

The Role of Transport Costs, Tariffs and the Real Exchange Rate in Chile's Export Trade with the EU: An Augmented Gravity Model Approach

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ABER

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Abstract

In the last decades Chile experienced noticeable tariff reductions both due to multilateral trade liberalization and bilateral Free Trade Agreements (FTAs) with developed and developing countries. From 2013 onwards (after completion of the transition phase) the benefits of the FTA between Chile and the EU (in force since 1 February 2003) should become fully visible and Chile's access to the EU market should be strongly improved. A major concern for Chile, however, is its distance to many interesting export markets and a disadvantage in transport costs with respect to numerous competitors. It is the objective of this paper to analyze the role of transport costs, tariffs, price competitiveness, real income and per capita income differences in Chilean export trade with the EU. To this end, Chile's most important export sectors are investigated using panel data from Chile's main trading partners in the EU over the period 1988-2002. The econometric model used in the simulations is a refined augmented gravity model. It is found that Chile's export success is perceptibly determined by transport costs, however with different sectoral incidence, depending on the export product. Transport costs play a very important role in the food-related sectors, but are not relevant in the mineral-based industries.

Keywords:

Transport costs, tariffs, Chile-EU sectoral trade, gravity model, panel analysis

JEL: F14, F17, C23

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1. Introduction

Since the 1990s Chile has followed a strategy of bilateral trade liberalization to improve its access to important export markets in North America, Europe and Asia. Free Trade Agreements (FTAs) have been established not only with Latin American countries but also with the United States, Canada, the EU and South Korea. Trade and Partnership Agreements are planned or under way with New Zealand, Japan, China and India.

In order to enhance economic cooperation with the EU and expand into European markets, Chile signed a far reaching FTA with the EU that came into force on 1 February 2003 (European Parliament, 2005). The agreement implies the total liberalization of tariffs and non-tariff barriers affecting trade in goods (excluding only some fishing and agricultural products) but contains transitional phases that vary between one and ten years, depending on the product. After the fourth year of implementation, the agreement will have eliminated tariffs on 96% of Chile's exports to the EU and, based on EU-25 figures, improve Chile's access to a market of more than 456.8 million¹ consumers (Chile Foreign Investment Committee, 2005).

The FTA between Chile and the EU, once fully implemented, will be beneficial to both the EU and Chile.² With respect to trade, the EU expects a major expansion of its manufactured exports to the Chilean market, whereas Chile hopes to expand its agricultural and light manufactured exports to the EU. Based on 2003 data, the EU is Chile's top trading partner worldwide. 25% of Chile's exports go to the EU and 19% of its imports come from the EU. During the first semester of 2003, mining (predominantly copper) still represented 46% of total Chilean goods exports, while agriculture, farming, forestry and fishing products represented 13.02% thereof. Trade with Chile represents 0.45 of total EU trade, putting Chile in 41st place among the EU's top trading partners. Between 1980 and 2002, EU imports from Chile increased

¹ Inhabitants on 1 January 2004.

² Next to trade facilitation through reduction and elimination of tariffs and modern customs techniques, it comprises economic co-operation and technological innovation, protection of the environment and natural resources and support for government reforms (http://europa.eu.int/comm./external_relations/chile/intro/index.htm; 16 February 2005).

from €1.5 billion to €4.8 billion, while EU exports to Chile increased from €0.7 billion to €3.1 billion.

From Chile's point of view, the agreement can be clearly considered as a means to maintain and/or strengthen its competitive position in the EU market. In the short run, a reduction or elimination of trade barriers through an FTA and its impact on relative prices will improve Chile's competitive position not only with respect to the EU countries but also with respect to third countries that do not have an FTA with the EU. In the medium to long run however, the effect of the FTA will be eroded if the EU also decides to conclude FTAs with countries like Brazil, Argentina, Paraguay, Uruguay, Bolivia, Peru, and perhaps some Asian countries. In addition, Chile has numerous competitors worldwide³: Norway, Russia, Indonesia, Malaysia, the Philippines and Thailand are, much like Chile, exporters of timber and rubber. The Southeast Asian countries have been able to significantly increase their light manufactured exports to industrial countries in the last decade. In the Southern Hemisphere, South Africa, Australia and New Zealand threaten Chile's position as a successful fruit and wine exporter. In agricultural products, Chile faces stiff competition from the EU countries. UK, Ireland and Norway are Chile's main competitors as far as fish exports are concerned. Furthermore, with its low labor costs, China has become a strong exporter of machinery and equipment, textiles and clothing, footwear, toys and sporting goods and mineral fuels, thus reversing Latin America's competitiveness in textile, clothing and shoe exports.

Chile's main export commodities comprise copper, fish, fruits, paper, paper pulp, and wine and are thus heavily natural resource based. Its main import commodities include consumer goods, chemicals, motor vehicles, fuels, electrical machinery, heavy industrial machinery and food. Chile applies low import tariffs (6% in 2003) and non-tariff barriers are not important due to the establishment of a liberal and transparent trade regime in 1974. The unilateral trade liberalization that Chile went through from 1975 to 2004⁴ implied the quasi-abolition of non-tariff trade barriers and the imposition of uniform tariffs. This implies that tariffs which impeded agricultural trade in the past will play a minor role in future Chile-EU trade.

³ Chile is still considered the most competitive and the least corrupt economy in Latin America.

⁴ Trade liberalization was interrupted during the debt crisis and the economic recession of the period 1982-1985.

It is to be expected that exchange rates and business cycles will remain influential for export trade. The role of relative prices and of business cycles has been well established in macroeconomic studies (Junz and Rhomberg, 1973; Khan, 1974; Goldstein and Khan, 1978; 1985; de Gregorio, 1984; Faini, 1994; Nowak-Lehmann D., 2004). In times of rising oil prices transport costs, even though declining over the last four decades⁵, will become a trade impeding factor in the future. Depending on the export product or sector they can be decisive for export success.

Only very few studies exist on the impact of the transport costs on trade. The IDB Report (2001) points to the importance of transport costs for Latin American trade. It claims that the effective rate of protection provided by transport costs is often higher than the rate provided by import tariffs. As for Chile, import tariffs represent less than 1% of the value of its exports to the United States, while transport costs are 12% or more of that value. Anderson and Wincoop (2004) emphasize the importance of trade costs for trade flows. They compute transportation costs (a component of trade costs) to amount to a tariff equivalent of 21%, based on estimates for U.S. data. However, they also mention the high variability of trade costs across both goods and countries. Therefore, we think that studying the impact of transport costs on trade is worth doing and that an augmented gravity model is the appropriate framework for analyzing the role of transport costs.

In line with the existing knowledge on trade-accelerating and trade-deterring factors, the objective of this paper is to separately analyze Chile's most important export sectors, to identify the determinants of its export strength on the EU market in the period 1988 to 2002 and to evaluate the role of transport costs for Chile's export flows. The empirical model used is an extended version of the gravity model that takes transport costs, trade barriers and trade preferences, real incomes, real per capita income differences, and price competition⁶ in the export trade between Chile and the EU into account. Starting from an assessment of underlying trade structures and the determinants of current trade flows between Chile and the EU, an export trade analysis will be performed for the Chilean economy.

