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# Determinants of Trade in Parts and Components: An Empirical Analysis

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## Abstract

The rapid rise of trade in part of components –in the context of an increasingly important global production chain – is a key future of Asia's economic miracle. This paper aims at analyzing empirically what are key determinants of trade in parts and components. The focus is Latin America and Asia so as to draw relevant lesson for the former to the latter. The success keys of Greater China and Mexico, within the Latin American region could, thus, be explained, at least partially by identifying such key determinants. Our results show that the size of the economy (GDP), human capital, labor costs and the institutional/infrastructural framework have played in enabling regions to develop their comparative advantages of trade in parts and components.

Keywords: International Trade, Production Networks, Trade in Parts and Components, Institutional Framework, Infrastructural Framework.

JEL: F10, F12, F15, F16.

# 1 Introduction

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Production networks or supply chains can be measured in various ways. A relatively direct and internationally consistent way to do so is to isolate trade in parts and components using international trade statistics. This allows us to compare and focus on some characteristics of production fragmentation over many years and involving many countries. In this paper, we will examine characteristics, trends and the main determinants of international trade in parts and components.

World trade grew more than twice as fast as Gross Domestic Product (GDP) in the last decade. Exports from developing countries also outpaced those from high-income countries. Much of this expansion and diversification in trade has been linked to the global fragmentation of production, especially in Asia and Latin America. Global production sharing in manufacturing has reached more than US\$ 2 trillion every year since 2000, or more than 30 percent of total world trade in manufactured products. Trade in parts and components, or intermediate goods, was growing faster than trade in other finished goods, emphasizing the increased importance of international trade and production networks (Yeats, 2001)<sup>1</sup>.

This paper examines the exports and imports of parts and components in production networks, and the importance of an efficient international transportation system, as well as customs and internal logistics in various countries. The pattern of successful growth is increasingly linked to production fragmentation and networks, whereby countries source components, or even whole stages of production, to countries with a comparative advantage both in terms of cost and productivity. China, India and Mexico have become production hubs for Asia and Latin America, but how did this regional and global trade balance evolve and why?

South Asia is still at an early stage of development in terms of its production network, while the production network of Mexico has its two-way trade focused more with the United States, with relatively little trade in parts and components with the rest of Latin America. Nonetheless, we think an examination of the two regions (Latin America and Asia) can provide us with comprehensive insights concerning networks that are at different stages of development.

In this paper we will examine the trends, characteristics and determinants of the trade and production networks of East Asia (China, Indonesia, Hong Kong, Japan, Malaysia, Mongolia, Philippines, Taiwan, Singapore, South Korea, Thailand and Vietnam) and Latin America (Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela). These regions contain some of the most dynamic developing economies, so economic integration via trade in parts and components is critically important to help us understand the economics and future development of these countries.

We have several objectives for this study. First of all, we would like to provide more insight into the regional and global implications of trade and production networks in developing countries from these regions. How important are the factors contributing to production networks in regional integration and operations, such as infrastructure, labor costs, human capital, and the quality of institutions?

To utilize proxies of “production networks”, we can use the measure of total trade of parts and components suggested by Ng and Yeats (2001). Using these proxies for each country, we then select determinants such as indices of the quality of institutions, the indices of the quality of infrastructure, proxies for labor costs and the extent of human capital and see if these determinants have significant impact on the extent of participation in the network.

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1: For details, see Yeats, A (2001), “Just How Big is Global Production Sharing?” Chapter 7 in *Fragmentation: New Production Pattern in the World Economy*, edited by S. Arndt and H. Kierzkowski, Oxford University Press.

This research can be expanded to include case studies examining the development of production networks of some developing countries. For example, in electronics, Taiwan has a long history of sub-contracting relationship with companies in Silicon Valley, California. Since the late 1990s, Taiwanese technology firms have increasingly moved their production facilities to Mainland China, thus linking Mainland China, Taiwan and California into a global electronics supply network. In the case of Singapore, a variety of tax incentives have been used for well over a decade to attract high-tech foreign multinationals to the Island country, making Singapore a transnational hub for electronics, pharmaceutical and bio-technology production. Mexico has also deepened its production linkages with U.S. firms, particularly in the automotive sector.

