

Economic Interdependence in Northeast Asia: Production Side Perspective with Emphasis on Russia*

Takashi Yano*

Hiroyuki Kosaka**

Abstract

The inter-regional inter-industry input structure of Northeast Asia with emphasis on Russia was analyzed by applying the value-added dependency ratio to a 34-sector version of the multi-regional input-output table for the region for the year 1995. The analysis revealed that the economic ties of Russia with the other Northeast Asian economies are remarkably weak, except for Mongolia, which receives most of its inputs from Russia while Russia has virtually no dependency on Mongolia. Furthermore, the Russian economy has substantially more links with the rest of the world (particularly Europe) than it has with Northeast Asia with respect to inputs. The analysis also revealed that Russia's self-dependency ratios for the textiles and apparel, leather products, metal products, and machinery sectors are quite low and that Russia's input structure in manufacturing is less balanced compared to China's, the other BRIC member in Northeast Asia.

Keywords: multi-regional input-output table, interdependency, input structure, Northeast Asia, Russia

1. Introduction

The inter-regional input structure of Northeast Asia with emphasis on Russia was analyzed in this paper. Reviewing the literature on inter-regional input-output analysis for the Northeast Asian economies, we find that this class of studies has been extremely limited due to data scarcity. An exception is the study by Shishido (2000), who constructed a multi-regional input-output table for Northeast Asia for the year 1995 and illustrated the inter-regional input-output structure of the region with respect to demand.

* LLP Institute for Multi-Sectoral Economic Research, Japan. E-mail: arrowfield@gol.com

** Faculty of Policy Management, Keio University, Japan. E-mail: hkosaka@sfc.keio.ac.jp

In contrast, we investigated the inter-regional inter-industry structure of the region in terms of input, with emphasis on Russia, by applying the value-added dependency ratio to the multi-regional input-output table developed by Shishido (2000). We focused on Russia for two reasons. One is the potential of the Russian economy. Due to its large population and natural resource richness, steady growth of the Russian economy is expected in the long run, although the recent global recession caused by the sub-prime crisis negatively affected its growth in the short run. The other reason is that, compared to China (the other BRIC economy in Northeast Asia), there have been few studies on Russia's trade structure; the ones that have been done include those by, for example, Kuboniwa (1994), Algieri (2004), Garanina (2008), and Konno (2008). Since the multi-regional input-output table consistently describes the input and trade structures, which are disaggregated by sector and type of good (i.e., intermediate and final goods), our analysis revealed in detail the bilateral interdependencies of Northeast Asia with respect to input.

The rest of the paper consists of four sections. Section 2 describes the model we used, and section 3 describes the data we used. Section 4 presents our main observations. Finally, section 5 summarizes the key points.

2. The Model

We applied the value-added dependency ratio to the multi-regional input-output table for Northeast Asia. Shimoda and Watanabe (2005) and Jin and Chen (2008), for example, used this ratio to analyze economic interdependencies in the Asia-Pacific region. Directly examining inter-regional trade is one of the approaches commonly used to analyze economic interdependencies. As Shimoda and Watanabe (2005, p. 47) pointed out, however, this approach cannot account for the imports required to produce the goods of interest. Economic interdependency reflects direct transactions as well as imports. Using the value-added dependency ratio is an effective way to grasp both factors.

Consider a multi-regional input-output table with n sectors and q regions. To begin, we formulate the input coefficient:

$$a_{ij}^{hk} = \frac{X_{ij}^{hk}}{X_j^k}, \quad (1)$$

where a_{ij}^{hk} is good i of region h required for unit production in sector j of region k , X_{ij}^{hk} is the intermediate goods delivered from sector i of region h to sector j of region k , and X_j^k is the total output in sector j of region k . Therefore, the matrix of input coefficients for the whole region (\mathbf{A}) can be expressed as

$$\mathbf{A} = \begin{bmatrix} a_{11}^{11} & \cdots & a_{1n}^{11} & \cdots & a_{11}^{1q} & \cdots & a_{1n}^{1q} \\ \vdots & \ddots & \vdots & \cdots & \vdots & \ddots & \vdots \\ a_{n1}^{11} & \cdots & a_{nm}^{11} & \cdots & a_{n1}^{1q} & \cdots & a_{nm}^{1q} \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ a_{11}^{q1} & \cdots & a_{1n}^{q1} & \cdots & a_{11}^{qq} & \cdots & a_{1n}^{qq} \\ \vdots & \ddots & \vdots & \cdots & \vdots & \ddots & \vdots \\ a_{n1}^{q1} & \cdots & a_{nm}^{q1} & \cdots & a_{n1}^{qq} & \cdots & a_{nm}^{qq} \end{bmatrix}. \quad (2)$$

