

Banco Central de Chile  
Documentos de Trabajo

Central Bank of Chile  
Working Papers

N° 426

Agosto 2007

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Documentos de Trabajo del Banco Central de Chile  
Working Papers of the Central Bank of Chile  
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## **ON THE SOURCES OF CHINA'S EXPORT GROWTH**

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### **Resumen**

En este trabajo se utiliza detallada información de exportaciones de China a Chile durante el período 1990-2005 para analizar las fuentes del crecimiento exportador de esta economía. China exporta una gran variedad de productos. Sin embargo, el crecimiento de sus exportaciones es explicado principalmente por un aumento de los productos que exporta en común con el resto del mundo (margen intensivo), y no por un aumento de las variedades de productos exportados (margen extensivo). Sorprendentemente, se encuentra que el crecimiento en el margen intensivo es explicado por un aumento en cantidades exportadas, sin que ello haya significado una caída significativa en el precio relativo de las variedades exportadas por China. Esta aparente paradoja sugiere que un aumento en el número no observado de variedades o un aumento en la disposición a pagar por productos chinos es la principal causa de su crecimiento exportador. Este trabajo presenta evidencia respecto al comportamiento de los precios de los bienes exportados por China, la similitud de sus exportaciones con países desarrollados y la evolución de la calidad relativa de sus productos para concluir que la mejora en la calidad de los productos chinos es una dimensión importante de su crecimiento exportador.

### **Abstract**

We use detailed data on Chilean imports between 1990 and 2005 to analyze the causes of China's import penetration relative to other countries. China exports a wide variety of products. The growth in China's exports, however, is mainly driven by an increase in import penetration within common product categories with the rest of the world—the intensive margin—rather than by an increase in the number of product varieties exported—the extensive margin. Surprisingly, the growth in the intensive margin is explained by an increase in exported quantities without a significant fall in the relative price of Chinese varieties. This apparent paradox suggests that an increase in either the number of unobserved varieties or the willingness to pay for Chinese products—an increase in the relative quality of Chinese products—is the driving force behind China's export performance. We present evidence regarding China's export prices, the similarity of China's export bundle to that of developed countries, and the relative quality of Chinese products, to conclude that improvements in the quality of Chinese products is an important dimension of Chinese export growth.

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We thank Álvaro García for assistance and Consuelo Edwards for editing this article. Sebastián Claro acknowledges the financial support from Fundación Andes through grant 14-060-9. E-mail: [ralvarez@bcentral.cl](mailto:ralvarez@bcentral.cl); [sclaro@facepuc.cl](mailto:sclaro@facepuc.cl).

## 1. Introduction

After several decades of autarky, Chinese exports have grown vigorously—especially since the 1990s—to become one of the most important trading partners in the world. This phenomenon has generated growing literature to analyze the potential impact of Chinese competition on third countries, especially in labor-intensive industries where China's exports are dominant. Although there are some descriptive and illustrative works discussing the potential impact of China (Devlin et al., 2006; Blásquez-Lidoy et al., 2006), only few papers have studied this phenomenon in detail. Some papers have focused on the impact on other Asian countries' exports (Eichengreen et al., 2004) while others have analyzed the effects on Latin American exports in a third market (López Córdova et al., 2005 and 2006). There is also some recent works on the potential effects of Chinese imports' competition on domestic industries. Alvarez and Claro (2007) study whether Chilean manufacturing plants have been negatively affected by Chinese competition or they have been able to adjust through changes in product mix and exports.<sup>1</sup> Contrary to the evidence of Bernard et al. (2006), who show that US manufacturing firms have escaped from import competition of low-wage countries through quality upgrading, the evidence for Chile suggests that room for upgrading is much smaller, meaning that domestic firms have shrunk in response to low-wage import competition.

However, a detailed study of the impact of Chinese competition on other economies requires an analysis of the characteristics of Chinese products. In other words, we do not have a complete and broad view of the characteristics of China's exports, which is crucial

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<sup>1</sup> See also Castro et al. (2007), for an empirical study of the impact of Chinese and Indian imports on manufacturing employment in Argentina.

to have a good understanding of the potential effects of Chinese exports on world markets. There is evidence that China's exports are higher in labor-intensive sectors, which is consistent with traditional endowment-based trade theory (see Leamer, 1995). There is, however, much less information regarding product heterogeneity within industries, like price and quality differences. Recently, the trade literature has emphasized that factor endowment differences can lead not only to cross-industry specialization but also to within-product specialization. For example, using imports data from the United States, Rodrik (2006) and Schott (2006) have shown that China's exports may be relatively more and less sophisticated compared to exports of other countries with similar factor endowments, depending on the metric used to compare exports sophistication. Branstetter and Lardy (2006) argue that the evidence of relatively high sophistication of Chinese exports, like in Rodrik (2006), does not take into account that China imports high-value-added parts and components, suggesting that after controlling for the structure of intermediate inputs, China's export structure reflects low costs of labor-intensive assembly. Our paper is an effort to analyze the characteristics of Chinese competition in developing countries, using highly-disaggregated data of Chilean imports between 1990 and 2005. We focus on within-industry heterogeneity in order to distinguish the characteristics of Chinese products vis-à-vis the rest of the world.

This paper is structured as follows. In section 2, we use the methodology developed by Hummels and Klenow (2005) to decompose import growth into two different margins: imports in common product categories from China and the rest of the world (intensive margin), and imports in different product categories (extensive margin). This distinction allows us to study the extent to which China's import penetration in Chile relative to the

rest of the world is due to an increase in the set of products produced and exported from China or rather to higher penetration in common product categories. We also decompose the intensive margin into price and quantity margins to distinguish whether within-industry import differences are due to price differences and/or quantity differences. In section 3, we analyze the relative sophistication of Chinese exports by comparing cross-country differences in export prices. Following the idea that prices may reflect—albeit imperfectly—the quality of goods, we estimate price differentials between China and the rest of the world, and analyze whether there are systematic differences in export prices. In section 4, we analyze quality differences more deeply. We compare China’s export basket to Chile with that of other exporters—especially OECD countries—and we report some results regarding quality differentials between Chinese varieties and those from the rest of the world. In section 5 we summarize our findings and conclude.