In the section 2, we will briefly examine the trends and characteristics of production sharing in Latin America and East Asia. In addition, we will provide a literature review of trade in parts and components or production networks. In Section 3, we provide our empirical analysis. In the last section we conclude.

## 2 A Survey of the Academic Literature and Characteristics of Trade in Parts and Components in Latin America and East Asia

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In this section, we first provide a selective survey of the academic literature. There is a broad agreement that except for the recent Great Recession, growth in world trade has far outpaced the growth in global output. Yi (2003) makes a strong case that only by studying production fragmentation can we account for the recent rapid growth in world trade. The splitting of the production process leads to products crossing borders many more times than in ordinary trade, giving rise to a sharp increase in the growth of global trade. Jones and Kierzkowski (2001) demonstrate that production fragmentation now gives countries an opportunity to specialize even within a single product, in different stages of producing that product. Yet, those stages are likely to be allocated in a way that reflects the comparative advantage of each country. Yi (2003), Deardorff (2001) and Jones and Kierzkowski (2001) discuss the fact that gains from trade may be enlarged as a result of trade fragmentation. Globally, the gains from trade should be larger, as more finely defined production processes can be allocated across countries more efficiently. But even within countries, trade liberalization may also lead to lower adjustment costs for workers who may be displaced, since the affected workers may only have to move from one stage of production to the next in the whole production chain.<sup>2</sup> The transition from one stage of production to the next one should in general be easier than the transition from one sector to a totally different sector.

In both the academic and policy literature, there are many papers that investigate these important phenomena.<sup>3</sup> Some recent theoretical studies build new models to explain the firm's decision to fragment the production process due to incomplete contracts (e.g., Antras, 2005; Antras and Helpman, 2004; Grossman and Helpman, 2004, 2005; McLaren, 2000). A few studies attempt to test these theories, (e.g., Antras, 2003; Feenstra and Hanson, 2005; Feenstra and Spencer, 2005), while others attempt to measure the extent of trade fragmentation (Yi, 2003; Hummels, Ishii and Yi, 2001; Athukorala, 2005; Ng and Yeats, 2001; Arndt and Kierzkowski, 2001). In addition, there is also a large and growing literature on the examination of the character of one important example of trade in parts and components: the case of China. Some of the recent studies include Dean, Lovely and Wang (2006), Wang (2003), Schott (2005), Rodrik (2006), Hammer (2006), Amiti and Javorcik (2005).

Next we briefly examine the trends and characteristics of trade in parts and components in Latin America and East Asia. Although there is no such thing as a Free Trade Area in Latin America, we use the Latin American Association for Integration (ALADI) as a benchmark to choose the countries of reference for this analysis. ALADI is currently composed of Argentina, Bolivia, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. We include all of them in our analysis except Cuba due to the distortions related to US sanctions. ALADI's total goods trade was \$1500 billion in 2010. Manufactured exports accounted for 63.3% of ALADI's intra-group exports and 38.7% of ALADI's exports to rest-of-world in 2010. Parts of telecommunication equipment (SITC 764) and parts of motor vehicles and accessories (SITC 784) are both the largest importing and exporting sectors of ALADI. With respect to the geographical distribution of ALADI's parts and components trade, North American Free Trade Area (NAFTA) countries are the most important sources and destinations of ALADI's parts and components trade. Among the NAFTA countries, the United States is the single largest trading partner of ALADI. The United States accounted for

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2: Deardorff (2005) argued that in a world of trade fragmentation, the gains from trade result will likely hold. However, it is unclear if some factors of production like unskilled workers may or may not be hurt by fragmentation. For an examination of offshoring of white-collar services, see also Markusen (2005).

3: For an excellent recent survey on international outsourcing/fragmentation, see Spencer (2005).

