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Shinozaki, Akihiko
Faculty of Economics, Kyushu University : Professor

Kubota, Shigehiro
Tohoku Bunka Gakuen University

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Akihiko SHINOZAKI, Shigehiro KUBOTA

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The U.S. service imports and cross-border mobility of skilled labor: Panel data analysis based on the network theory[1]

Akihiko SHINOZAKI[2], Shigehiro KUBOTA[3]

Abstract

This study aims to clarify what determines the expansion of service exports to the U.S. from both developed and developing countries with a special focus on the cross-border movement of skilled labor. For this purpose, we employed key concepts of network theory as an analytical framework and conducted a panel data analysis covering 31 countries from 1999 to 2008, the decade in which offshore outsourcing in service trade began to take off worldwide. The study used data for each country's service exports to the U.S., domestic demand in the U.S., number of H-1B visas issued, GNI per-capita, network readiness index, and English proficiency factors. We also investigated a partial correlation matrix to analyze the effect and interactions between these factors. These analyses yield three observations. First, service trade with the U.S. is more intensive among higher income countries. Second, the number of H-1B visas issued has a positive effect on service exports to the U.S. Third, individuals in lower-income countries tend to desire H-1B visas and create intensive skilled labor networks with the U.S., the path through which developing countries such as India expanded their service exports to the U.S.

JEL Classification: F14 Multilateral Trade and Developing Countries; F01 Globalization; F20 International Factor Movements; O10 Economic Growth and Development

Keywords: offshoring; trade in services; human resource network; H-1B visa

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[2] Kyushu University, Japan.
[3] Tohoku Bunka Gakuen University.

1. Introduction

This study examines the determinants of the service trade from both developed and developing countries to the U.S., with a special focus on cross-border skilled labor networks. The recent trend in offshore outsourcing, or offshoring, best symbolizes the growth in cross-border service trade, which includes business, professional and technical services such as computer and data processing services. We adopted network theory to clarify the impact and interactions between the various factors contributing to the service trade, such as income levels, IT network availability, human resource networks, English language skills, as well as macroeconomic conditions in the U.S.

According to UNCTAD (2009), the global offshoring market expanded 2.6 times between 1998 and 2008, roughly the decade following the late 1990s currency crises in Asia and Russia. During this period, the U.S., the largest service trade market in the world, saw an annual growth rate of 8.5% in service imports[4]. The growth momentum was especially strong in the offshoring segment, which expanded 11.3% annually. Consequently, this segment's share of overall service imports jumped from 18% in 1998 to 23% by 2008. Its volume exceeded travel services, cargo and transportation services, and even financial and insurance services by 2008.

Such trends in the U.S. have a significant ripple effect on the economies of the trading partner, such as India, a country with a robust trade in services with the U.S. India's economic growth rate since 2000 accelerated by 2.1% to 7.8%, up from an average rate of 5.7% in the 1980s-1990s. Service industries such as software development contributed the most to this increased growth momentum, contributing to accelerated aggregate economic growth of 2.8%, from 3.0% in the 1980s to 5.8% in the 2000s.

For interpreting this expansion in the trade in services, there are some limits to the traditional theories of economics, such as the "flying geese pattern" or "catching-up model" of economic development. To address this gap, we employ network theory as an analytical

[4] Data from the U.S. Department of Commerce, Bureau of Economic Analysis. See Table 1 for the data source.

framework to investigate the enabling factors of service trade empirically, focusing on the strength of cross-border skilled labor networks.

Specifically, we conduct a panel data analysis using a dataset of service exports to the U.S., domestic demand in the U.S., the number of H1-B visa holders, network readiness index, GNI per-capita, and an English proficiency dummy for 31 countries during 1999-2008. Moreover, we investigate the mutual effects and interactions between the six variables by analyzing a partial correlation matrix. We contribute some empirical analyses to help clarify what determines service exports to the U.S. and how low-income countries can leapfrog and develop their economies.

