the benefiting regions to the suffering region may be sufficient to narrow regional gaps.

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Appendix A

Since 2007, as a numerical simulation with general equilibrium model based on NEG, IDE–GSM has been developed for numerical analyses of the impacts of trade and transport facilitation measures (TTFMs) at a sub-national level. Our model comprises eight economic sectors, including manufacturing and non-manufacturing sectors, and more than 2,000 regions in 18 countries/economies in East Asia and CWA countries, Russia and Mongolia. The East Asian countries/economies include Bangladesh, Brunei Darussalam, Cambodia, China, Hong Kong, India, Indonesia, Japan, Korea, Lao PDR, Macao, Myanmar, Malaysia, Philippines, Singapore, Taiwan, Thailand, and Vietnam. IDE–GSM was developed as a strand of the Core-Periphery Model of Krugman (1991) and Fujita, Krugman, and Venbles (1999), with two main objectives, namely, (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 TTFMs on regional economies at sub-national levels. In our simulation model, more than 2,000 regions were included. There were two endowments: labor and land. Labor is mobile within a country, but prohibited to migrate to other countries, at this moment. Land is unequally spread across all regions and jointly owned by all labors of the region.

All products in the three sectors are tradeable. 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 to the producer’s price is regarded as the transport cost. Transport costs within the same region are considered negligible.

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

Primarily based on official statistics, we derived the gross regional product (GRP) for the agriculture sector, mining sector, five manufacturing sectors, and the service sector. The manufacturing sector was divided into five sub-sectors—food processing, garments and textiles, electronics, automotive, and other manufacturing. The population and area of arable land for each region were compiled from official statistical sources.

The number of routes included in the simulation was more than 10,000 (land: 6,500, sea: 950, air: 2,050 and railway: 450). The route data consisted of start city, end city, distance between the cities, the speed of the vehicle running on the route, etc. The land routes between cities were based mainly on the "Asian Highway" database of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). The actual road distances between cities were used; if the road distances were not available, the distances between cities in a straight line were employed. The data on air and sea routes are compiled from Nihon Kaiun Shukaijo (1983) and the data set assembled by the team of the Logistics Institute - Asia Pacific (TLIAP), and 950 sea routes and 2,050 air routes were selectively included in the model. The railway data was adopted from various sources, such as maps and official websites of railway companies.

The industry-related parameters are provided in Table A1. We mainly adopted the elasticity of substitution for the manufacturing sectors from Hummels (1999) and estimated it for services. Estimates for the elasticity of services were obtained from the estimation of the usual gravity equations for trade services, including such independent variables as the importer's GDP, exporter's GDP, importer's corporate tax, geographical distance between countries, a dummy for FTAs, linguistic commonality dummy, and a colonial dummy. For this estimation, we mainly employed data from the "Organisation for Economic Co-operation and Development Statistics on International Trade in Services."

Table A1 Industry parameters

	Consumption Share	Labor Input Share	Elasticity of Substitution
Agriculture	0.04	0.61	-
Automotive	0.02	0.57	7.10
E&E	0.02	0.57	8.80
Textile	0.01	0.64	8.40
Food	0.03	0.61	5.10
Oth. Mfg.	0.16	0.59	5.30
Services	0.70	1.00	3.00

(Source) Authors' calculations. Elasticity of substitution is mainly adopted from Hummels (1999).

The consumption share of consumers by industry was uniformly determined for the entire region in the model. It would be more realistic to change the share by country or region, but we could not do so because of a lack of sufficiently reliable consumption data at a finer level of geographical unit. The single labor input share for each industry was uniformly applied throughout the entire region and time period in the model. Although it may differ among countries/regions and across time, we used an "average" value, in this case, the value for Thailand, which is a country in the middle-stage of economic development and whose value was taken from the Asian International Input–Output Table for 2005 by the IDE–JETRO. For the manufacturing sector data source, we used the survey conducted by the JETRO (2013).

The transport parameters are listed in Table B2. Our transport costs comprised the physical transport costs, time costs, tariff rates, and non-tariff barriers. The physical transport costs were a function of the distance traveled, travel speed per hour, physical travel cost per kilometer, and holding costs for domestic/international transshipments at border crossings, stations, ports, or airports. The time costs depended on travel distance, travel speed per hour, time cost per hour, and holding times for domestic/international transshipments at border crossings, stations, ports, or airports. These parameters were derived from the ASEAN Logistics Network Map 2008 by the JETRO and by estimating the model of the firm-level transport mode choice with the "Establishment Survey on Innovation and Production Network" (ERIA) for 2008 and 2009, which includes manufacturers in Indonesia, Philippines, Thailand, and Vietnam.

Based on these parameters, we calculated the sum of physical transport and time costs for all possible routes between two regions. Employing the Floyd–Warshall algorithm for determining the optimal route and transport mode of each region and good (Cormen et al., 2001), we obtained the sum of physical transport and time costs for each pairing of two regions by industry. The procedures to calculate these parameters are explained in Kumagai et al. (2013).

Table A2 Transport parameters by mode

	Truck	Rail	Sea	Air	
Cost/Km	1	0.5	0.24	45.2	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$

(Source) Estimated by Authors.