## 2. The Intensive and Extensive Margins of Chinese Exports

### 2.1 Data Source

The data is obtained from Chile’s Customs office, and it comprises all import entries at the 8-digit HS level (4815 categories in 1990 and 6702 in 2005).<sup>2</sup> For each product, we have data for China and all other exporting countries on the CIF dollar value of imports and the quantity imported. We denote China with the subscript  $c$ , and the rest of the world by subscript  $r$ . Therefore, unitary import prices from country  $c$  in product  $j$ , defined at the 8-digit level, are computed as  $P_{cjt} = (M_{cjt} / X_{cjt})$ , where  $M_{cjt}$  is the CIF value of imports (in current US dollars) from country  $c$  in product  $j$  in year  $t$ , and  $X_{cjt}$

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<sup>2</sup> Throughout this paper, we refer to a product as an 8-digit level category.

is the quantity imported (i.e., pairs of shoes, pounds of folic acid, meters of carpets, etc.)

Table 1 reports a summary of the data.

We observe a significant increase not only in imports from China but also in China's market share. In 1990, China accounted for only 0.8% of total Chilean imports, and by 2005 this number had climbed to 8.5%, which represents an annual growth rate of 16.9%. These numbers coincide with the increase in China's total export growth in the same period (18% annually). The increase in the value of imports from China is accompanied by an increase in the number of 8-digit level products imported from China. The share of products that Chile imports from China rose from 21.5% in 1990 to 59.6% in 2005.

## 2.2 Export Margins

Based upon the work of Hummels and Klenow (2005), we analyze the structure of imports coming from China ( $c$ ) and ROW ( $r$ ). Import penetration of country  $c$  relative to country  $r$  is expressed as the Overall Share  $S$ , which is the ratio of total imports from  $c$  and  $r$ :

$$S_t = \frac{M_{ct}}{M_{rt}} = \frac{\sum_{j \in N_{ct}} M_{cjt}}{\sum_{j \in N_{rt}} M_{rjt}}, \quad (1)$$

where  $M_{ct}$  denotes total imports from country  $c$  in period  $t$ , and  $M_{rt}$  represents total imports from  $r$ .  $M_{ct}$  is equal to the sum of imports across all 8-digit product categories  $j$  in which  $c$  is present, denoted by  $N_{ct}$ . Likewise,  $N_{rt}$  stands for 8-digit products with positive imports from  $r$  in period  $t$ .

The Overall Share  $S_t$  can be expressed as the product of two components: the Extensive Margin and the Intensive Margin. Intuitively, the ratio of imports from  $c$  to  $r$  depends on the number of products  $j$  imported from each country and the average value of imports within common product categories. For example,  $c$ 's imports could be lower than  $r$ 's either because  $c$  exports fewer product categories than  $r$  or because imports from  $c$  are lower than imports from  $r$  within common categories. Analytically, the overall share in period  $t$  can be written as:

$$S_t = \frac{\sum_{j \in N_{ct}} M_{rjt}}{\sum_{j \in N_r} M_{rjt}} \cdot \frac{\sum_{j \in N_{ct}} M_{cjt}}{\sum_{j \in N_{ct}} M_{rjt}} = E_t \cdot I_t. \quad (2)$$

The Extensive Margin  $E_t$  measures the percentage of imports from  $r$  that is subject to direct competition from Chinese products, that is, the ratio of total imports from  $r$  in categories where  $c$  is present to total imports from  $r$ . The Intensive Margin  $I_t$  compares imports from  $c$  and  $r$  within common product categories; those imported from  $c$  (i.e.,  $N_{ct}$ ), and it can be further decomposed into a Quantity index and a Price index. Within the common set of products, the value of imports from  $c$  and  $r$  may differ because of differences in unit prices or because of differences in quantities imported. The Price index measures the (weighted) average ratio of  $c$  to  $r$  unit prices at each 8-digit level product  $j$ , where the weights are the shares of each product category in total imports of common categories. The Quantity index also weights the ratio of import quantities within each product according to their share in total imports. Analytically<sup>3</sup>:

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<sup>3</sup> See Sato (1976), Feenstra (1994), Hummels and Klenow (2005) and Broda and Weinstein (2006).



$$I_t = P_t \cdot X_t, \quad (3)$$

where  $P_t = \prod_{j \in N_{ct}} (p_{cjt} / p_{rjt})^{\omega_{jt}}$  and  $X_t = \prod_{j \in N_{ct}} (X_{cjt} / X_{rjt})^{\omega_{jt}}$ .  $p_{cjt}$  and  $p_{rjt}$  are CIF unit

prices and  $X_{cjt}$  and  $X_{rjt}$  are imported quantities of product  $j$  from  $c$  and  $r$ ,

respectively, and  $\omega_{jt} = \left( \frac{\phi_{cjt} - \phi_{rjt}}{\ln \phi_{cjt} - \ln \phi_{rjt}} \right) / \sum_{j \in N_{ct}} \frac{\phi_{cjt} - \phi_{rjt}}{\ln \phi_{cjt} - \ln \phi_{rjt}}$  is the logarithmic mean of

$\phi_{cjt}$  and  $\phi_{rjt}$  (the share of product  $j \in N_{ct}$  in total imports from  $c$  and  $r$ , respectively).

At the 8-digit level,  $P_{ct}$  is the ratio of  $c$  to  $r$  unit prices, and  $X_{ct}$  is the ratio of import quantities. At the aggregate level,  $P_{ct}$  and  $X_{ct}$  are weighted averages of 8-digit-level price and quantity ratios.

Table 2 reports the Overall Share  $S_t$ , the Extensive Margin  $E_t$ , the Intensive Margin  $I_t$ , the Price index  $P_t$  and the Quantity Index  $X_t$  computed for each year between 1990 and 2005. The Overall Share increased from 0.8% in 1990 to 9.3% in 2005, with an annual growth rate of 17.6%. In 2005,  $S_t$  is the product of an Extensive Margin of 47.8% and an Intensive Margin of 19.4%, meaning that almost 50% of  $r$ 's imports were subject to direct competition from Chinese products, and that the value of imports from China was almost 20% that of  $r$ 's within common categories. The Intensive Margin results from an average ratio of unit prices of 53% and an average ratio of import quantities of 36.5%. These margins are relatively similar to those computed by Hummels and Klenow (2005) for China's penetration in the U.S market in 1995:  $S = 9.3\%$ ,  $E = 70.4\%$ ,  $I = 13.3\%$ ,  $P = 56.3\%$  and  $X = 23.6\%$ .

Several elements of the evolution of these margins are interesting. The overall share increases continuously throughout the period. The extensive margin grows in the 1990s but it stagnates in 2000 at about 48%. In contrast, there is continuous increase in the intensive margin (see Figure 1). Figure 2 shows that the rise in the intensive margin results mainly from an increase in the quantity index—with an average annual rate of growth of 15.6%—and a fall in the price index, which fluctuates between 59.4% and 53.0% with an average rate of growth of -0.8%. Overall, these numbers are similar to those for the United States in the same period. For example, data from the U.S Census Bureau reveals that the Overall Share of China's imports to the United States grew at an annual rate of 12% between 1990 and 2005. Also, data on U.S imports from Feenstra et al. (2002) at the 2-digit level reveals that the largest part of the growth in China's import penetration in the United States is explained by the growth in the Intensive Margin. This data also shows that the price index of Chinese imports fell at an annual rate of 1.3% between 1990 and 2001.