The study is structured as follows. Section 2 gives an overview of Chilean exports under analysis, its structure and dynamism and Chilean competitors in the EU market. It also presents our extended version of the gravity model with its focus on

⁵ See study of Hufbauer (1991).

export flows in real terms. Section 3 contains the empirical application of the gravity model to Chile-EU trade and the estimation and simulation results. Section 4 concludes.

2. The augmented gravity model for modeling export flows

2.1 Economic background: Chile's exports to the EU and its market share in the EU market

In Table 1 we list Chile's largest export sectors.

[Table 1]

As far as agriculture is concerned, we selected sectors with an export value of more than 200 million ECU (yearly average 1988-2002). Pre-selection of the seven sectors was based on Chile's 30 largest sectors in 2002. We consider averages of sectoral export values over the period 1988 to 2002 in order to smooth out peaks and valleys. All seven of the sectors with a considerable export value also experienced remarkable export growth, beverages being the most dynamic sector with an annual growth rate of around 44.6%. It should be noted, however, that 'beverages' started from a lower level in 1988 than the more traditional sectors such as fruit, wood, pulp of wood, and copper.

Copper has the biggest market share of EU imports with 10.34%, followed by ores (3.75%), wood pulp (2.89%) and fruit (2.62%) in the period 1988 to 2002.

The development of sectoral exports will be discussed and analyzed in Section 3, where summary tables will also be presented.

2.2 Data and model set-up

We use EUROSTAT's trade database COMEXT (Intra- and Extra-EU Trade, Supplement 2, 2003). The analysis has to be restricted to six EU countries: France, Germany, Italy, the Netherlands, Portugal, Spain and the UK. Due to incompleteness of the data, we excluded nine EU-15 countries and all ten EU-10⁷ countries from the analysis. Wood, wood articles, and wood pulp must be exempted from the econometric analysis⁸ due to illegal logging that caused prices to lose their signaling function. We subject five export sectors—fish, fruit, beverages, ores and copper (at

⁶ Price competition in the EU market will be examined by looking at price competition from both the EU countries and the South East Asian + Southern Hemisphere countries as well as Norway.

⁷ The EU-10 countries have not yet been integrated into the COMEXT trade statistics thus impeding their analysis.

⁸ We did, however, carry out a descriptive analysis of Chile's market shares.

the two-digit level of the Harmonised System (HS) classification)—to econometric analysis. The period covered is 1988 to 2002. We have a maximum of six cross-sectional trade flows and 15 years, resulting in a maximum of 90 observations per sector. Sources and compilation of the data are outlined in the Appendix.

We utilize a variant of the gravity equation to model bilateral export flows from Chile to the EU and have added some refinements. A log-log specification of the gravity model is selected for Chilean exports.

According to the generalised gravity model of trade, the volume of exports between pairs of countries, X_{ij} , is a function of their incomes (GDPs), their populations, their geographical distance and a set of dummies,

$$X_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} N_i^{\beta_3} N_j^{\beta_4} D_{ij}^{\beta_5} A_{ij}^{\beta_6} u_{ij} \quad (1)$$

where Y_i (Y_j) indicates GDPs of the exporter (importer), N_i (N_j) are populations of the exporter (importer), D_{ij} measures the distance between the two countries' capitals (or economic centres) and A_{ij} represents any other factors aiding or preventing trade between pairs of countries. The error term is u_{ij} . An alternative formulation of equation (1) uses per capita income instead of population,

$$X_{ij} = \gamma_0 Y_i^{\gamma_1} Y_j^{\gamma_2} YH_i^{\gamma_3} YH_j^{\gamma_4} D_{ij}^{\gamma_5} A_{ij}^{\gamma_6} u_{ij} \quad (2)$$

where YH_i (YH_j) is exporter (importer) per capita GDP.

We deviate from the generalised gravity model in several respects. First, we do not focus on infrastructure and in particular not on terrestrial infrastructure (i.e., the circumstances of arriving at the domestic port and departing from the foreign port) when measuring distance., as was done by Martínez-Zarzoso and Nowak-Lehmann D., 2003). Instead we look at maritime transport costs per se. For this purpose, we scaled geographical distance (actual nautical miles) using the freight cost index to construct a new transport cost variable. We assumed that merchants would use sea transport whenever possible, given the fact that a certain quantity transported by ship (40-foot containers) costs about one-fifth of the same quantity transported by road (13.6-meter trailer). We do not consider land transport costs here since they are the same for all exporting countries and independent of the export port (Chile, Norway, Indonesia) once the destination (foreign) port (e.g., Hamburg) has been reached. But still it has to be noted that land transport costs of the exporting country (e.g., Chile, from Talca to Concepción) will differ from exporting country to exporting country

(Chile, Norway, Indonesia) and should therefore be considered. However, they are partly incorporated into the income variable of the exporting country. A country with higher GDP will also have better public infrastructure.

In this study, we also examine whether transport costs influence exports in a linear or non-linear way⁹. As to the latter, increasing knowledge about how to organize transport could cause each additional unit of transport costs to have a progressively decreasing effect on exports. Moreover, higher transport costs might enforce the more efficient use of port facilities, containers and personnel, and might therefore lead to an underproportional negative impact on exports. We also believe that sectoral differences can be found in the relationship between transportation costs and exports, depending on the products under investigation and the weight of transport costs in the value of exports. It might, for example, be more difficult to organize the export of frozen or smoked fish than of ores and copper. The export of fish requires modern containers with a refined cooling system, punctual forwarding agents, reliable carriers and shipping agents, and better knowledge of the importing country's port and road infrastructure and people's tastes than the export of minerals.

Second, concerning economic distance, we use differences in incomes between trading countries, a variable similar to that used in Arnon et al. (1996), in McPherson et al. (2000) and Martínez-Zarzoso, I. and F. Nowak-Lehmann D. (2004). Our variable is constructed as the absolute difference in per capita incomes in purchasing power parities (PPP).

We can identify two conflicting effects of this variable on trade. On the one hand, on the basis of the Linder (1961) model, when the trading countries have very different per capita incomes, lower economic distance might foster trade. With this effect, the more similar their per capita incomes, the more countries tend to increase their bilateral trade in similar products. We therefore expect more trade to be intra-industry trade (countries should both export and import the same goods) when per capita incomes converge.

On the other hand, if we consider the Heckscher-Ohlin (H-O) model, higher economic distance might foster inter-industry trade (countries import and export different goods). H-O focuses on expected trade patterns when countries have different factor

⁹ The non-linear specification contains the square of transport costs, which does not cause perfect multicollinearity since it is not a linear combination of transport costs.

endowments but similar tastes. Per capita income differences can represent inter-country differences in factor scarcity.

We assume that current trading patterns are affected by both factors. For some commodities, we expect that the Linder effect dominates the H-O effect and that economic distance has a negative effect on trade. For other commodities, the opposite might occur, in which case economic distance would have a positive effect on trade.