The value-added coefficient is defined in the usual manner for a standard input-output model:

$$v_j^k = \frac{V_j^k}{X_j^k}, \quad (3)$$

where v_j^k is the value-added coefficient for sector j of region k , and V_j^k is the value added in sector j of region k . The vector of value-added coefficients for region k (\mathbf{v}^k) can be written as

$$\mathbf{v}^k = [v_1^k \quad \cdots \quad v_n^k] \quad k = 1, 2, \dots, q. \quad (4)$$

By using the Leontief inverse which is based on the matrix of input coefficients in equation (2), and the vector of value-added coefficients in equation (4), the matrix of the dependency ratios (\mathbf{D}) is expressed as

$$\mathbf{D} = \mathbf{V}(\mathbf{I} - \mathbf{A})^{-1}, \quad (5)$$

where $\mathbf{V} = \begin{bmatrix} \mathbf{v}^1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \mathbf{v}^q \end{bmatrix}$, and \mathbf{I} is the $nq \times nq$ identity matrix. Using the same Leontief

inverse, we can write the vector of the dependency ratios for the rest of the world (\mathbf{f}) as

$$\mathbf{f} = \mathbf{z}(\mathbf{I} - \mathbf{A})^{-1}, \quad (6)$$

where $\mathbf{z} = \left[\frac{M_1^1}{X_1^1} \quad \cdots \quad \frac{M_n^1}{X_n^1} \quad \cdots \quad \frac{M_1^q}{X_1^q} \quad \cdots \quad \frac{M_n^q}{X_n^q} \right]$, and M_j^k is imports in sector j of region k

from the rest of the world.

Table 1. Cost Structure of Multi-Regional Input-Output Table for Northeast Asia

		<i>N</i>	<i>C</i>	<i>K</i>	<i>D</i>	<i>F</i>	<i>R</i>	<i>G</i>
Inter-mediate input (X^{hk})	Northeast China (<i>N</i>)	X^{NN}	X^{NC}	X^{NK}	X^{ND}	X^{NF}	X^{NR}	X^{NG}
	Rest of China (<i>C</i>)	X^{CN}	X^{CC}	X^{CK}	X^{CD}	X^{CF}	X^{CR}	X^{CG}
	South Korea (<i>K</i>)	X^{KN}	X^{KC}	X^{KK}	X^{KD}	X^{KF}	X^{KR}	X^{KG}
	North Korea (<i>D</i>)	X^{DN}	X^{DC}	X^{DK}	X^{DD}	X^{DF}	X^{DR}	X^{DG}
	Far East Russia (<i>F</i>)	X^{FN}	X^{FC}	X^{FK}	X^{FD}	X^{FF}	X^{FR}	X^{FG}
	Rest of Russia (<i>R</i>)	X^{RN}	X^{RC}	X^{RK}	X^{RD}	X^{RF}	X^{RR}	X^{RG}
	Mongolia (<i>G</i>)	X^{GN}	X^{GC}	X^{GK}	X^{GD}	X^{GF}	X^{GR}	X^{GG}
Unclassified (<i>Q</i>)	Q^N	Q^C	Q^K	Q^D	Q^F	Q^R	Q^G	
Imports from Japan (<i>MJ</i>)	MJ^N	MJ^C	MJ^K	MJ^D	MJ^F	MJ^R	MJ^G	
Imports from the United States (<i>MU</i>)	MU^N	MU^C	MU^K	MU^D	MU^F	MU^R	MU^G	
Imports from the ROW (<i>MR</i>)	MR^N	MR^C	MR^K	MR^D	MR^F	MR^R	MR^G	
Value added (<i>V</i>)	V^N	V^C	V^K	V^D	V^F	V^R	V^G	
Output (X^k)	X^N	X^C	X^K	X^D	X^F	X^R	X^G	

Note: ROW denotes “rest of the world”.

3. Data

We used the multi-regional input-output table for Northeast Asia for the year 1995 compiled by Shishido (2000). This table is denominated in U.S. dollars, consists of 34 sectors, and covers 7 regions (Northeast China, the rest of China, South Korea, North Korea, Far East Russia, the rest of Russia, Mongolia). In addition to the seven regions, the table contains data for three other economies: Japan, the United States, and the rest of the world (i.e., the rest of the world in the model is further divided into these three economies). The basic structure of the table follows that of an international input-output table such as the Institute of Developing Economies’ Asian International Input-Output Table.¹ The cost structure of the table is presented in Table 1. It is worth noting that, although the table was developed in order to construct the Chenery-Moses inter-regional input-output model for economies in Northeast Asia, the table itself is described in the format of the Isard framework. A 34×34 matrix of the intermediate transactions between two distinct economies (i.e., X^{hk} $h \neq k$; $h, k = N, C, K, D, F, R, G$ in Table 1) is a diagonal matrix. That is, the diagonal elements are non-zero as long as trade between the two economies occurs in the sector of interest and the non-diagonal elements are zero. The unclassified sector is not included in the 34 sector classification, and the aggregated unclassified sector is added to the table as one of the factors in the input structure. The table is described in more detail elsewhere (Shishido, 2000).

