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# Intra-industry trade, fragmentation and export margins: An empirical examination of sub-regional international trade

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### ABSTRACT

This study contributes to the existing empirical investigation of international trade by providing new evidence of intra-industry trade using sub-regions within a nation. We calculate the Grubel–Lloyd intra-industry trade index for 41 Japanese regions with Korea during the period from 1988 to 2006. In sub-regional intra-industry trade regression models, we introduce extensive and intensive margins of prefecture exports as new explanatory variables. We find that a rise in sub-regional intra-industry trade is driven by the introduction of a new variety of exports, while intra-industry trade is discouraged by an increase in the trade value of products that are already exported.

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## 1. Introduction

The growing importance of intra-industry trade over the last two decades is well recognized. For example, the rapid growth in East Asian intra-regional trade can be attributed in large part to recent developments in intra-industry trade (Kimura, Takahashi, & Hayakawa, 2007; Murshed, 2001). Murshed (2001) documents that the share of intra-industry trade as a proportion of total manufactured trade in Asian economies has increased since 1980. Kimura et al. (2007) observed a 1000% growth in machinery parts and components trade in East Asia from 1987 to 2003.

Kimura et al. (2007) further claim that component trade in East Asia is driven by international fragmentation of the production process, as explained in Arndt and Kierzkowski (2001). Firms fragment the production process, choosing different countries for each stage of production. As a result, a capital-abundant country may import parts and components produced in labor-abundant countries and export finished products back to these labor-abundant countries.

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Intra-industry trade due to the international fragmentation of production must be vertical in nature whereas intra-industry due to consumers' preferences for larger variety is horizontal (Krugman, 1979; Lancaster, 1980). Hummels, Ishii, and Yi (2001) uses input–output tables to examine a phenomenon that is closely related to vertical intra-industry trade, vertical specialization, or the use of imported inputs to produce goods that are then exported. When vertical specialization extends to more than two countries, the value-added through the global chain of production also becomes important (Koopman, Powers, Wang, & Wei, 2011).

One way to measure vertical intra-industry trade is to use the threshold value of relative unit values of exports and imports (Greenaway, Hine, & Milner, 1994). However, vertical intra-industry trade can occur for reasons other than the fragmentation of production. Consumers benefit from having the option to choose from different sets of qualities (Flam & Helpman, 1987). A high-income country exports high quality products while importing low quality products of the same type. Therefore, we cannot be sure whether vertical intra-industry trade is caused by consumers' tastes for different qualities or by the fragmentation of production.

A more direct way to capture the degree of fragmentation occurring is to use firm-level datasets. At the firm level, we can identify two flows of trade as part of the fragmentation of production: a trade flow out of a firm that is later matched by an incoming trade flow of the same product group and vice versa. Rather than relying on firm-level observations, we suggest a methodology that restricts trade flows to a much smaller region than a country. Intra-industry trade measured using this methodology can reflect a higher proportion of trade caused by fragmentation in observed intra-industry trade.<sup>1</sup>

One of the most important contributions of this paper is to provide new evidence for the international fragmentation of production and for vertical specialization in Asia. We do so by introducing sub-regional intra-industry indices as a proxy for these direct measurements.<sup>2</sup> Many previous studies highlight the important role of fragmentation and vertical specialization in explaining international trade in Asia. For example, by examining vertical intra-industry trade in East Asia, Ando (2006) finds that the fragmentation of international production is a major cause of the observed high degree of vertical intra-industry trade. Athukorala and Yamashita (2006) document that vertical specialization in Asia actually caused Asian economies to depend more on extra-regional trade in final goods. Moreover, by comparing proposed measures of vertical specialization across the world, Amador and Cabral (2009) find that East Asia shows the most significant and growing vertical specialization activities. This study intends to shed some new light on fragmentation of production and vertical specialization in Asia by examining traditional intra-industry trade at much smaller sub-regional levels within a country.

Our analysis depends heavily on Japanese international trade data provided by the Japan Custom, Ministry of Finance (JCMF). The JCMF dataset classifies traded products using 9-digit classifications and includes over 7000 codes in export and over 8000 codes in imports. The first six digits correspond to the international standard classification of the Harmonized System (HS). In addition to international trade at the country level, the JCMF also provides detailed international trade data at the level of international ports in Japan. We aggregated data from these international ports to construct an international trade dataset for prefectures. Because some prefectures have no international ports or reported no positive international trade, we have data for 41 out of 47 existing prefectures.<sup>3</sup> It should be noted that prefectures are only political units, and an economic unit may extend over two adjacent prefectures. However, prefectures are large enough to encompass most industry clusters within a geographic area. The sample covers the period from 1988 to 2006.

<sup>1</sup> This sub-regional methodology also has an advantage over firm-level observations. The sub-regional approach can capture intra-industry trade at the level of industry clusters in cities, while the firm-level approach may miss, for example, a trade flow passing through another subsidiary before reaching the final parent firm.

<sup>2</sup> It should be noted that vertical specialization need not take the form of using imported inputs from the *same* industry as the one for the final exports. Thus, the implications of vertical specialization have a narrower scope when one uses sub-regional intra-industry trade indices, as we do in this paper. We thank an anonymous referee for pointing this out.

<sup>3</sup> These 41 prefectures are Aichi, Akita, Aomori, Chiba, Ehime, Fukui, Fukuoka, Fukushima, Hiroshima, Hokkaido, Hyogo, Ibaragi, Ishikawa, Iwate, Kagawa, Kagoshima, Kanagawa, Kochi, Kumamoto, Kyoto, Mie, Miyagi, Miyazaki, Nagasaki, Niigata, Oita, Okayama, Okinawa, Osaka, Saga, Shiga, Shimane, Shizuoka, Tochigi, Tokushima, Tokyo, Tottori, Toyama, Wakayama, Yamagata and Yamaguchi.

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