Finally, we add a real exchange rate variable to our specification (Bergstrand, 1985, 1989; Soloaga, Winters, 1999, Nowak-Lehmann D. and Martínez-Zarzoso, 2005). We calculated Chile's and its competitors' bilateral real effective¹⁰ exchange rates (price quotation system) taking into account protection. Average tariffs imposed by the EU and EU subsidies enter the formula (see WTO Trade Policy Review European Union, Vol. 1, 2000, page 101). All the calculations are shown in the Appendix.

Exports from country *i* to country *j* in period *t* of commodity *k* are then modelled as a log-log function:

$$\ln x_{ijkt} = \alpha_{ijk} + \beta_0 \ln y_{ijt} + \beta_1 \ln \text{diff}_{ijt} + \beta_2 \ln \text{reer}_{ijkt} + \beta_3 \ln \text{index}_{ijt} + \beta_4 \ln \text{index}_{ijt}^2 + \mu_{ijkt} \quad (3a)$$

$$\ln x_{ijkt} = \alpha_{ijk} + \beta_0 \ln y_{ijt} + \beta_1 \ln \text{diff}_{ijt} + \beta_2 \ln \text{reer}_{ijkt} + \beta_3 \ln \text{reer}_{ijkt}^* + \beta_4 \ln \text{dte}_{ijt}^* + \beta_5 \ln \text{dte}_{ijt}^{*2} + \mu_{ijkt} \quad (3b)$$

Equation (3a) is used if competition comes from EU countries only, whereas equation (3b) applies if there is also competition from non-EU-countries, characterized by * . In this case, the relative prices of the non-EU competitors and difference in transport costs between Chile and the non-EU competitor do appear in the equation. The asterisk * stands for the foreign competitor.

$\ln x_{ijkt}$ is the natural logarithm of exports of sector *k* from country *i* to country *j* in period *t* in real terms. The total income of the trading countries (in purchasing power parities (PPP) is $\ln y_{ijt}$. This summarizes the impact of the income of trading pairs on exports. The natural logarithm of differences in per capita income in absolute terms and in PPP between the trading countries is $\ln \text{diff}_{ijt}$, while $\ln \text{reer}_{ijkt}$ is the real effective exchange rate (price quotation system), taking into account sector-specific protection.

¹⁰ Effective implies that EU import tariffs and subsidies are taken into account. This definition differs from the IMF definition, which understands real effective exchange rates as multilateral trade-weighted real exchange rates.

Accordingly, $lreer_{ikjt}^*$ is the real effective exchange rate of Chile's extra-EU competitors. We assume the competitors' (extra-EU price competition) real effective exchange rate to be especially relevant in beverages: wine, spirits and vinegar (22), wood pulp (47), whereas for copper (74), the world market price in US-dollar terms is decisive. We have data suggesting that extra-EU competition is not very influential in fishery, agriculture, wood, and ores (sectors 03, 08, 44, 26), but of course intra-EU competition is. $lrcindex_{ijt}$ stands for the natural logarithm of transport costs between countries i and j and $ldtc_{ijt}^*$ is used in equation (3b) to signal the difference in transport costs between Chile and its main extra-EU competitor.

A possible non-linear relationship between the transport cost ($lrcindex$) or the transport cost disadvantage ($ldtc$) is yielded by inserting its quadratic form as well. If a non-linear relationship exists, we expect a negative sign for Chile's transport cost disadvantage and a positive sign for the square of Chile's transport cost disadvantage.

Fully liberalizing trade between Chile and the EU is expected to have a large impact on Chilean exports facing high or very high protection in the EU, such as fishery and agricultural products. Chile's price competitiveness is expected to be decisive for export success in all sectors under investigation. Expectations on the role of transport costs, differences in transport costs and differences in per capita income in Chile's export trade are less conclusive. The importance of these factors is believed to vary from sector to sector.

The construction of the variables is described in the Appendix. α_{ijk} stands for the specific country-pair effects for sector k and allows us to control for all omitted variables that are cross-sectionally specific but remain constant over time, such as contiguity, language and cultural ties.

A dynamic specification in the form of an autoregressive distributed lag model (ARDL) leading to eq. (3a') and (3b') was tested for all sectors:

$$lxr_{ijkt} = \alpha_{ijk} + \beta_0 lyt_{ijt} + \beta_1 lydiff_{ijt} + \beta_2 lreer_{ijkt} + \beta_3 lrcindex_{ijt} + \beta_4 lrcindex_{ijt}^2 + \lambda lxr_{ijkt-1} + \mu_{ijkt}$$

(3a') or

$$lxr_{ijkt} = \alpha_{ijk} + \beta_0 lyt_{ijt} + \beta_1 lydiff_{ijt} + \beta_2 lreer_{ijkt} + \beta_3 lreer_{ijkt}^* + \beta_4 ldtc_{ijt}^* + \beta_5 ldtc_{ijt}^{*2} + \lambda lxr_{ijkt-1} + \mu_{ijkt}$$

(3b')

However, the ARDL specification even though widely used in dynamic panel models did not fit our data. The ARDL presupposes a geometric lag (Koyck lag) relationship between the dependent and the independent variables (Koyck, 1954; Kelejian and Oates, 1981). With respect to our data, cross-correlation pairs between the dependent variable and the independent variables rejected the existence of a geometric relationship for most of those pairs. The geometric relationship is expressed through the parameter λ of eq. (3a') and (3b') in the ARDL model. The ARDL, summarizing the pair-wise geometric relationships between dependent and independent variables in the coefficient λ of the lagged dependent variable, necessarily requires a geometric adjustment between exports and lagged exports (the lagged endogenous variable). In our case, the adjustment coefficient λ was negative in some sectors instead of taking values of $0 < \lambda < 1$, as required by the ARDL model. In some sectors it was positive but went in hand in hand with a negative autocorrelation coefficient¹¹ ρ in the FGLS- estimation. However, only positive ($0 \leq \rho \leq 1$) autocorrelation coefficients¹² are compatible with the time series properties found in the data (see section 2.3).¹³ Therefore, we rejected the idea of estimating an ARDL and eventually estimated eq. (3a) or eq. (3b), the long-run version of the model.

2.3 Estimation and simulation techniques

Panel data methodology is used to estimate equations (3a-b). We mainly apply Feasible Generalized Least Squares (FGLS) combined with the Seemingly Unrelated Regression (SUR) technique, thus controlling for correlation between error terms over time and between cross-sections. The use of panel data methodology has several advantages over cross-section analysis. First, panels make it possible to capture the relevant relationships among variables over time. Second, a major advantage of using panel data is the ability to monitor the possible unobservable trading-partner pairs' individual effects. When individual effects are omitted, OLS estimates will be biased if individual effects are correlated with the regressors.

¹¹ The autocorrelation coefficient measures the degree of correlation between the error terms over time, Eg.

$\mu_{ijkt} = \rho \mu_{ijkt-1}$. It is also an indicator of unit-root processes in the series.