These figures suggest two puzzles. First, while Chinese varieties are significantly cheaper than those from the rest of world, consumption of Chinese products is relatively small. Therefore, elements other than—or in addition to—relative prices explain consumption patterns. Second, the evidence that the increase in China's quantity penetration has been achieved without a significant drop in its relative product prices also points to the hypothesis that features other than the evolution of relative prices explaining the growth in imports from China. There are at least two possible explanations for these phenomena. One possibility is that there is heterogeneity across products even within highly disaggregated product categories (i.e., 8-digit HS level), meaning that countries

produce different numbers of varieties of each product. If consumers have preferences for varieties, imports are higher from countries that produce more varieties. Alternatively, there might be differences in the quality of varieties or in the willingness to pay for varieties from different sources, which explains the different demand for products within the same 8-digit category. In other words, it is possible that China offers a low number of varieties of each product or that the quality of its products is relatively low compared to products from the rest of the world. At the same time, it is possible that the increase in quantity penetration is due to more varieties being produced in China or to quality improvements. Alvarez and Claro (2006a) address this issue in detail.

### **3. The Price of Chinese Exports and Within-Product Specialization**

The empirical literature dealing with international trade has typically used broad industry aggregates to study the determinants of international specialization (see, for example, Leamer, 1987, Harrigan 1997). In two recent papers, however, Schott (2003, 2004) has shown that traditional classifications in international trade hide significant differences in the way countries specialize. Consistently with factor-endowment-based theory of comparative advantage, we expect China to specialize in labor-intensive industries. Nevertheless, specialization could not only occur across industries, but also within industries and even within narrowly-defined products. Using disaggregated information for product defined to 10-digit of the Harmonized System, Schott (2004) shows that product prices differ significantly according to income and factor endowments. Rich countries (relatively more abundant in physical and human capital) specialize in high-priced products, which use their abundant factors more intensively.

We test this hypothesis using Chilean imports data. In particular, we first show evidence of systematic relationship between import prices and exporter's income, and analyze how Chinese product prices compare to those of countries with similar income per capita. We use highly-disaggregated 8-digit Harmonized System (HS) import data from all importing countries during the period 1990-2005 from Chilean Customs. We compute the price for each product as unit value: imports in dollars over imported quantity.

We first estimate the following equation<sup>4</sup>:

$$\text{Log}P_{jit} = \alpha_{jt} + \delta \cdot \text{Log}I_{it} + \varepsilon_{jit} \quad (1)$$

where  $P_{jit}$  is unit value (in dollars) of imports from country  $i$  in 8-digit product  $j$  in year and  $I_{it}$  is per capita GDP in PPP for the exporter country  $i$ . Product-year fixed effects are denoted by  $\alpha_{jt}$ . The parameter  $\delta$  of interest is expected to be positive, which is consistent with the idea that richer countries specialize in high-priced goods. The results confirm the hypothesis of within-product specialization (Table 3). The parameter  $\delta$  in column (1) is estimated to be 0.24, meaning that a 10 percent increase in per capita income is associated with a 2.4 percent increase in product prices. In column (2) we get a similar result using a restricted sample of product imported from both low and high income countries<sup>5</sup>.

In Alvarez and Claro (2006b), using a sample of 44 exporting countries for the period 1990-2003, we estimate equation (1) for each of 80 manufacturing industries at 4-digit

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<sup>4</sup> We also include year-fixed effects for controlling for shocks that are common across products imported from different countries.

<sup>5</sup> Low-income countries are those with income per capita lower than that of 30% of countries in the sample, and high-income countries are those with income per capita higher than that of 70% of countries in the sample. Per capita GDP in PPP is taken from World Development Indicators.

ISIC to check whether the estimated coefficient varies across industries. The results are fairly consistent with the idea that richer countries receive higher prices for their exports across all sectors. In 65 out of 80 industries (81.3% of the manufacturing industries) the estimated parameter is positive and significant (at 5%), and only for one industry the parameter is negative but not significant.

We estimate a different version of equation (1) to analyze whether Chinese import prices differ from those of other countries after controlling for income per capita. The specification used is:

$$\text{Log}P_{jit} = \alpha_{jt} + \beta \cdot \text{CHN} + \delta \cdot \log I_{it} + \varepsilon_{jit} \quad (2)$$

In equation (2), CHN is a dummy variable for products imported from China. We are particularly interested in testing if  $\beta$  is negative or positive. In the case that  $\beta$  is negative we conclude that China's products are cheaper than those of countries with similar per capita income. The results are shown in the third and fourth columns of Table 3. We find that imports from China receive a price that is—on average—28.6 and 31.9 percent lower than that of countries at similar development stages. The evidence that Chinese products are relatively cheap, even compared to countries with similar income is consistent with that from Schott (2006), who shows that, during the 1990s, Chinese products on average sold for a discount relative to products of countries with similar GDP per capita in the United States.<sup>6</sup>

We also analyze how the China coefficient has changed over time. Columns (5) and (6) report the evidence of estimating equation (2) including an interaction term between

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<sup>6</sup> He also provides evidence that the number of product categories exported from China to the United States is significantly larger than those of countries at similar stages of development. This explains why he argues that China's exports are relatively sophisticated compared to those of countries with similar income.

the dummy for China and period-specific dummy variables for the period 1990-1995, 1996-2000 and 2001-2005. Our results show no evidence of a statistical price difference, after controlling for income, for the period 1990-1995, and weak evidence for the period 1996-2000. However, there is significant evidence that Chinese prices have declined relative to countries with similar income per capita in the period 2001-2005. This evidence is robust if we restrict the sample to include only products imported from low- and high-income economies.<sup>7</sup>

In sum, we have found evidence of within-product specialization, in the sense that income per capita differences are associated with differences in product prices within highly-disaggregated product categories, which presumably reflect cross-country differences in the types of varieties produced in response to differences in technology and factor abundance. In particular, price differences are highly correlated with income per capita of the exporter's country, and products imported from China are low priced compared to those of countries with similar income per capita. Finally, we also find that the prices of Chinese products have declined relative to those from the rest of the world since the mid 1990s. However, this decline is relatively small, suggesting that elements other than relative prices explain China's export growth.