2. Theoretical framework

In this study, we focus on high-skilled human resource networks in knowledge-based business, such as professional and technical services in the information industry, as a driving force to expand cross-border trade. As Chandler (2000, p. 3) notes, the U.S. economy transformed "from the Industrial into the Information Age in the last decade of the twentieth century." Traditionally, development theories adopted Petty-Clark's law, that is, major productivity shifts sequentially from the agriculture to the manufacturing industry, and from then on to the services industry. In India's case, however, the economy appears to be "leapfrogging" straight from an agriculture-centric economy to a software-intensive Information Age, somewhat bypassing the manufacturing-based Industrial Age.[5]

Likewise, concepts such as the "flying geese" or "catching-up" model of development are a familiar feature of international trade theories in the manufacturing industry (Kojima, 2000). In contrast, offshoring, which best exemplifies the international services trade model between the U.S. and India, is a new phenomenon in the Information Age. Therefore, traditional theoretical

[5] Fong (2009) provides a comprehensive review of leapfrogging development and Singh (1999) adopts this view to illustrate the Indian telecommunication industry.

frameworks may not sufficiently capture and describe this development trajectory.

We thus employ network theory as the theoretical framework to understand leapfrogging development, with a special focus on cross-border skilled labor networks.[6] This theory contains three major concepts of value to our study: the re-wiring of regular networks, small world networks, and multi-level networks. A regular network has highly ordered and proximity-based features in its structure, while a small world network has a few random links via re-wiring in the regular network (Nishiguchi, 2009).

In general, individuals and organizations, illustrated as nodes in Figure 1, usually create a regular network based on proximity with limited and close links to each other. If they randomly re-wired some of their links to a distant node, they can make a small world and benefit from new links. In other words, re-wiring provides a proximity effect between different distant entities, which leverages and revitalizes the entire network.

[Figure 1]

The economy consists of several layers of networks such as personal networks, organizational networks, and cross-country networks, referred to as multi-level networks. Networks sometimes affect each other across different layers. For example, personal-level relations influence those of the affiliated organization or country; likewise, a country- or organizational-level relationship influences individual-level behavior and performance (Hitt et al., 2007).

These network theory concepts are useful to analyze the offshoring business model in U.S. firms (Suenaga et al., 2014). Based on network theory, a large number of H1-B visa holders, or competent students, professionals, and technical experts, emigrate to the U.S. from their home countries (re-wiring). They then join U.S. multinational firms or start up their own businesses,

[6] Blinder (2006, pp.114-115) points out that "in modern economies, nature's whimsy is far less important than it was in the past. Today, much comparative advantage derives from human effort rather than natural conditions."

consequently creating greater cross-border business networks between both countries (small-world networks). Finally, these networks trigger growth in service trade between their countries and the U.S. at the national-level (multi-level networks).

3. Empirical analysis

Model and dataset

Based on the theoretical framework, our study specifies model (1) to verify whether human resource networks with the U.S. contributed to growth in offshoring business and the consequent national service exports to the U.S.

$$\ln usaimp = C + \beta_1 visa + \beta_2 networkreadiness + \beta_3 \ln nipercap + \beta_4 englishdummy + \beta_5 \ln usadd \ldots \quad (1)$$

In this model, ln represents logarithm. The dependent variable is the logarithm of service exports from each country to the U.S. (*usaimp*), with the following independent variables: the number of H-1B visas issued (*visa*), IT network availability (*networkreadiness*), income level or development stage (*nipercap*), the English proficiency dummy variable (*englishdummy*), and the logarithm of domestic demand in the U.S. (*usadd*).

[Table 1]

Table 1 summarizes the sources of dataset in this study. This includes: 1) the value of each country's service exports to the U.S. from the U.S. Department of Commerce, 2) number of H1-B visas issued for highly-skilled technical workers from the U.S. Department of State as a proxy for high-skilled labor networks, 3) the World Economic Forum network readiness index as a proxy of IT network availability, 4) GNI per-capita from the World Bank database as a proxy for each county's income level or development stage, 5) an English dummy variable equal to 1 if English is an official or subsidiary official language and 0 otherwise as a proxy of

English proficiency, and 6) domestic demand in the U.S. from the U.S. Department of Commerce as a macroeconomic control factor in the U.S.

[Table 2]

Due to limited data availability, this study focuses on the 31 countries outside the U.S. listed in Table 2. These include 19 OECD member countries, or developed countries, and 12 non-member countries, or developing countries, such as India. The dataset period covers 1999 to 2008, a decade between the late 1990s currency crisis in Asia and the global financial crisis in the late 2000s triggered by the Lehman Brothers bankruptcy, when offshoring coincidentally grew significantly worldwide.