¹² In the long-run model ρ , the coefficient of the AR(1)-term, is always in the interval [0; 1] and significant at confidence level of 99% (see tables 2-6)..

¹³ Panel unit root test were applied to all series before starting the econometric analysis.

Mátyás (1997), Chen and Wall (1999) and Egger (2000) present a discussion of the advantages of using this methodology to estimate the gravity equation of trade.

Panel unit-root tests are conducted for exports in real terms (aggregated), the real exchange rate, total income, per capita income differences and transport costs. Stochastic trends that express themselves as autocorrelation of the error terms are found to prevail in all series analysed.

Due to missing data and possibly an insufficient number of observations, Period SUR¹⁴ cannot be performed. We control for autocorrelation of the disturbances by plugging in AR-terms whenever they prove to be significant.

Simulations are based on 1988-2002 data and the coefficients for this period. We assume that a change in tariffs has the same effect on exports as a change in subsidies according to the construction of the real effective exchange rate variable. The simulation is performed via a replacement of the free-price vector through the 'new' corresponding price vector under the FTA. All other independent variables remain unchanged. The coefficients used in simulating a change in sectoral exports are based on the fixed-effect multiple linear regression model that takes different weights of the influencing factors into account. This simulation method yields the same results as simulations based on standardized β - coefficients. It should be pointed out that simulation results hinge crucially on the information available on sectoral protection in the EU. Our information stems primarily from the WTO Trade policy Review, European Union Vol. I, 1995, 1997, 2000 and an UNCTAD report by Supper (2001).

3. Chile's sectoral exports to the EU and the impact of an FTA: Empirical evidence

The export development and export strength of five prominent Chilean export sectors will be econometrically evaluated in two steps:

First, the role of price competition, transport costs, and real incomes will be analyzed by estimating sectoral export flows based on eq. (3a) or (3b).

Second, the impact of the FTA between Chile and the EU on Chilean sectoral exports will be simulated based on the coefficients derived from eq. (3a) or (3b).

Before turning to the econometric analysis, it is worthwhile to look at the development of the real bilateral exchange rates in the period of 1988 to 2002. One can observe

¹⁴ Which controls for correlation between periods.

an appreciation of the real exchange rate with respect to Germany (DEU), France (FRA) and the Netherlands starting in 1990 and ending in 2000 with the introduction of a flexible exchange rate system in Chile. The real appreciation starts a bit later (around 1993) in Italy (ITA) and Spain (ESP) and is reversed in 2000 here as well. Only the bilateral real exchange rate between Chile and the UK (GBR) already starts to appreciate in 1995.

3.1 Results for fish, crustaceans, molluscs (03)

In the period 1988 to 2002, EU protection in sector 03 amounted to tariffs of 12% and subsidies of 10%. Liberalization in the framework of the FTA between Chile and the EU will be carried out over a ten-year period for 93% of current trade. The FTA agreement focuses on mutual access to markets for fish exports (European Parliament, 2005). Competition on fishery products comes mainly from within the EU (UK, Ireland, Portugal, Spain, Italy), and on salmon and trout mainly from Norway.

Given that salmon (and trout) are the main export products of sector 03, the role of Norwegian price competition (expressed by $lreer03nor$) was tested. In the export equation it turned out to be insignificant with a t-statistic of 1.13 and a p-value of 0.26, possibly indicating the role played by non-price factors. Chilean and Norwegian salmon might differ in quality (taste, color, size) and health standards (treatment with antibiotics to avoid diseases). Nonetheless, Norway remained in the equation and we controlled for the role of its transport cost advantage/Chile's transport cost disadvantage.

Table 2 summarizes the explanatory factors for Chile's fishery exports to the EU.

[Table 2]

Looking at only significant results in column 2 of Table 2, price competition via tariffs and subsidies and changes in the real exchange rate have a significant impact on Chilean fish exports. A 10% depreciation of the real effective exchange rate will increase real exports by 6.3%. Transport costs have a tremendous non-linear effect on real exports. This means that a 1% increase in transport disadvantage¹⁵ with respect to Norway will initially (!) severely reduce real exports (by 61.17%), but once the transport cost disadvantage has reached a certain level, some countervailing export effect (e.g., cost reduction strategies) will set in, thus weakening the negative

¹⁵ In terms of actual nautical miles, Chile is of course farther away from the EU market than Norway.

impact of transport costs on exports.¹⁶ It is this effect that causes the non-linear relationship between transport costs and exports. The standardized β -coefficients reveal the extreme importance of the transport cost disadvantage for Chilean fish exporters. Price competition does not play a major relative role in the fish sector, possibly due to quality-related product characteristics of fish.

Abolition of tariffs on fish exports would increase Chilean fish exports to the EU by 7.4% and full trade liberalization, i.e., the elimination of tariffs and subsidies, would increase Chile's fish exports by 14.8%. However, this effect will probably occur in 2013, after a ten-year transition period.

3.2 Results for edible fruit and nuts (08)

The EU limits fruit imports via tariffs of about 12% and EU subsidies of around 5%. Additional seasonal tariffs do not apply to Chilean fruit exports coming from the Southern Hemisphere, but competition from Australia and South Africa are strong in the Chilean harvesting season. 97% to 98% of agricultural trade under the FTA agreement is to be liberalized over a ten-year period. This rule applies to both parties, the EU and Chile (European Parliament, 2005).

Econometric pre-tests showed that price competition with the EU countries was of noticeable importance. Competition was much heavier from Australia, as identified by $Ireer08aus$ and $Idtcaus$, than from South Africa. Therefore, competition from South Africa was not taken into account.

[Table 3]

According to column 2 of Table 3, a 10% increase in Chilean price competition with respect to the EU countries will increase Chile's fruit exports in real terms by 20.8%. Price competition from Australia carries the expected negative sign, but is insignificant. An increase in total real income has a significant positive impact on Chilean exports. An increase in PPP-per capita income differences, which can be interpreted as an increase in differences in fruit production costs between Chile and the EU, also has a positive impact on Chile's real fruit exports. Transport costs have a linear relationship with Chilean exports in the fruit sector. This implies that a deterioration of Australia's transport cost disadvantage¹⁷ steadily improves Chile's fruit exports. This result is in line with the findings of Limao and Venables (2001), who

¹⁶ Limao and Venables (2001) stress that long-distance trade (typically cross-continental) is a particular penalty for African exporters.

¹⁷ In terms of actual nautical miles Australia is farther away from the EU-market than Chile.

demonstrate on the aggregated level and for another sample of (African) countries that raising transport costs by 10% reduces trade volumes by more than 20%.

A look at β -coefficients shows that transports costs are of higher relative importance than total real income or price competition in the EU market.

As for the FTA effect, Chilean fruit exports could increase by 26.6% if tariffs were brought down to zero. They could even expand by 40.8% if both tariffs and subsidies were fully abolished. However, this huge effect would not be felt until 2013, after a ten-year transition period.