4. Results

4.1 Interdependence of Northeast Asia at Macro Level

Table 2 shows the dependency ratios for Northeast Asia at the macro level. The self-dependency ratio for North Korea is remarkably high, nearly 95%, indicating that almost all of

¹ The latest version of the Asian International Input-Output Table is compiled by the Institute of Developing Economies—Japan External Trade Organization (2006).

North Korea's inputs are domestic products. The rest of China, the rest of Russia, South Korea, and Northeast China have self-dependency ratios of roughly 80%. In contrast, that of Mongolia is substantially lower, 62.5%, indicating that approximately 40% of its inputs are imported. The ratio for Far East Russia is also lower, 60%; however, the rest of Russia provides most of the imported inputs.

The table also shows that Northeast China imports approximately 16% of its inputs from the rest of China; however, the rest of China depends more on the rest of the world rather than on Northeast China. This indicates a one-way dependency of Northeast China on the rest of China. Far East Russia exhibits a similar relation with the rest of Russia. In addition to Far East Russia, Mongolia depends highly on the rest of Russia. It also depends more on the rest of China and on the rest of the world than on the other economies. Roughly 33% of Mongolia's inputs come from these three economies. South Korea imports about 11% of its inputs from the rest of the world, about 6% from Japan, and about 5% from the United States. Unlike the other Northeast Asian economies, South Korea has stronger economic relations with Japan and the United States.

The high dependencies of Northeast China on the rest of China and of Far East Russia on the rest of Russia are not surprising since these are intra-country dependencies. The dependencies of Northeast China, the rest of China, South Korea, and the rest of Russia on the Northeast Asian economies are less than those on Japan or the United States. This indicates that the bilateral interdependencies of Northeast China, the rest of China, South Korea, and the rest of Russia with the Northeast Asian economies are weak. In contrast, the dependencies of North Korea and Far East Russia on China as a whole (Northeast China plus the rest of China) and of Mongolia on the rest of Russia and the rest of China are higher than their dependencies on Japan and the United States. In this sense, the inter-regional dependencies of North Korea, Far East Russia, and Mongolia are somewhat strong.

Table 2. Dependency Ratios for Northeast Asia in 1995: One-Sector Economies (%)

Supplier	Purchaser						
	Northeast China	Rest of China	South Korea	North Korea	Far East Russia	Rest of Russia	Mongolia
Northeast China	75.584	1.401	0.147	1.138	2.504	0.077	0.163
Rest of China	16.107	84.676	0.950	0.591	2.772	0.152	7.874
South Korea	0.642	0.623	77.027	0.037	0.646	0.199	1.312
North Korea	0.088	0.004	0.000	94.922	0.006	0.000	0.000
Far East Russia	0.502	0.015	0.028	0.014	59.864	1.388	0.204
Rest of Russia	0.539	0.323	0.221	0.233	28.336	81.985	11.968
Mongolia	0.001	0.005	0.001	0.000	0.000	0.000	62.480
Japan	1.797	1.893	5.822	1.032	0.864	0.273	1.723
United States	0.707	1.175	4.743	0.041	1.683	1.023	0.744
Rest of the world	4.027	9.879	10.871	1.989	3.032	14.063	12.752
Unclassified	0.007	0.005	0.188	0.002	0.292	0.840	0.780

Table 3. Dependency Ratios for Rest of Russia on Northeast Asia in 1995 (%)