66.9% of ALADI's parts and components exports and 26.6% of its parts and components imports in 2010. However, ALADI's parts and components imports from Europe and Central Asia declined between 1990 and 2010, so did those from NAFTA between 2000 and 2010. There seems to be a tendency for ALADI's parts and components imports from Europe and Central Asia and NAFTA to be displaced by imports from Greater China (China, Hong Kong and Taiwan) and East Asia, particularly after 2000. This indicates the growing importance of an emerging manufacturing network between Greater China and East Asia and Latin America.

Shifting our focus to Asia, it seems that Greater China has developed a close trading relationship with East Asian economies, including the three Greater China economies. East Asian economies here include Indonesia, Japan, South Korea, Malaysia, Mongolia, Philippines, Singapore, Thailand and Vietnam. The volume of trade among these 12 (mostly) small East Asian economies exceeds those between Greater China and NAFTA, and between Greater China and EU 27. The importance of the East Asian economies in Greater China's manufacturing production can be highlighted by the fact that Greater China and East Asian economies are the primary sources of Greater China's parts and components imports, representing more than 75% of Greater China's imports since 1990. Europe and Central Asia and NAFTA countries, however, account for about 20% of Greater China's parts and components imports only. On the exports side, while the three Greater China economies are the largest destinations of their own parts and components exports, East Asian, NAFTA, European and Central Asian countries are also major exporting markets of Greater China's parts and components. East Asia, NAFTA, and Europe and Central Asia each accounts for 10% to 20% of Greater China's parts and components exports. Moreover Greater China's parts and components exports to Europe and Central Asia, ALADI, Middle East and North Africa, and South Asia have increased continuously since 1990, whereas exports to NAFTA declined significantly between 2000 and 2010. This tends to indicate that Greater China has successfully explored new export destinations and North America is no longer Greater China's largest export market outside Asia Pacific.

### 3 Empirical Analysis

In this section we will present our empirical results. We would like to find out the factors that determine trade in parts and components. We use data of trade in parts and components for 26 countries from 1990 to 2010. The criterion for selecting parts and components from the COMTRADE data is based on Ng and Yeats (2001). For explanatory variables, we select the following based on our survey of the academic literature. First, the size of the economy involved. As discussed before, a larger economy may signify a “thicker” market for suppliers and manufacturers to match up, facilitating the supply chain businesses. We expect the size of the economy, as approximated by GDP to be positively related to trade in parts and components. Second, we have labor market variables. Participation in the production network may require higher quality of labor. This can be approximated by a measure of human capital. In addition, we also need a measure of wages in the manufacturing sectors. Unlike the human capital measure, wages may have conflicting effects on trade in parts and components. A lower wage lowers the cost of production and can increase the extent of the production network. But a higher wage may also represent a higher quality of labor, increasing trade in parts and components. Lastly we need several proxies of the quality of institutions/infrastructure. Here we use five indices to measure the ease of conducting trade in parts and components. The first one is “Trading Across Border”. This indicator measures the time and cost (excluding tariffs) associated with exporting and importing by sea transport, and the number of documents necessary to complete the transaction. The index covers documentation requirements and procedures at customs and other regulatory agencies as well as at the port. It also cover logistical aspects, including the time and cost of inland transport between the largest business city and the main port used by traders. The second measure of the quality of institution/infrastructure is “Burden of Customs Procedures”. It measures the country's efficiency of handling customs procedures. The third measure is the “Shipping Connectivity Index”, which indicates how well countries are connected to global shipping networks based on the status of their maritime transport sector. The fourth measure is “Quality of Port Infrastructure”, which measures business perceptions of the quality of the country's port facilities. The last measure of the quality of the institution/infrastructure is the “Logistics Performance Index”. Its overall index reflects perceptions of a country's logistics based on efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time. From these indices, we constructed the following dummies to be used in our analysis:

Table 1

**List of institutional and infrastructure dummy variables**

Dummy variable	Indicator	benchmark	Interpretation	Expected sign
Dummy1	Trading across Border	1 if value ≤ 250; 0 otherwise	Dummy=1 means “relatively efficient”	+
Dummy2	Burden of customs procedure	1 if value ≥ 4; 0 otherwise	Dummy=1 means “relatively efficient”	+
Dummy3	Shipping connectivity index	1 if value ≥ 42; 0 otherwise	Dummy=1 means “relatively efficient”	+
Dummy4	Quality of port infrastructure	1 if value ≥ 4; 0 otherwise	Dummy=1 means “relatively high quality”	+
Dummy5	Logistics performance index	1 if value ≥ 3; 0 otherwise	Dummy=1 means “relatively high performance”	+

Thus our explanatory variables for trade in parts and components are: size of the economy GDP (expected sign positive), human capital as proxied by percent of population completed secondary school S (expected sign positive), labor cost as measured by manufacturing wage W (expected sign can be positive or negative) and the institutional/infrastructure dummies 1 to 5 (expected signs all positive). We ran the regressions for both exports and imports of trade in parts and components separately.

For exports, GDP has a positive and significant impact on the extent of trade in parts and components. This seems to confirm the “thickness” of suppliers hypothesis. Human capital has a positive and significant effect as well. In addition, higher manufacturing wages are positively and significantly related to exports of parts and components. Results related to the labor market determinants seem to indicate that quality of labor is very important to the exports of intermediates. Lower wages do not seem to lead to more participation in the supply chains. For the dummies, all five are positively related to exports of parts and components. But only Dummy 1 (Trading Across Border) and Dummy 5 (Logistics Performance Index) are significant. This indicates that while broadly speaking, hard and soft infrastructure qualities are important in encouraging the involvement of the production network, for policymakers and businesses, a more nuanced and selective look is necessary to facilitate such trade.

Next we examine imports of parts and components. From a purely economic standpoint, researchers are less concerned whether a country is involved in exports or imports of parts. The important aspect is the participation in the network. However, for political-economic reasons, policymakers may favor the encouragement of exports more than imports. Such proposed policies may not have strong economic logic, but it may be worthwhile to at least examine this from the perspective of policymakers and businesses. It turns out that the significant determinants for imports of parts and components are the same as exports of parts and components. They are GDP (positive and significant), human capital (positive and significant), wages (positive and significant) and Dummy 1 (Trading Across Border) and Dummy 5 (Logistics Performance Index) are both positive and significant. It is comforting that for both the exports and imports sides of the production networks, the same factors explain their extent.

After concluding our analysis on the determinants of trade in parts and components, the next logical question to ask was: How does trade in parts and components differ from trade in all goods?

We re-ran our models but now focusing on explaining trade in all goods for the same countries and same time periods. Interestingly, there are indeed differences. For both exports and imports of all goods, GDP is positive and significant. Human capital is also positive and significant. For the dummies, as in the case for trade in parts and components, Dummy 1 and Dummy 5 are positive and significant. However, Dummy 2 (Burden of Customs Procedure) is now positive and significant. But wages are no longer significant.

From our regression results, we have three potential implications. First, both exports and imports of parts and components are positively and significantly related to the size of the economy as well as the quality of labor. Second, infrastructure and institutional qualities matter. Third, trade in parts and components are at least somewhat different from trade in all goods. Trade in parts and components are much more sensitive to the quality of labor (with both W and S significant and positive). In addition, the extent of the production network is responsive to a narrower subsets of measures of quality of infrastructure/institutions (Dummy 1 and 5 and not the rest).



## 4 Conclusion

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In this paper, we examine the characteristics and trends of trade in parts and components in Latin America and East Asia. We also perform regressions related to the determinants of trade in parts and components.

From our regressions, we find that for both exports and imports of parts and components, the positive and significant variables are the size of the economy, quality of labor (human capital and wages) and selective aspects of infrastructure/institution (trading across border index and logistics performance index). Furthermore, we find that trade in parts and components have somewhat different determinants compared to trade in all goods. Trade in parts and components are responsive only to a smaller group of institutional and infrastructure measures. In addition, the quality of labor is more important to trade in parts and components than to trade in all goods. This argues for much more nuanced and judiciously selected policies when one is thinking about encouraging more involvement in the production network.

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