#### **4. Quality Dimensions of Chinese Exports**

In this section, we analyze the relative sophistication (or quality) of Chinese exports in two dimensions. First, we look at China's export basket compared to that of developed economies. Second, we present some evidence regarding quality differences between

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<sup>7</sup> For both specifications, the null hypothesis that China's coefficient is the same in 1995-2000 and 2001-2005 is rejected at 1% of significance.

varieties of China and the rest of the world. The idea is to search for direct or indirect evidence supporting the hypothesis that there has been an increase in quality or willingness to pay for Chinese products relative to the rest of the world.

#### 4.1 Similarity of Export Baskets

A first measure of an increase in the quality of Chinese products is obtained by comparing China's export basket to that of other countries, especially developed economies. Following Rodrik (2006) and Schott (2006), we conjecture that China's export mix has become more sophisticated over time if it has become more similar to that of developed countries. We measure the similarity of export baskets using an index developed by Finger and Kreinin (1979). For any two exporters, say China ( $c$ ) and other country ( $i$ ), the export similarity index in Chile is given by:

$$\text{SIM}_{\text{cit}} = \sum_j \min(s_{jct}, s_{jit}), \quad (3)$$

where  $j$  is an 8-digit level product category,  $s_{jct}$  is the share of product  $j$  in total Chinese exports to Chile in year  $t$ , and  $s_{jit}$  is the share of product  $j$  in total exports of country  $i$  to Chile in year  $t$ . This bilateral measure is bounded by zero (if there are no common product categories between China and country  $i$ ) and one (if the share of each product in total exports is identical in both countries). To illustrate how Chinese exports perform relative to countries at different development stages, we compare export similarity of China with three groups of countries: Asia, Latin America, and OECD.<sup>8</sup>

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<sup>8</sup> While grouping countries, we sum exports over countries in the group and then use group-level rather than individual export shares for computing the similarity index.

The results are shown in Figure 3. Comparing the three groups of countries, we find that China's export bundle resembles more that of other Asian countries than those of Latin American and OECD countries. This is true at the beginning and at the end of the period. Interestingly, there is convergence in the Export Similarity index between China and OECD countries over time. In fact, the index went from 0.121 in 1990 to 0.182 in 2005. Although there is also some convergence with the export structure of Asian and Latin American economies, this trend is significantly higher with OECD countries. In fact, the increase in the similarity index with OECD is 50.4% between 1990 and 2005, while it is only 31.5% with Latin American countries, and 29.6% with Asian countries. In sum, Chinese exports have tended to be more similar over time with high-income countries than with countries in Latin America and Asia.

We also compare China's export similarity in relation with individual developing countries. In Table 4, we show a sample of twenty Asian and Latin American countries with the highest export similarity to the OECD countries. China has been one of the top five countries in this ranking in both 1990 and 2005, meaning that it has a high degree of similarity with OECD countries among developing economies. In Figure 4, we show the performance of China for the entire sample. With the exception of 2002, where it was ranked 7<sup>th</sup>, China has been most of the time between the 5<sup>th</sup> and the 6<sup>th</sup> place of countries with higher export similarity to OECD. This result corroborates Rodrik's (2006) evidence that China has a sophisticated export mix given its level of income per capita, because a high share of its exports corresponds to products mainly exported by high-income countries.



The evidence that China's export similarity with OECD countries is one of the highest among developing countries, and that the similarity has increased significantly in the last 15 years, suggests some kind of increasing sophistication of Chinese exports.<sup>9</sup> This can be understood as indirect evidence that the quality of Chinese varieties has improved over time. This link is weak in several dimensions, however. On the one hand, as discussed by Branstetter and Lardy (2006), the Chinese export mix does not take into account that China imports high-value-added intermediate inputs, meaning that China should be judged in terms of the value added of the export basket, which is highly intensive in labor. Another issue is that the link between export sophistication and the export similarity index with OECD countries implicitly assumes that products are homogeneous. In other words, it assumes that varieties within each product category have similar quality or price. For instance, if both China and Italy only export "pants", the exports similarity index will take the maximum value of one, and we will conclude that Chinese exports are as sophisticated as Italian exports. However, as shown above, even within narrowly defined products there are large differences in prices across countries. Unless we take into account these price (and quality) differentials, the comparison of the export similarity index may not be an adequate measure for export sophistication. In the next subsection, we explore a more direct measure of product quality.

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<sup>9</sup> Claro (2007) presents a model where FDI liberalization in China generates a shift in the export structure toward labor-intensive products. In this context, exports are dominated by productivity-advanced foreign-owned firms rather than productivity-backward domestically-owned enterprises. Therefore, the increase in the willingness to pay for Chinese products relative to those from other countries may obey to an increase in the relative "sophistication" of exporting firms.

## 4.2 Estimation of Quality Differences

The results in last section illustrate how Chinese exports tend to be relatively sophisticated in comparison with other developing countries'. This comes out from comparing its export similarity to that of OECD countries. However, more specific measures of sophistication are required to strengthen the hypothesis that elements other than relative product prices explain China's export growth. Yet it can be assumed that product prices reflect product quality, and price differences also reflect several other features.<sup>10</sup> Product quality is unobservable, and we need some methodology for inferring quality measures from trade statistics. Alvarez and Claro (2006a) develop a theoretical model to distinguish the impact of prices and unobserved variety and quality on import penetration. Under traditional assumptions of monopolistic competition in a three-region setup (Chile, China and the rest of the world), they show that the ratio of consumption in  $z$  (Chile) of some product variety  $j$  imported from countries  $c$  (China) and  $r$  (rest of the world) can be expressed as:

$$\ln X_{jt}^z = \alpha_{0j} + \alpha_1 \cdot t + \alpha_2 \cdot \ln p_{jt}^z + \alpha_3 \cdot \ln \phi_{jt} + \alpha_4 \ln \omega_{cjt} + \alpha_5 \ln \omega_{zjt} + \alpha_6 \ln \tau_{jt} + \nu_{jt}, (4)$$

where  $X_{jt}$  is the China/ROW ratio of imported quantities of product  $j$ ,  $p_{jt}$  is the China/ROW relative price of product  $j$ ,  $\phi_{jt}$  is relative size of China and the rest of the world,  $\omega_{cjt}$  and  $\omega_{zjt}$  are relative factor prices between China and the rest of the world and Chile and the rest of the world<sup>11</sup>, respectively, and  $\tau_{jt}$  are trade costs measured as

<sup>10</sup> See Hallak and Schott (2005) for a discussion on how prices are an imperfect measure of product quality.