Sector	Supplier											Un- classified
	Northeast China	Rest of China	South Korea	North Korea	Far East Russia	Rest of Russia	Mongolia	Japan	United States	Rest of the world		
Agriculture	0.024	0.042	0.089	0.000	0.705	86.258	0.000	0.121	1.466	11.010	0.286	
Forestry	0.030	0.048	0.088	0.000	1.255	85.496	0.000	0.124	0.837	11.836	0.285	
Fishery	0.819	1.004	0.214	0.002	36.257	24.907	0.000	0.151	1.734	34.659	0.254	
Coal	0.012	0.023	0.069	0.000	0.695	79.339	0.000	0.172	0.374	18.503	0.814	
Crude oil and natural gas	0.013	0.011	0.036	0.000	0.911	92.101	0.000	0.061	0.127	6.307	0.434	
Metal mining	0.023	0.038	0.053	0.000	4.749	79.157	0.000	0.270	0.971	14.139	0.602	
Other mining	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Food and tobacco	0.127	0.298	0.300	0.000	1.646	61.942	0.000	0.087	3.652	31.605	0.342	
Textiles and apparel	0.850	3.356	0.693	0.001	0.426	25.841	0.000	0.204	0.853	67.519	0.258	
Wooden products	0.021	0.060	0.106	0.000	1.290	77.287	0.000	0.139	0.918	19.678	0.502	
Furniture	0.021	0.060	0.183	0.000	1.299	77.651	0.000	0.166	0.672	19.450	0.497	
Pulp and paper	0.035	0.106	0.220	0.000	1.183	71.333	0.000	0.145	0.629	25.896	0.454	
Printing and publishing	0.023	0.068	0.089	0.000	1.461	87.911	0.000	0.157	0.433	9.295	0.563	
Chemical products	0.021	0.061	0.059	0.000	0.848	67.771	0.000	0.221	1.190	29.235	0.593	
Petroleum and coal products	0.023	0.022	0.166	0.000	0.901	92.275	0.000	0.136	0.198	5.845	0.433	
Rubber products	0.020	0.053	0.299	0.000	0.930	68.305	0.000	2.718	1.137	25.943	0.595	
Leather products	0.095	0.534	0.089	0.000	0.203	24.318	0.000	0.048	0.435	74.036	0.241	
Ceramics	0.020	0.046	0.049	0.000	1.196	83.573	0.000	0.196	0.460	13.792	0.668	
Iron and steel	0.047	0.097	0.115	0.000	1.690	77.621	0.000	1.978	0.757	16.885	0.810	

Table 3. (Continued)

Sector	Supplier										Rest of the world	Un-classified
	Northeast China	Rest of China	South Korea	North Korea	Far East Russia	Rest of Russia	Mongolia	Japan	United States	Rest of the world		
Non-ferrous metal	0.031	0.046	0.052	0.000	11.350	75.559	0.000	0.177	0.364	11.937	0.485	
Metal products	0.016	0.042	0.708	0.000	0.971	57.562	0.000	0.429	1.307	38.478	0.486	
General machinery	0.014	0.033	0.378	0.000	0.960	57.866	0.000	1.308	3.122	35.831	0.487	
Electrical machinery	0.030	0.097	1.723	0.000	0.919	58.632	0.000	2.021	2.673	33.413	0.491	
Motor vehicles and aircraft	0.017	0.039	0.898	0.000	0.927	58.317	0.000	1.521	4.812	32.981	0.489	
Other transport equipment	0.019	0.053	0.962	0.000	0.971	57.769	0.000	0.849	2.070	36.819	0.488	
Precision machines	0.017	0.085	0.263	0.001	0.969	58.058	0.000	2.164	4.068	33.885	0.490	
Other manufacturing	0.054	0.162	0.509	0.000	1.439	74.876	0.000	0.412	2.195	19.487	0.866	
Construction	0.010	0.023	0.067	0.000	0.909	91.409	0.000	0.217	0.383	6.447	0.536	
Electricity and gas	0.011	0.020	0.058	0.000	2.355	91.765	0.000	0.117	0.257	4.716	0.701	
Trade	0.010	0.023	0.028	0.000	1.359	94.799	0.000	0.046	0.174	2.323	1.239	
Transportation	0.014	0.029	0.057	0.000	3.393	91.699	0.000	0.128	0.269	3.782	0.631	
Communication	0.014	0.029	0.057	0.000	3.393	91.699	0.000	0.128	0.269	3.782	0.631	
Finance and real estate	0.020	0.056	0.079	0.000	0.885	90.377	0.000	0.125	0.461	5.989	2.006	
Other services	0.023	0.054	0.065	0.000	1.484	90.857	0.000	0.113	0.426	5.866	1.112	

4.2 Dependence of Rest of Russia on Northeast Asia at Sector Level

Given that the share of Far East Russia's output as a share of Russia's total output was only about 6.6% in 1995 and that Far East Russia's dependency on the rest of Russia is one-way, we presume that the rest of Russia rather than Far East Russia better represents production in Russia as a whole with respect to both volume and structure. Hence, we focus on the inter-regional input structure of the rest of Russia.