Panel data analysis

We estimate model (1) for three categories: the pooling model, the fixed effects model, and the random effects model. Table 3 reports the results of the estimations. In each model, the coefficient of H-1B visa shows a significantly positive relationship with service trade with the U.S. In other words, the results strongly verify that highly skilled human resource networks with the U.S. have statistically significant and positive effects on the growth of service exports to the U.S. Additionally, per-capita income shows a similar significant and positive effect, indicating that service trade with the U.S. is more intensive among higher income countries[7].

[Table 3]

This leads to another question: why and how did low-income countries like India expand their service trade with the U.S.? To address these questions, we must clarify how individual variables interact and affect service exports to the U.S. One problem with multivariate analyses is that the coefficients of independent variables include both the direct impact of independent variables on dependent variables and that of other factors. Therefore, we must remove pseudo-correlations and rigorously distinguish between direct and indirect relationships for a

[7] Kimura and Lee (2006) estimate a gravity equation model and find that per capita income shows a statistically positive relationship with the growth of international service trade.

detailed examination. One way to do this is by observing the partial correlation matrix in Table 4. It appears to show a negative partial correlation between human resource networks (*visa*) and income level (*nipercap*), despite their positive effects on service trade (*usaimp*).

[Table 4]

Results and implications

The network theory we employed in this study helps to interpret these results. In terms of model (1), the regular network in Figure 1 illustrates the proximity of income levels, that is, economic development stages, to cross-border service trade. In other words, developed countries with higher income levels close to those of the U.S. generally tend to have higher volume services trade with the U.S.

On the contrary, developing countries with income levels very distant from those of the U.S. tend to desire H-1B visas to improve their opportunities and create intensive human resource networks among highly skilled communities. Thus, there is a negative relationship between GNI per-capita and H-1B visa. Consequently, these cross-border human resource networks from developing countries to the U.S. generate a re-wiring effect and promote services trade with the U.S., despite their income level disadvantage.

4. Conclusion

This study uses network theory to analyze empirically the growth trajectory of service exports from both developed and developing countries to the U.S. with a special focus on the cross-border movement of skilled labor. We conducted a panel data analysis covering 31 countries from 1999 to 2008 using a dataset of service exports to the U.S., domestic demand in the U.S., number of U.S. H-1B visas issued, GNI per capita, network readiness index, and an English dummy representing the official language.

Our study yielded three major findings. First, service trade with the U.S. is more intensive among higher income countries. Second, the number of H-1B visas issued have a positive effect

on service exports to the U.S. Third, individuals in developing countries tend to desire H-1B visas and create intensive high-skilled human networks with the U.S., the path through which developing countries such as India expanded their service exports to the U.S. Traditionally, higher-income economies had more robust services trade with the U.S. Our research results are significant because they traced a clear path of how these trade links changed via re-wiring due to skilled labor movement from developing countries.

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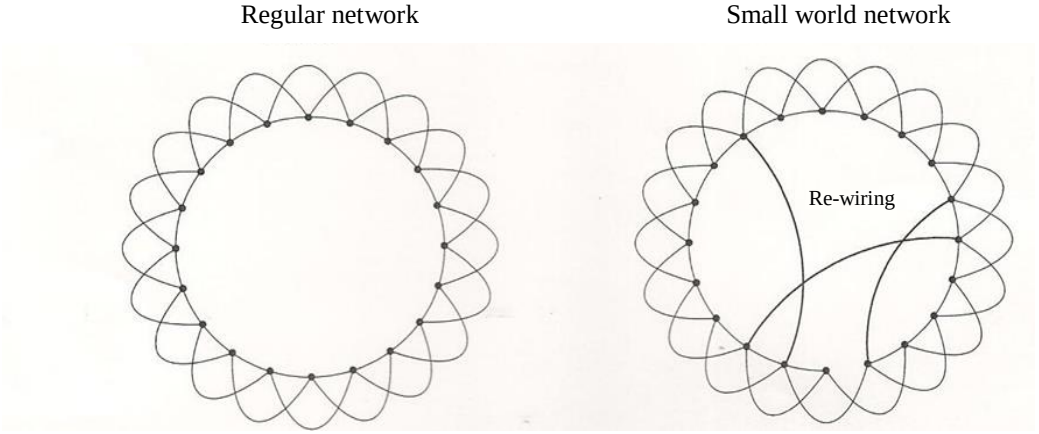
Figures and Tables

Figure 1.