<sup>11</sup> Relative size is measured as the PPP-adjusted GDP ratio and relative productivities as the PPP-adjusted per capita GDP ratio. Both variables are obtained from the World Development Indicators of the World Bank.

average nominal tariffs in Chile. The variable  $t$  is time trend resulting from the assumption that relative exports quality is given by:

$$q_{jt} = e^{\delta_{oj} + \delta_{1j}t},$$

where  $q_{jt}$  is the China/ROW quality ratio in product  $j$ . The annual growth in the quality ratio between imports from China and the rest of the world is recovered, after estimating equation (4), as  $\delta_1 = -\alpha_1 / (\alpha_2 + \alpha_4 + 1)$ .

Table 5 reports results for the exports quality growth obtained by Alvarez and Claro (2006a). Under different specifications, they find that relative export quality growth of Chinese products is positive and statistically significant. Moreover, the point estimate is very similar for each specification. In Panel A, results refer to GDP and income variables measured for all importers at 8-digit products and Panel B corresponds to these variables measured for all importers at 2-digit products.<sup>12</sup> For both cases, the model is estimated with and without tariffs. The results show that the annualized rate of growth of the quality ratio is between 9.8 and 11.5 percent.

Alvarez and Claro (2006a) explore the causes of cross-product differences in quantity penetration, estimating differences in the rate of growth of the quality ratio across products depending on their degree of differentiation. If quality growth matters for the growing importance of China, we should observe that an increase in quality is more relevant for products in which product differentiation is more important. In the case of homogeneous products, we should not expect significant differences in price and quality

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<sup>12</sup> This is, the relevant rest of the world may be assumed to be all exporters of the same product (8-digit HS) or to some lower level of aggregation (2-digit HS).

at very detailed product classifications. In such a case, perfect competition would imply that a country imports only from the cheapest source.

We show here the estimates of quality growth for different product groups according to the classification provided by Rauch (1999). Table 6 presents the average rate of quality growth for differentiated goods, reference priced goods and homogeneous goods. There is strong evidence that quality growth is much higher for differentiated products than for reference priced and homogeneous products. Note, for example, in column (1), that the annual rate of growth of the quality of Chinese varieties relative to the rest of the world is 11.2% (12.9%) for differentiated products, and only 4.8% (4.8%) and 2.8% (4.3%) for reference priced and homogeneous products, respectively.<sup>13</sup>

The bottom part of Table 6 reports tests for the equality of quality growth across these three groups of products. In general, the null hypotheses that quality growth is the same for differentiated and reference priced products can be rejected for all the cases analyzed. The same is true for the test of equality of growth between differentiated and homogenous products. In sum, the evidence seems to favor the idea that the quality of Chinese exports has grown more rapidly in more differentiated products. Interestingly, these products are those with a deepest fall in the relative price of Chinese varieties (see Alvarez and Claro, 2006a), revealing that the fall in prices is associated with an increase in quality. The first culprit for this association is productivity growth: a high rate of growth of productivity in differentiated products may explain an increase in their quality together with a fall in their price. This process coincides with the increasing dominant position of productivity-advanced foreign firms in China's exports. A formal test of this

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<sup>13</sup> The results are similar, albeit somewhat weaker, when products are differentiated according to the elasticity of substitution across varieties within each product computed by Broda and Weinstein (2006).

link is far beyond the scope of this paper, but we think it constitutes a very important avenue for future research.

## **5. Conclusions**

The impact of Chinese competition is commonly thought to be transmitted through prices. In particular, based upon traditional endowment-based trade theory, the main impact of China's competition is expected to be associated with a fall in the relative price of labor-intensive products and high penetration in labor-intensive sectors. Although there is some evidence supporting this view, we find that a large part of the action takes place within sectors. The literature has provided strong evidence that there is also differentiation within products, which presumably reflects factor endowment and technological differences. As expected, rich countries export high-priced products while poor countries export low-priced products.

In this context, this paper analyzes the sources of China's export growth. Using highly-disaggregated data on Chilean imports between 1990 and 2005, we first show that China's strong export penetration relative to other countries is mainly explained by an increase in the intensive margin, that is, an increase in the volume of exports in product categories that are also exported by other countries. Surprisingly, the main source of growth in the intensive margin is explained by an increase in exported quantities, without a significant fall in the relative price of Chinese products. One explanation for this apparent paradox is an increase in the willingness to pay for—quality of—Chinese products relative to the rest of the world. The paper provides detailed evidence showing that the fall in Chinese prices is relatively small to explain the huge increase in export

quantities. We also show direct and indirect evidence of growing sophistication of China's export mix. In particular, we show that exports from China have increased their similarity with exports from rich countries, and we also show that the quality of Chinese exports has improved over time. This is consistent with the idea that product quality is an important dimension of Chinese export growth.

## References

- Álvarez, R. and S. Claro (2007) “David versus Goliath: The Impact of Chinese Competition of Developing Countries,” manuscript, Central Bank of Chile and Pontificia Universidad Católica de Chile.
- \_\_\_\_\_ (2006a) “The China Phenomenon: Price, Quality or Variety?” Working Paper No. 411, Central Bank of Chile
- \_\_\_\_\_ (2006b) “The China Price: Evidence and Some Implications,” *Estudios de Economía* 33(2):117-39.
- Bernard, A.B., Jensen, J.B. and P.K. Schott (2006) “Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants,” *Journal of International Economics*, 68(1): 219-37.
- Blázquez-Lidoy, J., Rodríguez, J. and J. Santiso (2006). “Angel or Devil? China’s Trade Impact on Latin American Emerging Markets,” OECD Development Centre Working Paper No. 252, June.
- Branstetter, L. and N. Lardy (2006) “China’s Embrace of Globalization,” NBER Working Paper 12373.
- Broda, C. and D. Weinstein (2006) “Globalization and the Gains from Varieties,” *Quarterly Journal of Economics* 121(2):541-85.
- Castro, L., Olarreaga, M. and D. Saslavsky (2007) “The Impact of Trade with China and India on Argentina's Manufacturing Employment,” World Bank Policy Research Working Paper No. 4153.