Table 3 presents the sectoral dependency ratios for the rest of Russia on Northeast Asia. For the construction, electricity and gas, trade, transportation, communication, finance and real estate, and other services industries, over 90% of the inputs are domestic products, which is reasonable given that production and consumption in these industries usually occur at roughly the same time and in roughly the same place. The self-dependency ratios are also over 90% for the crude oil and natural gas as well as the petroleum and coal products sectors due to Russia's abundance of energy resources. However, the coal sector does import roughly 20% of its inputs from the rest of the world. In contrast, the self-dependency ratios in the fishery, other mining, textiles and apparel, and leather products sectors are low, less than 30%.² For the other light industries (food and tobacco, wooden products, furniture, pulp and paper, and printing and publishing), approximately 60–90% of the inputs are domestic products, and the rest are inputs mainly from the rest of the world. Among the heavy industries, the self-dependency ratios of the metal products as well as the machinery sectors (general machinery, electrical machinery, motor vehicles and aircraft, other transport equipment, and precision machines) are less than 60%. More than 30% of their inputs are products of the rest of the world. For the agriculture and other manufacturing sectors, the self-dependency ratios vary from 60–90%, and the remaining inputs are largely imported from the rest of the world.

One interesting finding is that the self-dependency ratio for the heavy industries sector is particularly low (less than 60%). Moreover, the self-dependency ratios for the heavy industries for the rest of Russia are low compared to those for the rest of China (the other BRIC country in this study), which are shown in Table 4.³

Why are the self-dependency ratios for the heavy industries for the rest of Russia low? Tabata (2006), using time-series data for Russia from 1991 to 2005, showed that industrial output diminished due to the so-called "Dutch disease", which occurred in the process of deregulation and liberalization during Russia's economic transition.⁴ In addition, Tabata (2006) pointed out that investment also declined during the contraction of industrial output. De Broeck and Koen (2000) and Kuboniwa (2001, 2004) pointed out that there was low investment and infrequent renewal of capital stock in the manufacturing sectors.⁵

² The self-dependency ratio and total output are zero for the other mining sector, indicating a data collection problem.

³ In addition to their levels, the self-dependency ratios for the manufacturing sectors for the rest of Russia are less balanced than those for the rest of China. The Gini coefficient of the self-dependency ratios for the manufacturing sector for the rest of Russia is 0.13, far greater than that for the rest of China (0.05).

⁴ Although they used data from 2003 to 2004, Ahrend et al. (2007) cast doubt on the Dutch disease explanation.

⁵ According to Kuboniwa (2007), the frequency of updating capital stock in Russia remains low.

Table 4. Self-Dependency Ratios for Rest of China in 1995: Manufacturing Sectors (%)

Sector	Self-dependency ratio
Food and tobacco	89.7
Textiles and apparel	81.7
Wooden products	75.2
Furniture	87.4
Pulp and paper	81.7
Printing and publishing	91.1
Chemical products	77.1
Petroleum and coal products	73.6
Rubber products	82.5
Leather products	75.5
Ceramics	89.4
Iron and steel	79.0
Non-ferrous metal	78.6
Metal products	84.9
General machinery	66.3
Electrical machinery	68.7
Motor vehicles and aircraft	76.5
Other transport equipment	79.6
Precision machines	59.4
Other manufacturing	76.9

With old technology embodied in aged capital stock, improvement in competitiveness cannot be expected. Accordingly, we conclude that the low self-dependency ratios for the heavy industries are due to the deterioration of competitiveness in those industries, which was triggered by the system transition and then deepened by low investment up to 1995. The low investment is reflected in Russia's position in the international financial market. Sincular (1998) and Kuboniwa (2001, 2004) showed that there was massive capital flight and limited foreign capital inflow in Russia.⁶ In contrast, as shown by Sincular (1998) and Buck et al. (2000), China receives far more net foreign capital than Russia, probably due to China's "open door policy" (see, e.g., Chow 2002) and China's better investment environment (e.g., macroeconomic stability).⁷ In China, these foreign capital inflows (particularly foreign direct investment) have had positive effects on growth and

⁶ Uegaki (2006) analyzed capital flight from Russia whereas Buck et al. (2000) analyzed capital flow into Russia.

⁷ According to Buch et al. (1999), Loungani and Mauro (2001), Shiells (2003), and Suganuma (2006), instability/uncertainty in political and legal systems, tax policy, and the macroeconomy are particularly to blame for the limited amount of net capital flows into Russia. With this in mind, we can say that the Russian government failed to give participants in the international capital market sufficient incentives to invest in Russia.

development in the manufacturing sector (see, e.g., Pei 2001; Vu et al. 2008) and on fixed investment at the macro level (Sun 1998). On the basis of these studies, we consider that the low investment in Russia is caused by a low amount of net capital inflows, leading to the collapse of output and the continuation of low competitiveness. The collapse of competitiveness resulted in low self-dependency ratios in the heavy industries. Since the Russian government is responsible for resolving the obstacles to net capital inflow (instability/uncertainty in political and legal systems, tax policy, and the macroeconomy), the negative effect of Russia's investment conditions (including policy) on industrial development is not minimal.