3.3 Results for beverages (22)

In the beverages sector, EU tariffs are as high as 25%. The average EU tariff on fruit and vegetable juices was even higher, at 28% (WTO, Trade Policy Review, European Union, 2000). EU subsidies amounted to about 5%. It is fair to say that EU protection puts Chile at a relatively strong disadvantage as far as price competition is concerned.

It should be noted that the FTA between Chile and the EU also includes a wine and spirits agreement. This will grant mutual respect of protected names and oenological practices, as well as increased market access on both sides (European Parliament, 2005). In the spirits and wine agreement, Chilean wine producers agreed to phase out the use of geographic labels such as Chablis, Burgundy, Champagne etc. over the next 12 years (starting in 2003). Under the deal, the EU has also agreed to cut tariffs on Chilean wine exports from 5 to 6% to zero over the next four years (Wines & Vines, 2003). The average EU tariff on wine is about 8%, but the EU tariff on Chilean wine is currently 5 to 6% due to preferential treatment¹⁸.

When checking for the relevance of non-EU competition in a pre-test, Australia did not turn out to be a threat for Chile, but South Africa did.

[Table 4]

Total real income has the expected positive and significant impact on exports. Chile's transport cost disadvantage with respect to South Africa impacts negatively on Chilean beverage exports. A 1% increase in transport cost disadvantage will lead to a 4.75% decrease in Chilean beverages exports. In general terms, this finding replicates the results of a study by Limao and Venables (2001) on African countries.

¹⁸ The margins of preference for which Mercosur countries and Chile are eligible under the European GSP (General System of Preferences) are only minor (Chaire Mercosur-Science Po, 2002-2003)

The abolition of tariffs on beverages would increase Chilean exports by 41.3% and the abolition of tariffs and subsidies would boost beverage exports by 53.0% and wine exports by 21.3%. Elimination of tariffs and subsidies would lead to a 33% increase in exports after a four-year transitional phase.

3.4 Results for ores, slag and ash (26)

According to the WTO Trade Policy Review, European Union, 2000, ores, slag and ash were tariff-free. Therefore, we do not expect that the FTA would cause any increase in exports in this sector. If the price vector stays the same, simulations with the model applied here show zero impact.

Since Australia and Brazil are the main exporters of ores, we tested the role of competition from these non-EU countries. However, their price competitiveness turned out to be irrelevant for Chilean export success. This could be due to the fact that Chile and Australia/Brazil produce ores of different qualities or in different sub-segments.

[Table 5]

According to column 2 of Table 5 only the coefficient of Brazil's price competitiveness is significant in the export regression, implying that an improvement of Brazil's price competitiveness will reduce Chile's exports of ores. However, the negative impact is very small. The β -coefficients point to the tremendous non-linear impact of transport costs in the trade of ores. Chile's disadvantage in transport costs first impedes Chile's exports, but after a certain point, it forces Chilean exporters to rationalize and cut costs, thus leading to no further decrease in exports.

Trade liberalization via an FTA between Chile and the EU will have no further impact on the export of ores, slag and ash since there was no tangible tariff protection in the base period.

3.5 Results for wood (44) and wood pulp (47)

According to Figures 2a and 2b, which display exports in real terms, Chile was able to maintain its wood exports and succeeded in expanding its wood pulp exports to the EU.

[Figure 2a]

[Figure 2b]

In the wood sector (44), Chile faced strong competition from the EU (Sweden, Finland) in the 1988-1996 period (see SHW44), decreasing its market share. Competition with non-EU countries (see SHNONEU44) such as Norway, Russia, and Canada was subject to up-and-down swings.

Regarding its competitive position in the wood pulp sector (47), Chile was able to increase its overall market share (see SHW47), especially with respect to non-EU countries (see SHNONEU47).

However, pre-tests on the relevance of price competition from non-EU countries (Norway, Russia, Malaysia, Thailand) in sectors 44 and 47 revealed their insignificance. Also EU price competition from Sweden and Finland turned out to be insignificant. Our investigation of this phenomenon revealed the global problem of illegal logging. As a result of this phenomenon, prices lost their signalling function and ecological groups drafted EU regulations to outlaw illegal wood imports (FERN, Greenpeace, WWF, 2004). Illegal logging distorted official trade flows not only of all timber products (roundwood, sawnwood, veneer, plywood, boards, semi-finished and finished products, and furniture, but also of pulp, paper, printed products and cellulose). Illegal logging is estimated to comprise up to 50% of all logging activity in the key countries of Eastern Europe and Russia, up to 94% in the key Asian countries, up to 80% in the key African countries and up to 80% in the key Latin American countries (WWF, 2005). Since the augmented gravity model (eq. 3a-b) does not apply in the case of wood and products thereof, an econometric export analysis was not performed.

3.6 Results for copper (74)

The relative price for copper differs from the real exchange rate concept applicable in the previously sectors investigated. Copper is traded on the major stock exchanges, where the world market price is determined. Accordingly, Chilean copper exports are determined by the Chilean peso-US\$ exchange rate, the development of world copper prices in the stock exchanges (e.g., London Metal Exchange (LME), New York Stock Exchange, Shanghai Stock Exchange), as well as by the Chilean GDP deflator, total real income or real income in the countries in need of copper, per capita income differences, and transport costs.

According to analysts from the LME, a negative correlation exists between the trade-weighted US\$ exchange rate and the copper price (base metal price index) (LME 2003, The Metals Seminar). With respect to Chile, this relationship implies that a devalued peso is accompanied by high copper prices, whereas an appreciated peso is accompanied by low copper prices. The coefficient of correlation is -0.92 for Chile. We construct a new variable 'rpcopper' (the Chilean copper price in real terms) that contains the nominal peso-US\$ exchange rate times the world copper price divided by Chile's GDP deflator. We expect a positive reaction of Chilean copper exports when the real copper price rises. This is because supplier countries are currently at a strong advantage given that world demand for copper exceeds world supply thanks to strong economic growth throughout Asia and especially in China.

Therefore we can set up the following log-log model for Chilean copper exports.

$$\text{Lxr74}_{ijt} = \alpha_{ijt} + \gamma_1 \text{lrpcopper}_t + \gamma_2 \text{lyt}_{ijt} + \gamma_3 \text{lydiff}_{ijt} + \gamma_4 \text{ldtcsaf}_t + \gamma_5 \text{ldtcsaf}_t^2 + u_{ijt} \quad (4a)$$

$$\text{Lxr74}_{ijt} = \alpha_{ijt} + \gamma_1 \text{lrpcopper}_t + \gamma_2 \text{lyr}_{jt} + \gamma_3 \text{lydiff}_{ijt} + \gamma_4 \text{ldtcsaf}_t + \gamma_5 \text{ldtcsaf}_t^2 + u_{ijt} \quad (4b)$$

+/- + + - - +

with

α_{ijt} = intercept; is modelled as a country-specific constant (fixed effect)

lxr74_{ijt} = log of real copper exports from Chile to EU country j in time t

lrpcopper_t = log of world market price of copper in real terms from the point of view of Chile over time¹⁹

lyt_{ijt} = log of total income of Chile (i) and importing country j in PPP terms in time t

lyr_{jt} = log of real income of importing country j in constant 1995 US\$ in time t

lydiff_{ijt} = log of per capita income differences in PPP terms between Chile (i) and j; can serve as indicator of differences in labour or production costs

ldtcsaf_t = log of transport cost disadvantage of Chile with respect to South Africa

We expect autonomous exports to be either positive or negative. An increase in Chile's real copper price is expected to give a positive incentive to copper exports since demand exceeds supply on a worldwide level. An increase in total real income

or real income of the importing country will lead to an increase of Chilean copper exports due to an increase in demand for copper in the production process. An increase in income differences should lead to an increase of Chilean exports due to a possibly underlying production cost advantage for Chile. And an increase in the transport cost disadvantage of Chile with regard to South Africa is expected to diminish Chilean copper exports starting at a certain level (non-linear relationship between transport costs and copper exports).