- Claro, S. (2007) “FDI Liberalization as a Source of Comparative Advantage in China,” manuscript, Instituto de Economía, Pontificia Universidad Católica de Chile.
- Devlin, R., Estevadeordal, A. and A. Rodríguez (2006) *The Emergence of China: Opportunities and Challenges for Latin America and the Caribbean*. David Rockefeller Center for Latin American Studies and Inter-American Development Bank.
- Eichengreen, B., Rhee, Y. and H. Tong (2004) “The Impact of China on the Exports of Other Asian Countries,” NBER Working Paper No. 10768, September.
- Feenstra, R. (1994) “New Product Varieties and the Measurement of International Prices,” *American Economic Review* 84(1):157-77.
- Finger, J.M. and M.E. Kreinin (1979) “A Measure of ‘Export Similarity’ and Its Possible Uses,” *Economic Journal* 89:905-912.
- Hallak, J.C. and P.K. Schott (2005) “Estimating Cross-country Differences in Product Quality,” manuscript, Yale School of Management.
- Harrigan, J. (1997) “Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model,” *American Economic Review* 87(4): 475–94.
- Hummels, D. and P. Klenow (2005) “The Variety and Quality of a Nation’s Exports,” *American Economic Review* 95:704-23.
- Leamer, E.E. (1987) “Paths of Development in the Three- Factor, n-Good General Equilibrium Model,” *Journal of Political Economy* 95(5): 961–99.
- \_\_\_\_\_(1995). *The Heckscher-Ohlin Model in Theory and Practice*. Princeton Studies in International Finance 77.



López Córdova, E., Micco, A. and D. Molina. (2006) “Competing with the Dragon: Latin America and Chinese Exports to the U.S. Market,” manuscript, Inter-American Development Bank.

\_\_\_\_\_ (2005) “How Sensitive are Latin American Exports to Chinese Competition in the U.S. Markets,” manuscript, Inter-American Development Bank.

Nicita, A. and M. Olarreaga. (2006) “Trade, Production and Protection 1976-2004,” *World Bank Economic Review* 21(1): 165-71.

Rauch, J. (1999) “Networks versus Markets in International Trade,” *Journal of International Economics* 48(1): 7-35.

Rodrik, D. (2006) “What’s So Special about China’s Exports?,” Working Paper 06-001, John Kennedy School of Government, Harvard University.

Schott, P.K. (2006) “The Relative Sophistication of Chinese Exports,” NBER Working Paper No. 12173, August.

\_\_\_\_\_ (2004) “Across-Product versus Within-Product Specialization in International Trade,” *Quarterly Journal of Economics* 119(2): 647-78.

\_\_\_\_\_ (2003) “One Size Fits All? Heckscher-Ohlin Specialization in Global Production,” *American Economic Review*, XCII: 686-708.

Table 1: Chilean Imports, 1990-2005

	<i>Imports (Millions of Dollars)</i>			<i>Number of Products ( 8-Digit HS)</i>		
	Total	China	Participation	Total	China	Participation
1990	7,023	57	0.8	4,815	1,035	21.5
1991	7,515	95	1.3	4,874	1,065	21.9
1992	9,542	147	1.5	4,969	1,252	25.2
1993	10,641	212	2.0	4,949	1,445	29.2
1994	11,291	281	2.5	4,950	1,478	29.9
1995	15,061	390	2.6	5,037	1,665	33.1
1996	16,975	515	3.0	5,429	1,803	33.2
1997	18,330	659	3.6	5,163	1,944	37.7
1998	17,155	753	4.4	5,142	2,103	40.9
1999	13,703	647	4.7	5,197	2,090	40.2
2000	16,790	949	5.7	5,215	2,276	43.6
2001	16,134	1,014	6.3	5,151	2,346	45.5
2002	15,639	1,102	7.0	6,724	3,182	47.3
2003	17,549	1,290	7.4	6,670	3,470	52.0
2004	22,483	1,848	8.2	6,745	3,759	55.7
2005	29,932	2,541	8.5	6,702	3,994	59.6

Source: Chilean Customs

Table 2: China's Export Margins relative to ROW: Chile: 1990-2005

Percent

	<i>Overall</i>	<i>Extensive</i>	<i>Intensive</i>	<i>Price</i>	<i>Quantity</i>
1990	0.8	33.1	2.5	59.4	4.1
1991	1.3	28.4	4.5	54.7	8.2
1992	1.6	30.8	5.1	55.3	9.1
1993	2.0	37.8	5.4	57.1	9.4
1994	2.5	35.9	7.1	61.0	11.6
1995	2.7	40.2	6.6	61.1	10.8
1996	3.1	38.8	8.1	59.0	13.7
1997	3.7	45.6	8.2	57.5	14.2
1998	4.6	46.4	9.9	49.9	19.7
1999	5.0	50.1	9.9	57.5	17.2
2000	6.0	47.1	12.7	56.8	22.4
2001	6.7	49.6	13.5	55.3	24.4
2002	7.6	45.6	16.6	58.6	28.3
2003	7.9	43.0	18.5	54.9	33.6
2004	9.0	45.7	19.6	56.6	34.6
2005	9.3	47.8	19.4	53.0	36.5
Annualized Growth (%)	17.6	2.5	14.7	-0.8	15.6

Source: Authors' elaboration using Chilean Customs data.

Table 3: Import Prices and Per Capita GDP

	(1)	(2)	(3)	(4)	(5)	(6)
Per Capita GDP (in logs)	0.238 (9.93)**	0.242 (9.77)**	0.219 (8.37)**	0.222 (8.32)**	0.220 (8.36)**	0.222 (8.32)**
China	--	--	-0.286 (2.13)*	-0.319 (2.32)*	--	--
China 1990-1995	--	--	--	--	-0.111 (-0.79)	-0.361 (-0.94)
China 1996-2000	--	--	--	--	-0.227 (1.72)	-0.263 (1.94)
China 2001-2005	--	--	--	--	-0.398 (2.93)**	-0.442 (3.20)**
Constant	5.105 (17.06)**	5.207 (16.08)**	4.961 (16.26)**	5.056 (15.76)**	4.962 (16.25)**	5.057 (15.76)**
Observations	757,397	649,074	757,397	649,074	757,397	649,074
R-squared	0.73	0.72	0.73	0.72	0.73	0.72

Robust t statistics in italics. Standard errors adjusted at the country level. \* significant at 5%; \*\* significant at 1%. Columns (1), (3) and (5) include all products. Columns (2), (4), and (6) include products imported from at least one low and high income country. Low income countries are those with income per capita lower than the 30% of countries in the sample, and high income countries are those with income per capita higher than the 70% of countries in the sample. Per capita GDP in PPP is from World Development Indicators.

Table 4: Countries with the Highest Export Similarity to OECD Exports in Chile

<i>Country</i>	<i>1990</i>	<i>Country</i>	<i>2005</i>
Brazil	0.602	South Korea	0.700
Taiwan	0.540	Brazil	0.568
Mexico	0.467	Taiwan	0.544
Argentina	0.398	Mexico	0.484
<i>China</i>	<i>0.388</i>	<i>China</i>	<i>0.434</i>
South Korea	0.370	Colombia	0.384
Indonesia	0.368	Uruguay	0.382
Panama	0.240	India	0.360
Peru	0.224	Singapore	0.353
Colombia	0.215	Thailand	0.343
Uruguay	0.176	Argentina	0.276
Singapore	0.162	Panama	0.242
Thailand	0.151	Malaysia	0.230
India	0.118	Indonesia	0.227
Venezuela	0.118	Venezuela	0.225
Malaysia	0.114	Costa Rica	0.216
Trinidad and Tobago	0.109	Philippines	0.199
Philippines	0.095	Peru	0.078
Guatemala	0.084	Vietnam	0.070
Jamaica	0.073	Bolivia	0.062

Source: Authors' elaboration using Chilean Customs data.