It is worth noting that the rest of Russia's imports of inputs from North Korea and Mongolia are almost zero.⁸ The sectoral dependency ratios for the rest of Russia on the other Northeast Asian economies are quite low; however, those on the rest of the world are high. Hence, we can conclude that the rest of Russia depends on the rest of the world more than on Northeast Asia even at the sector level.

4.3 Dependence of Northeast Asia on Rest of Russia at Sector Level

The sectoral dependency ratios for the Northeast Asian economies on the rest of Russia are presented in Table 5. The dependencies for Northeast China, the rest of China, South Korea, and North Korea on the rest of Russia are fairly low.⁹ Although they are less than 6%, the dependency ratios for natural resources (metal mining, non-ferrous metal, crude oil and natural gas) are slightly higher among the 34 sectors for these regions. In contrast, the dependency ratios for the manufacturing sector for Mongolia on the rest of Russia are high; however the ratios are roughly 2% for the textiles and apparel, leather products, electrical machinery, and other transport equipment sectors, which have low self-dependency ratios for the rest of Russia.¹⁰ A striking observation is that Mongolia imports over 90% of its crude oil and natural gas as well as petroleum and coal products from the rest of Russia.

In short, except for Mongolia, Northeast Asia does not depend on the rest of Russia at the sector level either. Both Tables 3 and 5 demonstrate that the rest of Russia and Northeast Asia (other than Mongolia) are mutually independent economies.

⁸ Although Table 3 shows that the sectoral dependencies for the rest of Russia on North Korea and Mongolia are zero, they are not necessarily nil. Some of the figures are zero due to rounding.

⁹ According to Imamura (2005, 2007), Russia was the main trading partner of North Korea; however, particularly after the breakup of the Soviet Union, Russia was replaced by China. Our findings agree with these observations.

¹⁰ Far East Russia imports manufactured goods mostly from the rest of Russia; however, this is not a striking observation since this is an intra-country case.

Table 5. Dependency Ratios for Northeast Asia on Rest of Russia in 1995 (%)

Sector	Northeast	Rest of	South	North	Far East	
	China	China	Korea	Korea	Russia	Mongolia
Agriculture	0.152	0.116	0.084	0.115	12.830	1.635
Forestry	0.170	0.120	0.017	0.053	13.000	0.000
Fishery	0.124	0.089	0.342	0.229	12.351	24.907
Coal	0.453	0.366	0.759	0.219	38.203	9.004
Crude oil and natural gas	0.286	0.268	1.445	4.083	25.237	92.101
Metal mining	3.120	2.102	5.004	5.549	35.762	8.511
Other mining	0.229	0.186	0.078	0.151	0.000	4.799
Food and tobacco	0.583	0.177	0.148	0.244	25.822	5.801
Textiles and apparel	0.162	0.115	0.124	0.275	4.163	1.559
Wooden products	1.620	1.020	1.389	1.052	15.816	36.902
Furniture	1.085	1.075	0.790	0.816	15.985	77.651
Pulp and paper	0.462	0.360	0.324	0.481	15.038	71.333
Printing and publishing	0.613	0.799	0.361	0.491	16.686	17.943
Chemical products	0.550	0.389	0.353	0.762	20.160	26.506
Petroleum and coal products	0.389	0.585	1.007	1.944	24.323	92.275
Rubber products	0.381	0.363	0.377	0.571	8.799	17.194
Leather products	0.175	0.118	0.118	0.233	13.542	2.548
Ceramics	0.349	0.258	0.180	0.358	8.068	6.322
Iron and steel	3.613	1.886	1.123	1.728	15.793	77.621
Non-ferrous metal	3.266	1.554	1.727	4.058	7.910	27.828
Metal products	1.085	0.827	0.559	0.997	45.342	46.846
General machinery	2.084	0.625	0.343	0.836	45.496	57.508
Electrical machinery	0.767	0.404	0.166	0.415	46.955	2.181
Motor vehicles and aircraft	0.970	0.522	0.317	1.109	47.287	51.399
Other transport equipment	0.822	0.504	0.450	2.437	44.392	1.789
Precision machines	0.485	0.313	0.103	0.365	43.076	10.401
Other manufacturing	0.417	0.243	0.192	0.384	12.697	0.769
Construction	0.665	0.385	0.226	0.409	7.909	13.253
Electricity and gas	0.220	0.186	0.310	0.248	9.515	3.774
Trade	0.227	0.143	0.051	0.084	2.844	2.328
Transportation	0.234	0.200	0.180	0.311	5.723	4.887
Communication	0.226	0.194	0.022	0.038	5.723	3.082
Finance and real estate	0.183	0.133	0.032	0.051	12.768	0.000
Other services	0.238	0.169	0.068	0.091	12.571	4.789