[Table 6]

The regression results presented in column 2 and 3 are very similar. Except for income differences, the coefficients carry the expected sign. Only total income or real income of the importing country have a positive and significant impact on exports, which points to the importance of growing economies' demand for copper to be used in manufacturing and production. None of the other variables have a significant impact on copper. Weighted R^2 is 0.93 and the correction for autocorrelation via FGLS leads to Durbin-Watson statistic of 1.87-1.88.

According to the standardized coefficient, transport costs are of strong relevance for copper exports, followed by variables such as real income that point to the importance of the business cycle both in the copper exporting countries and the copper importing countries (see column 4 and 5 of Table 6).

4. Conclusions

In the fish sector, real effective exchange rates and transport costs were important and significant determinants of Chilean exports to the EU. Fruit exports were determined by relative prices, total real income, differences in per capita incomes and transport costs. Exports of Chilean beverages (wine, juices) could be explained by total real income and transport costs. Relative price competitiveness was not significant, possibly pointing to the role of quality. As far as ores are concerned, an increase in Brazil's price competitiveness in the EU market had a negative impact on Chilean exports. Transport costs were unimportant in this sector. Copper exports were significantly determined by the business cycle in the exporting and importing

¹⁹ If $I_{rpcopper}$ is endogenous, then Dynamic OLS (DOLS), a relatively new method developed by Stock and Watson (1993), is called for. In our case, however, the time series are not long enough to apply the cointegration test and to perform DOLS.

countries. Again, a disadvantage in transport costs did not have a significant negative impact on copper exports.

Examining the role of transport costs more closely, we found that the transport cost advantage over Australia exerted a positive effect on Chilean fruit exports, independent of the level of transport costs reached, and that the transport cost disadvantage with respect to South Africa exerted a negative effect on Chilean wine exports, no matter how high transport costs. This finding points to a linear relationship between transport costs and exports in the fruit and beverage sector. We found a non-linear relationship between transport costs and exports in the fish sector, implying that transport costs cease to have a steadily increasing negative impact on fish exports once they have reached a certain level. Our results point to the tremendous importance of transport costs in the sectors agriculture and fishery. And in contrast to the above-mentioned sectors, transport costs did not have a significant influence on ores or copper exports.

The FTA between Chile and the EU is expected to have a noticeable, positive impact on fish, fruit and beverages, but only once the transitional phase of the FTA has been completed. With respect to an abolition of tariffs, fish exports would increase by 7.4% and fruit exports would rise by 26.6% after a ten-year transitional phase. Exports of wine would shoot up by 21.3% after a four-year transitional period.

From a policy perspective, Chile's strategy to negotiate bilateral trade agreements with a multitude of countries will certainly boost Chilean exports. Export success depends to a large extent on the degree of trade liberalization. This applies to agriculture and related sectors. Moreover, we have learnt that export success depends on the incidence of transport costs. Transport costs play a very important role in the food-related sectors, but are not relevant in the mineral-based industries.

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Tables

Table 1: Chile's seven most important export products

HS code	Sector	Av. export value in mill. current ECU (1988-2002)	Export value in mill. current ECU in 2002	Annual percent. change of exports (1988-2002)	Export share in 2002 ²⁰	Potential extra-EU competitor	Av. market share in the EU ²¹ (1988-2002)
03	Fish and crustaceans, molluscs	142.6	247.0	7.2 %	5.2 %	Norway	1.22 %
08	Edible fruit and nuts	371.5	476.6	7.5 %	10.0 %	South Africa, Australia, New Zealand	2.62 %
22	Beverages, spirits and vinegar	125.4	373.4	44.6 %	7.8 %	South Africa, Australia	0.77 %
26	Ores, slag and ash	331.3	434.9	11.9 %	9.1 %	Australia, Brazil, China	3.75 %
44	Wood and articles of wood	51.5	70.7	12.4 %	1.5 %	Norway, Russia, Canada, Malaysia, Indonesia	0.26 %
47	Pulp of wood	224.3	315.6	13.9 %	6.6 %	Norway, Canada,	2.89 %

²⁰ Share of Chile's sectoral exports in total Chilean exports.

²¹ Share of EU imports from Chile in total EU imports (both from other EU-countries and non-EU countries).

						Russia	
74	Copper and articles thereof	1,285.6	1,767.9	5.4 %	37.0 %	South Africa, Canada	10.34%

Source: EUROSTAT (2003); COMEXT CD ROM, 'Intra- and Extra-EU Trade, Annual data, Combined Nomenclature', European Commission ; own calculations.



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Table 2: Results from panel analysis and simulation in the fish et al. sector

	Exports (l _{xr03}) Panel regression results	Computation of standardized β -coefficients
Estimation method	FGLS combined with SUR	
Fixed Effects	Yes	
Lreer03	0.63** (t=2.02)	0.09**
Lreer03nor	0.50 (t=1.13)	0.09
Lyt	1.52 (t= 0.89)	0.18
Lydiff	0.26 (t=0.34)	0.015
Ldtnor	-61.17 *** (t=-2.79)	-17.09***
Ldtnor ²	3.36 *** (t=2.81)	17.64***
AR(1)	0.72*** (t=11.45)	
R ² unweighted statistics	0.90	
Standard error of regression	1.06	
DW unweighted statistics	2.37	
Simulation results		
Impact of Chile-EU FTA on Chilean fish exports		
Assumption: EU subsidy = 0.10 EU tariff = 0.12	7.4% increase in fish exports if tariffs are eliminated 14.8% increase in fish exports if tariffs and subsidies are abolished, After a ten-year transition period	

Table 3: Results from panel analysis and simulation in the fruit sector

	Exports (l _{xr08}) Panel regression results	Computation standardized coefficients	of β -
Estimation method	FGLS combined with SUR		
Fixed Effects	Yes		
Lreer08	2.08*** (t=4.66)	0.43***	
Lreer08aus	-0.08 (t=0.86)	-0.02	
Lyt	3.00** (t=2.21)	0.50**	
Lydiff	1.89** (t=1.98)	0.16**	
Ldtcaus	1.98*** (t= 3.20)	0.78***	
AR(1)	0.53*** (t=6.02)		
R ² unweighted statistics	0.90		
Standard error of regression	1.06		
DW unweighted statistics	2.04		
Simulation results Impact of Chile-EU FTA			
Assumption: EU subsidy = 0.05 EU tariff = 0.12	26.6% increase in fruit exports if tariffs are eliminated 40.8% increase in fruit exports if tariffs and subsidies are abolished After a ten-year transition period		