Table 5: China's Relative Exports Quality Growth, 1990-2005

<i>Sample<sup>a</sup></i>	<i>Trade Barriers<sup>b</sup></i>	<i>Mean<sup>c</sup></i>	<i>95% Conf. Interval</i>	
<i>Panel A: ROW comprises countries with positive imports in the corresponding 8-digit product category.</i>				
	Yes	9.8	8.3	11.3
	No	10.7	8.9	12.4
<i>Panel B: ROW comprises countries with positive imports in at least one 8-digit product category within the 2-digit level group.</i>				
	Yes	11.2	8.8	13.5
	No	11.5	9.4	13.6

<sup>a</sup>: Includes product-year observations with  $0.05 < p_{jt} < 20$ .

<sup>b</sup>: Yes means that the regression includes nominal average tariffs.

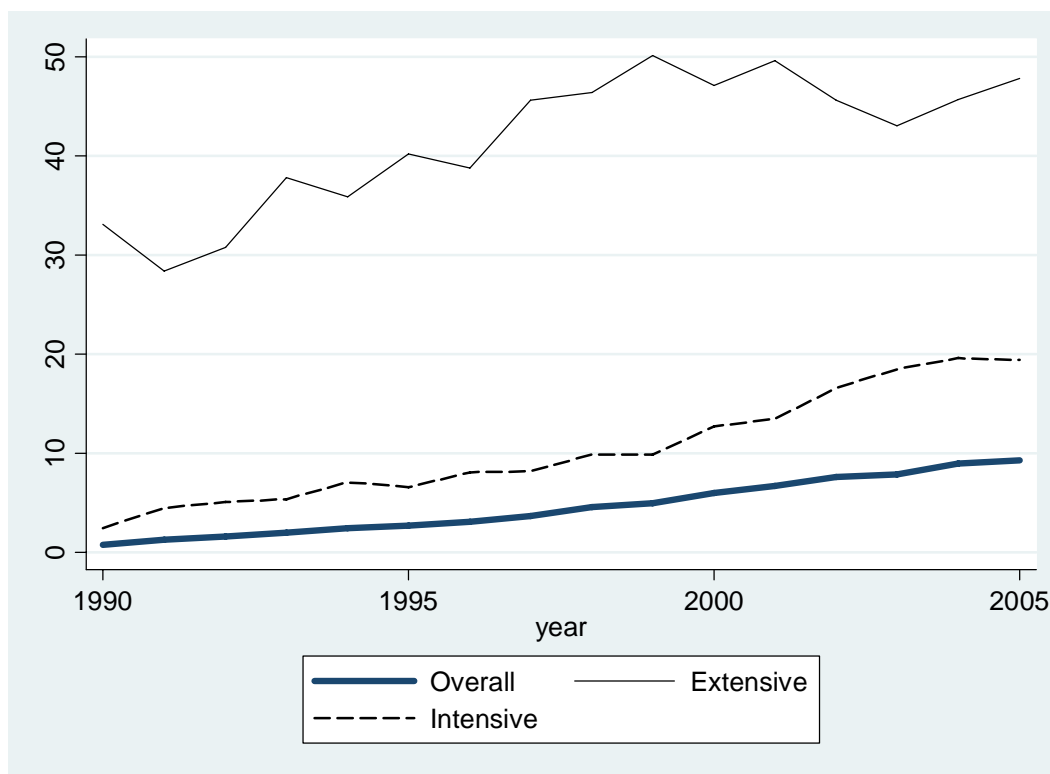
<sup>c</sup>: Compound annualized rate of growth of the quality gap.

Table 6: Across-Product differences in Quality Growth  
Product conservative classification from Rauch (1999)

<i>Type of Product</i>	<i>Panel A: 8 digit income variables</i>	<i>Panel B: 2digit income variables</i>
Differentiated	11.2	12.9
	<i>1.2</i>	<i>1.8</i>
Reference priced	4.8	4.8
	<i>0.3</i>	<i>0.9</i>
Homogeneous	2.8	4.3
	<i>0.8</i>	<i>1.4</i>
Test (Probability > F)		
q(Diff) = q(Ref)	0.00	0.00
q(Diff) = q(Hom)	0.00	0.00
q(Ref) = q(Hom)	0.02	0.77

Standard errors in Italics. All regressions include product-year observations in which  $0.05 < p_{jt} < 20$  and control for trade barriers.

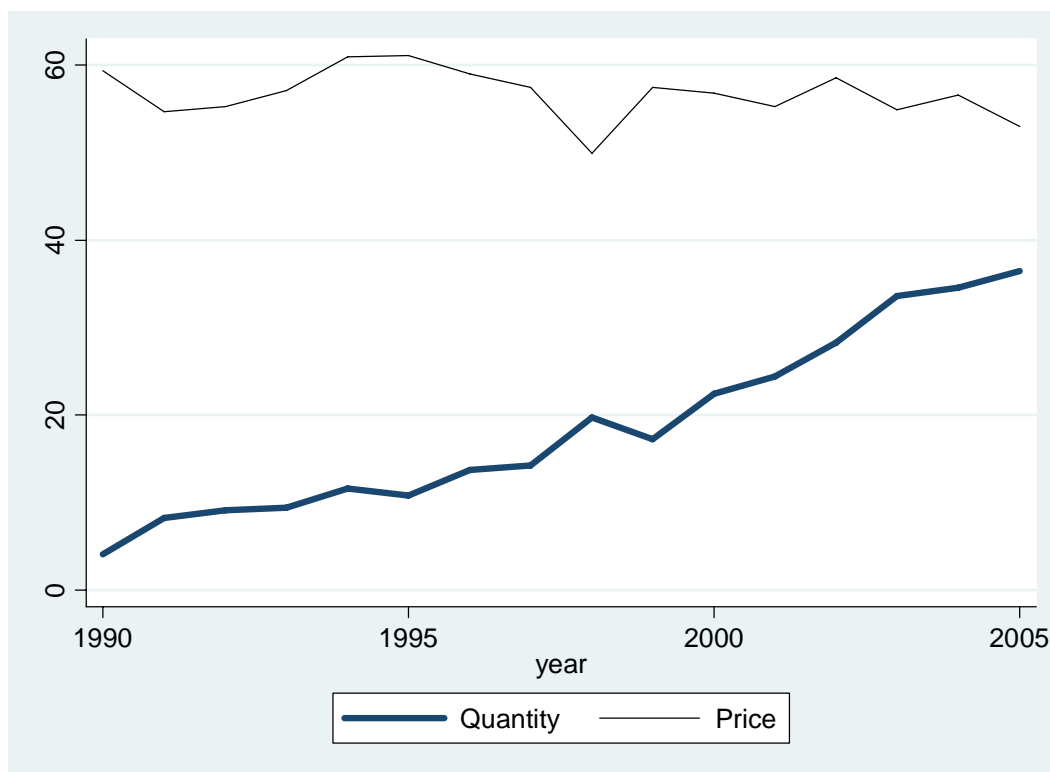
Figure 1: Evolution of Chinese Export Margins, 1990-2005



Source: Authors' elaboration using Chilean Customs data.