5. Conclusion

We analyzed the inter-regional inter-industry input structure of Northeast Asia with emphasis on Russia by measuring the inter-regional dependency ratios. We found that the international

dependencies among the Northeast Asian economies are quite weak except for the those between North Korea and China as a whole (Northeast China plus the rest of China), between Far East Russia and China as a whole, between the rest of China and Mongolia, and between the rest of Russia and Mongolia. In particular, most of the Mongolian inputs are products imported from the rest of Russia whereas the rest of Russia does not depend on Mongolia at all. We also found that the rest of Russia is economically linked with the rest of the world rather than with Northeast Asia, particularly in several manufacturing sectors (textiles and apparel, leather products, and machinery).

Russia exports energy mainly to European and CIS countries (e.g., Kuboniwa 2004, p. 147), and our results show that imports of energy in the Northeast Asian economies (excluding Mongolia) from Russia were minimal in the year 1995. The self-dependency ratio for crude oil and natural gas for China is over 80% whereas South and North Korea import over 90% of their crude oil and natural gas from the rest of the world and China, respectively.¹¹ Japan as well imports most of its crude oil (from the Middle East). Due to its rapid economic development, energy demand in China is growing rapidly.¹² As Harrison (2002) and Hyun-Jae (2003) noted, this energy environment implies that the risk of insufficient energy supply is serious in Northeast Asia (including Japan), thus diversification of source countries is necessary. Energy exports from Russia to the Northeast Asia countries could reduce some of this risk. In fact, Russia started exporting natural gas to Japan through Sakhalin in February 2009, and China entered a long-term contract to purchase Russia's crude oil in exchange for financial assistance to Russian energy firms.¹³ Given these observations, we expect that economic interdependencies among the Northeast Asian economies and the influence of Russia in the region will become stronger.¹⁴

Unfortunately, we could investigate the region's interdependencies for only a single point, the year 1995, due to data limitations. Our future tasks include compiling multi-regional input-output tables for Northeast Asia for other years and using them to analyze recent changes in the inter-regional input-output structure of the region.

Acknowledgments

We thank Professor Shuntaro Shishido for providing us with the multi-regional input-output table for Northeast Asia, 1995. We are also grateful to the two anonymous referees for their valuable comments. Any errors and omissions are the responsibility of the authors. Any opinions expressed are those of the authors and not of their affiliations.

¹¹ North Korea's energy trade with China as well as the increasing importance of Russia as an energy supplier to North Korea were shown by Imamura (2005, 2007).

¹² The International Energy Agency (2007) conducted an intensive analysis of energy supply and demand in China.

¹³ Winning D., Oster, S., and Wilson, A., 2009. China, Russia Strike \$25 Billion Oil Pact: In Third Deal in a Week, Beijing Moves to Lock Up Natural Resources at Bargain Prices to Fuel Its Growth. *The Wall Street Journal* (Eastern Edition), February 18, p. A8.

¹⁴ Concerning the prospective effects of Russian energy on Northeast Asia, see Motomura (2008).