Table 4: Results from panel analysis and simulation in the 'beverages' sector

	Exports (l _{xr22}) Panel regression results	Computation of standardized β - coefficients
Estimation method	FGLS combined with SUR	
Fixed Effects	Yes	
Lreer22	1.54 (t=1.19)	0.11
Lreer22saf	-1.15 (t=-0.88)	-0.07
Lyt	4.66* (1.71)	0.26*
Lydiff	-1.82 (t=-1.34)	-0.05
Ldtcsaf	-4.75*** (t=-2.72)	-0.62***
AR(1)	0.64*** (t=9.11)	
R ² unweighted statistics	0.96	
Standard error of regression	1.05	
DW unweighted statistics	1.99	
Simulation results		
Impact of Chile-EU FTA on Chilean beverages		
Assumption: EU subsidy = 0.05 EU tariff = 0.25	41.3% increase in exports of beverages if tariffs are eliminated 53.0% increase in exports of beverages if tariffs and subsidies are abolished	

Table 5: Results from panel analysis and simulation in the 'ores, slag and ash' sector

	Exports (l _{xr26}) Panel regression results	Computation of standardized β - coefficients
Estimation method	FGLS combined with SUR	
Fixed Effects	Yes	
L _{reer26}	0.03 (t=0.06)	0.01
L _{reer26bra}	-0.04** (t=-2.12)	-0.32**
L _{yt}	-3.44 (t=-0.99)	-0.95
L _{ydiff}	0.06 (t=0.04)	0.009
L _{dtcbra}	-32.14 (t=-0.89)	-21.06
L _{dtcbra} ²	2.01 (t=0.86)	21.28
AR(1)	0.59*** (t=6.79)	
R ² unweighted statistics	0.86	
Standard error of regression	1.07	
DW unweighted statistics	1.92	
Simulation results		
Impact of Chile-EU FTA on Chilean ores exports		
Assumption: No noticeable protection → FTA without impact		

Table 6: Regression results for copper exports

	Exports (l _{xr74}) Panel regression results Eq. (4a)	Exports (l _{xr74}) Panel regression results Eq. (4b)	Standardized γ coefficients of column 2 Eq. (4a)	Standardized γ coefficients of column 3 Eq. (4b)
Estimation method	FGLS combined with SUR	FGLS combined with SUR		
Fixed effects	Yes	Yes		
L _r pcopper	0.37 (t=0.83)	0.43 (t=0.96)	0.26	0.30
L _y t	13.99*** (t=2.90)	-----	2.19***	----
L _y r ²²	-----	11.76*** (t=2.14)	----	1.85***
L _y diff	-2.00 (t=-1.00)	-3.12 (t=-1.24)	-0.16	-0.25
L _d tcsaf	-31.17 (t=-0.80)	-27.74 (t=0.63)	-11.61	-10.33
L _d tcsaf ²	2.30 (t=0.83)	1.94 (t=0.64)	13.03	10.99
AR(1)	0.79*** (t=9.73)	0.82*** (t=10.95)		
R ² unweighted statistics	0.93	0.93		
Standard error of regression	0.39	0.40		
Durbin-Watson statistics	1.87	1.88		
Simulation results				
Impact of Chile-EU FTA on Chilean copper exports				

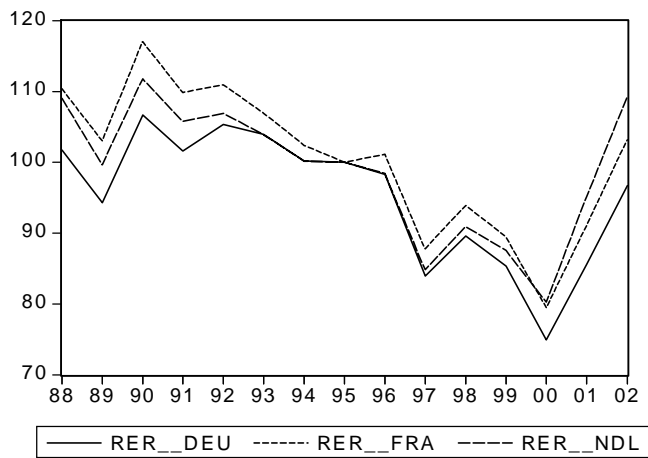
²² Here the real income of the importing country (l_yr) is used instead of total real income of the exporting and the importing country in PPP (l_yt).

Assumption : No noticeable protection → FTA without impact



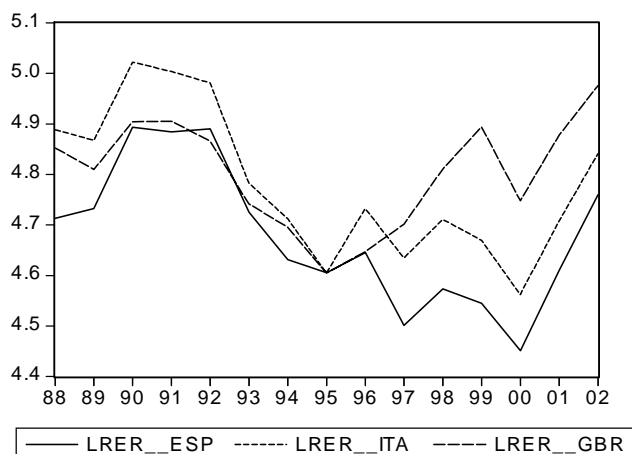
Figures

Figure 1a: Chile's bilateral real exchange rate with Germany, France and the Netherlands (1988-2002)



Source: World Development Indicators (2004); own calculations

Figure 1b: Chile's bilateral real exchange rate with Spain, Italy and UK (1988-2002)



Source: World Development Indicators (2004); own calculations

Figure 2a: Chile's exports of wood (44) and wood pulp (47) to the EU in the period 1988 to 2002