Regular and small world networks



Source: Nishiguchi (2009), with some modifications.

Table 1.

Dataset

Variable	Abbreviation	Source
Service exports to the U.S. (millions of USD)	*usaimp*	Service imports from the statistics section of Private Services Trade by Area and Country, International Services, U.S. Department of Commerce, Bureau of Economic Analysis.
Domestic Demand in the U.S. (millions of USD)	*usadd*	National income and product accounts (NIPAs), U.S. Department of Commerce, Bureau of Economic Analysis.
Number of H-1B visas issued (person)	*visa*	H-1B visa from the Visa Statistics, U.S. Department of State, Bureau of Consular Affairs, Nonimmigrant Visa Issuances by Visa Class and by Nationality.
Network readiness index	*networkreadiness*	Networked Readiness Index from *The Global Information Technology Report* issued by the World Economic Forum.
GNI per-capita (current international dollar: PPP)	*nipercap*	GNI per capita, PPP (current international $) provided by the World Bank.
English proficiency factor (dummy variable)	*englishdummy*	"1" if English is an official or subsidiary official language and "0" otherwise

Table 2.

Countries

Region	Countries and economies
America	United States*, Canada*, Mexico*, Brazil, Argentina, Chile*, Venezuela
Europe	Ireland*, United Kingdom*, Italy*, Netherlands*, Switzerland*, Sweden,*, Spain*, Germany*, Norway*, France*, Belgium*
Asia and Oceania	Japan*, Australia*, New Zealand*, Singapore, Hon Kong, South Korea*, Indonesia, Thailand, Philippines, Malaysia, China, India
Other region	Israel*, South Africa

Note: OECD member counties are marked with *.

Table 3.

Results of Panel data analysis

	Pooling model		Fixed effect model		Random effect model	
	Estimated Coefficient	t-statistics	Estimated Coefficient	t-statistics	Estimated Coefficient	z-statistics
networkreadiness	0.20	[1.087]	0.12	[2.441]**	0.12	[2.558]**
ln *nipercap*	0.76	[3.755]***	0.82	[4.212]***	0.76	[4.798]***
englishdummy	-0.05	[-0.358]	—	—	0.15	[0.346]
ln *usadd*	0.91	[1.952]*	0.86	[4.266]***	0.91	[5.453]***
visa	41.01	[5.432]***	15.29	[3.469]***	16.68	[3.942]***
Const.	-15.16	[-2.078]**	-14.44	[-8.502]***	-14.85	[-9.554]***
Number of observations	273		273		273	
R-squared	0.32		—		—	
Adj-R-squared	0.31		—		—	
R-sq: within	—		0.73		0.73	
between	—		0.25		0.27	
overall	—		0.27		0.28	
	F test: F stat. 329.47, p-value (0.000)					
	Hausman test: Hausman stat. 1.45, p-value (0.836)					
	Breusch and Pagan test: LM stat. 1028.80, p-value (0.000)					

Note: *, **, and *** indicate significance at the 10%, 5%, 1% levels, respectively.

Table 4.

Partial correlation matrix

	Variables	A	B	C	D	E	F
A	ln *usaimp*	—					
B	*visa*	0.315	—				
C	*networkreadiness*	0.066	0.363	—			
D	ln *nipercap*	0.224	-0.604	0.846	—		
E	*englishdummy*	-0.022	0.167	0.217	-0.129	—	
F	ln *usadd*	0.119	0.150	-0.237	0.269	0.044	—

〔A list of back numbers〕

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ICR InfoCom Research, Inc.

Urban Net Nihonbashi Bldg., 2-14-10, Nihonbashi Ningyo-cho, Chuo-ku,
Tokyo 103-0013, Japan
Telephone 03-3663-7153
For further information, visit http://www.icr.co.jp/ICT/, or please contact Masato NOGUCHI, Director and Executive Analyst.