References

- Algieri, B.**, 2004. Trade Specialization Patterns: The Case of Russia. BOFIT Discussion Paper No. 19/2004, Institute for Economies in Transition, Bank of Finland.
- Ahrend, R., de Rosa, D., and Tompson W.**, 2007. Russian Manufacturing and the Threat of ‘Dutch disease’: A Comparison of Competitiveness Developments in Russian and Ukrainian Industry. OECD Economics Department Working Papers No. 540, Organization for Economic Co-operation and Development.
- Buch, C. M., Heinrich, R. P., and Pierdzioch C.**, 1999. The Value of Waiting: Russia’s Integration into the International Capital Markets. *Journal of Comparative Economics*, 27(2), 209–230.
- Buck, T., Filatotchev, I., Nolan, P., and Wright, M.**, 2000. Different Paths to Economic Reform in Russia and China: Causes and Consequences. *Journal of World Business*, 35(4), 379–400.
- Chow, G. C.**, 2002. *China’s Economic Transformation*. Malden, Mass.: Blackwell Publishers.
- De Broeck, M. and Koen, V.**, 2000. The Great Contractions in Russia, the Baltics and the Other Countries of the Former Soviet Union: A View from the Supply Side. IMF Working Paper No. WP/00/32, International Monetary Fund.
- Garanina, O.**, 2008. What Beyond Oil and Gas? Russian Trade Specialization in Manufactures. BOFIT Discussion Paper No. 23/2008, Institute for Economies in Transition, Bank of Finland.
- Harrison, S. S.**, 2002. Toward Oil and Gas Cooperation in Northeast Asia: New Opportunities for Reducing Dependence on the Middle East. *Asia Program Special Report* No. 106, Woodrow Wilson International Center for Scholars.
- Hyun-Jae, D.**, 2003. Energy Cooperation in Northeast Asia: Prospects and Challenges. *East Asian Review*, 15(3), 85–110.
- Imamura, H.**, 2005. North Korean Economy and Its Impact on Neighboring Countries. *Far Eastern Studies*, 4, 35–49.
- Imamura, H.**, 2007. A Study of North Korean Foreign Trade. *Far Eastern Studies*, 6, 1–29.
- Institute of Developing Economies–Japan External Trade Organization**, 2006. *Asian International Input-Output Table 2000, Volume 2: Data*. Chiba: Institute of Developing Economies–Japan External Trade Organization.
- International Energy Agency**, 2007. *World Energy Outlook 2007: China and India Insights*. Paris: International Energy Agency.
- Jin, D. and Chen, Y.**, 2008. Changes of Dependency Structure in East Asia from 1990 to 2000: Analysis by Intermediate Input According to Sector. *Far Eastern Studies*, 7, 1–21.
- Konno, Y.**, 2008. Analysis of Structural Changes in Russia’s Trade with CIS Countries. *Slavic Studies*, 55, 29–59. (in Japanese)
- Kuboniwa, M.**, 1994. The Structure of Russian Foreign Trade in Transition. *Hitotsubashi Journal of Economics*, 35(2), 73–94.
- Kuboniwa, M.**, 2001. A Singularity of Russia’s Marketization: An Analysis of the Trade Margins. *Economic Review* (Institute of Economic Research, Hitotsubashi University), 52(2), 157–165. (in Japanese)
- Kuboniwa, M.**, 2004. A New Growth Wave with Peculiar Industrial Structure in Russia. *Economic*

- Review* (Institute of Economic Research, Hitotsubashi University), 55(2), 135–154. (in Japanese)
- Kuboniwa, M.**, 2007. Russian Economic Growth at a Turning Point: Views from the Supply and Income Sides. *Economic Review* (Institute of Economic Research, Hitotsubashi University), 58(3), 246–262. (in Japanese)
- Loungani, P. and Mauro P.**, 2001. Capital Flight from Russia. *World Economy*, 24(5), 689–706.
- Motomura, M.**, 2008. The Russian Energy Outlook and Its Influence on East Asia. *Acta Slavica Iaponica*, 25, 67–87.
- Pei, C.**, 2001. The Changing Trend of FDI Patterns in China. *The Chinese Economy*, 34(1), 89–100.
- Shiells, C. R.**, 2003. FDI and the Investment Climate in the CIS Countries. IMF Policy Discussion Paper No. PDP/03/5, International Monetary Fund.
- Shimoda, M. and Watanabe, T.**, 2005. A Structure of International Division of Labor in Asia-Pacific Region: An Empirical Study Using IDE International IO Tables. *Input-Output Analysis*, 13(2), 42–53. (in Japanese)
- Shishido, S.**, 2000. A Multiregional Input-Output Table for Northeast Asia 1995: Compilation and Analysis. *ERINA Report*, 36, 20–28. (in Japanese)
- Sincular, T.**, 1998. Capital Flight and Foreign Investment: Two Tales from China and Russia. *The World Economy*, 21(5), 589–602.
- Suganuma, K.**, 2006. Foreign Direct Investment in Transition Economies: Focusing on Russia. *Japanese Journal of Comparative Economics*, 43(2), 15–30. (in Japanese)
- Sun, H.**, 1998. Macroeconomic Impact of Direct Foreign Investment in China: 1979-96. *The World Economy*, 21(5), 675–694.
- Tabata, S.**, 2006. Transition in the Structure of the Russian Economy (1991-2005). *Economic Review* (Institute of Economic Research, Hitotsubashi University), 57(2), 136–150. (in Japanese)
- Uegaki, A.**, 2006. Capital Flight from Russia. In: S. Tabata, ed. *Dependent on Oil and Gas: Russia's Integration into the World Economy*, the 21st Century COE Program, Slavic Eurasian Studies, No. 11, Sapporo: Slavic Research Center, Hokkaido University, 51–84.
- Vu, T. B., Gangnes, B., and Noy, I.**, 2008. Is Foreign Direct Investment Good for Growth? Evidence from Sectoral Analysis of China and Vietnam. *Journal of the Asia Pacific Economy*, 13(4), 542–562.