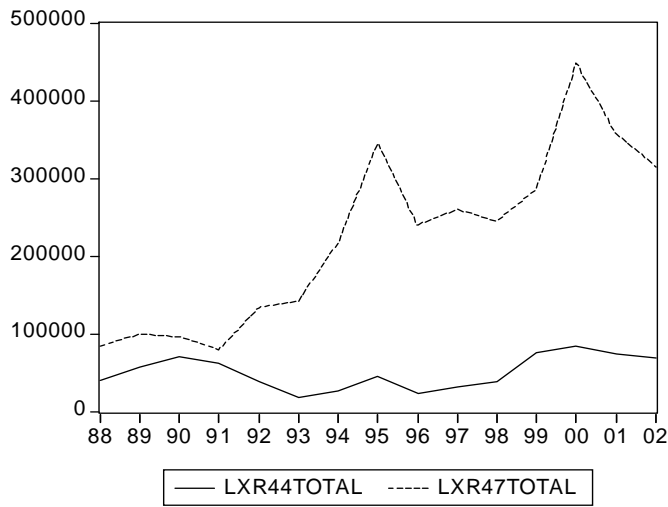
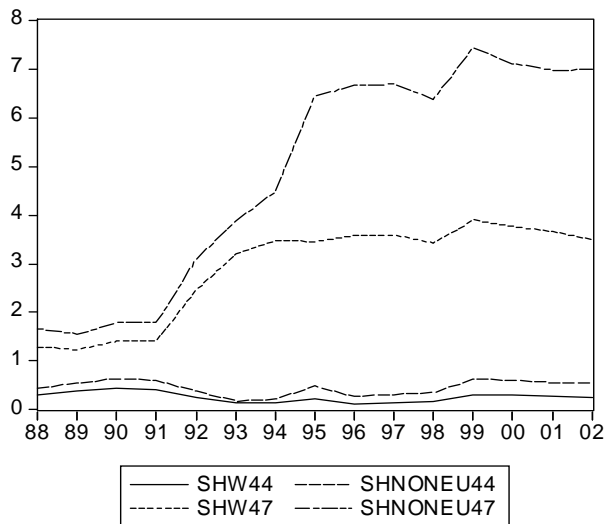


Figure 2b: Chile's market share in EU's imports of wood (44) and wood pulp (47) in the period 1988 to 2002



Appendix

Description of Data

In the following, the variables presented in Tables 2-6 and equations (3a-b) : l_{xr} , l_{yt} , l_{ydiff} , l_{reer} , l_{reer}^* , l_{tindex} and l_{dto}^* will be described in original form (not in logs). All data run from 1988 to 2002.

In our case, six cross-sections (6 EU countries: Germany, Spain, France, UK, Italy, the Netherlands) had overall complete time series.²³

(1) Chilean exports to the EU or EU imports from Chile: xr

The export data x (in 1000 ECU) are taken from the COMEXT trade database of EUROSTAT (Intra- and extra-EU trade, Annual data, Combined Nomenclature, Supplement 2, 2003). They have been converted into real terms data (from the point of view of Chile) by considering changes of the Chilean Peso exchange rate with respect to the ECU (EUR) and changes in the Chilean price level (as measured by the GDP deflator of Chile).

(2) Total income of the trading pairs in PPP: yt

The yt data stem from the 2004 World Development Indicators CD-ROM. This variable stands for PPP-income of Chile plus PPP-income of the relevant EU trading partner.

(3) Per capita income differences of the trading pairs in PPP: $ydiff$

The $ydiff$ series is taken from the 2004 World Development Indicators CD-ROM. It is computed as PPP-per capita income of relevant EU country minus PPP-per capita income of Chile.

(4a) The Chilean real effective exchange rate: $reer$

$reer$ is the bilateral real effective exchange rate between Chile and the EU countries (price quotation system) from Chile's perspective. It consists of the real exchange rate (rer) and basic indicators of EU protection such as EU tariffs (t) and EU subsidies (s).

It is computed (all data for 'rer' are taken from World Development Indicators CD ROM of 2004) as:

$$rer = e \cdot P_{EU}/P_{Chile} \quad \text{with}$$

rer = real bilateral exchange rate between Chile and relevant EU country

²³ Due to missing data, Austria, Belgium, Finland, Luxemburg and Sweden were excluded from the analysis.
June 28-29, 2010
St. Hugh's College, Oxford University, Oxford, UK

e = nominal exchange rate (x Chilean Peso/1EUR) between Chile and relevant EU country

P_{EU} = GDP deflator of the EU country under consideration with 1995 as base year (1995 $\hat{=}$ 100)

P_{Chile} = GDP deflator of Chile with 1995 as base year (1995 $\hat{=}$ 100)

rer has been adjusted for EU tariff protection (in terms of average EU tariff rate (t)) and non-tariff protection (in terms of EU subsidy rate (s)). Tariff rates prevailing in the EU can be found in Trade Policy Review European Union, Volume 1, 2000, pp. 88-101 (WTO) and rough subsidy equivalents are based on qualitative information on non-tariff protection collected, explained and nicely presented for UNCTAD by Supper (2001).

So we get:

$$reer = rer \cdot (1-s)/(1+t)$$

For the simulations, we assume that the FTA between Chile and the EU brings tariffs down to zero.

(4b) Chile's copper price in real terms: rpcopper

$$rpcopper = pcopper \cdot e_{RCHUS}/GDPDEF_{L_{RCH}}$$

with

$pcopper$ = world market price of copper in US\$ per ton

e_{RCHUS} = nominal exchange rate Chilean Peso/US\$ (price quotation system)

$GDPDEF_{L_{RCH}}$ = Chilean GDP deflator

(5) Chile's competitors real effective exchange rates :reer*

In analogy to (4) the real effective exchange rates of Chile's main competitors Norway, South Africa, Russia, Indonesia are computed. Nominal exchange rates, Norway's, South Africa's, Russia's and Indonesia's GDP deflators are computed from World Development Indicators CD ROM 2004. Tariff and subsidy rates are borrowed from WTO and UNCTAD (see (4)).

(6) Chile's transport costs to main EU ports: tcindex

The transport cost index consists of two components: 1) the actual distance via available sea routes (not great circle distance) between Chile and the EU country under consideration, converted from nautical miles into km.²⁴ Sea distance in km is widely regarded as appropriate because sea transport costs one-fifth of land

²⁴ http://www.maritimechain.com/port/port_distance.asp

transport! ²⁵ 2) a freight cost index²⁶ to be found in Busse (2003) citing Hufbauer (1991), Figure 6: Transport and Communications Costs, 1930-2000 (in 1990 US\$) that is extrapolated for the period of 1988 to 2002. Actual sea distance is multiplied by the freight cost index with base year 2002.

$$tcindex = kmsea \cdot fci$$

tcindex = transport cost (from Chile to relevant EU port)

kmsea = sea distance in km of Chile to relevant EU port

fci = freight cost index with 2002 as base year (2002 $\hat{=}$ 1)

(7) Transport cost differential between Chile and its main competitors: dtc

dtc measures differences in transport costs between Chile and Norway/South Africa etc. to the EU market multiplied through with the freight cost index in the period of 1988 to 2002.

$$dtc^* = (kmsea^* - kmsea) \cdot fci$$

dtc* = transport cost differential between Chile and extra-EU competitor *

kmsea* = sea distance in km of main extra-EU competitor (Norway, South Africa etc.) to relevant EU port

kmsea = sea distance in km of Chile to relevant EU port

fci = freight cost index with 2002 as base year (2002 $\hat{=}$ 1)

²⁵ This information was transmitted by fax on 17 August 2004 by the ShortSeaShipping Promotion Center, c/o Bundesverkehrsministerium für Verkehr, Bau- und Wohnungswesen (BMVBW Bonn ABTLG LS).

²⁶ Average ocean freight and port charges per short ton of import and export cargo.