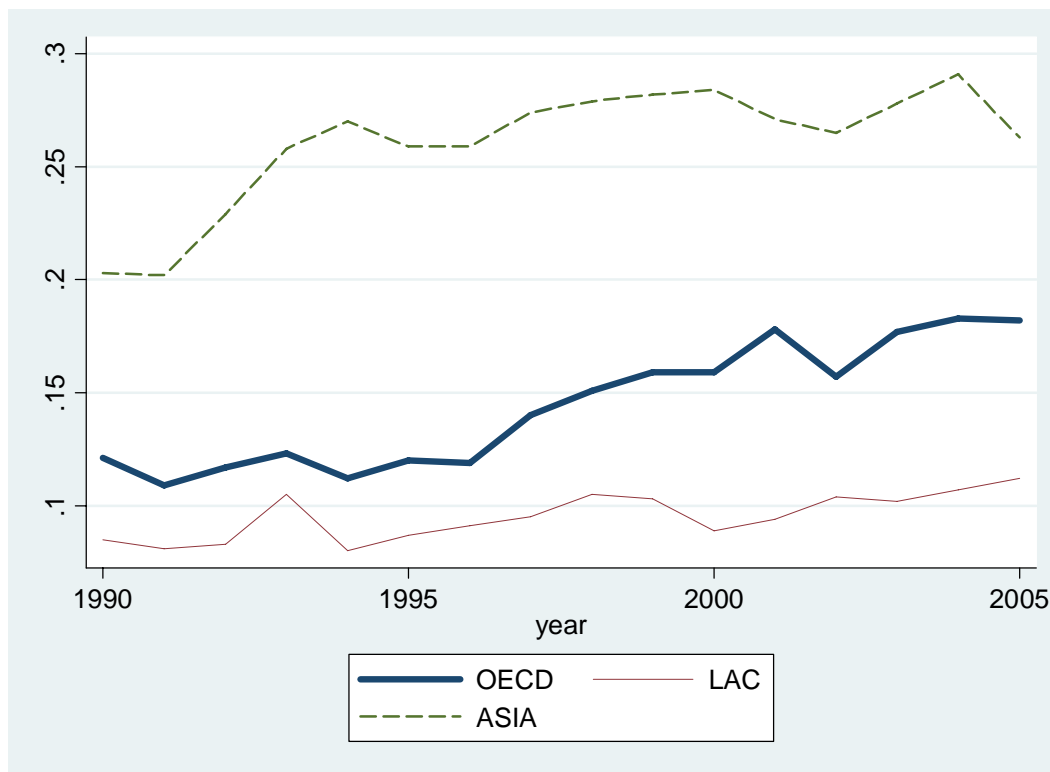


Figure 2: Evolution of Quantity and Price Margins, 1990-2005



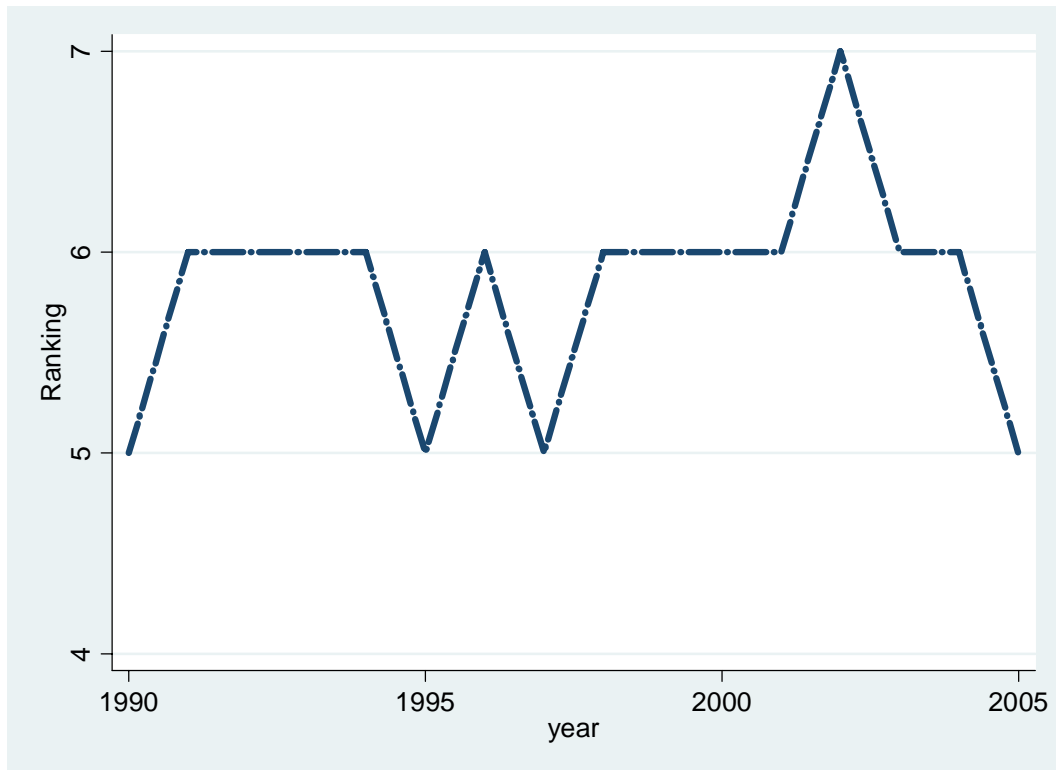
Source: Authors' elaboration using Chilean Customs data.

Figure 3: Export Similarity Index



Source: Authors' elaboration using Chilean Customs data.

Figure 4: Ranking of Export Similarity Compared to OECD



Source: Authors' elaboration using Chilean Customs data.

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