

Dissecting the Chilean Export Boom*

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Abstract

Since 1975, Chilean exports have boomed, growing at a 6% average rate per year in real terms. In this paper, we use Chilean micro data at the level of firms to empirically investigate the relationship between exports, plant dynamics, and productivity. Our findings are consistent with the predictions of the new heterogeneous firms' trade theories. First, most of the increase in exports came from new exporters (63.3% of total export growth), rather than from increasing export intensity at existing exporters. Second, we show that productivity and exports have co-moved over the Chilean boom. Moreover, the exports expansion is associated to a productivity enhancing reallocation of resources towards more efficient plants.

JEL Classification Codes: F14, L10, L60.

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1. Introduction

Recent empirical research based on plant level data has consistently shown that there is wide heterogeneity in productivity across units, even within narrowly defined sectors at any given period of time. Thus, as several studies document, the reallocation of inputs and outputs is a key source of productivity gains and aggregate growth. New heterogeneous firms' models have analyzed these intra-industry effects in the context of international trade. Melitz (2003) and Bernard, Eaton, Jensen and Kortum (2003) developed alternative models of international trade that predict that only the more productive firms exports, and that the industry's exposure to trade induces aggregate productivity gains due to reallocation effects -- effects that are completely ignored by the standard representative firm framework. A growing body of empirical literature has studied the extent and causes of productivity differential between exporters and non-exporters.¹ There is little evidence on the relevance of trade-driven reallocation effects.

In this paper we analyze these exporter facts and the relative relevance of firm heterogeneity in the dynamics of aggregate exports, using a sample of Chilean manufacturing firms over the 1990 - 2001 period. Specifically we empirically investigate the microeconomic sources of trade and their effects on economic units at both, the extensive and intensive margins. To do so, we study the relationship between exports intensity, reallocation, entry and exit, both across sectors and economic units, and across exporters and non exporters. The analysis also considers the role of efficiency. Several previous studies have looked at the facts on reallocation and within-plant productivity gains using data on Chilean plants. However, they focus on limited data as they typically consider a period of time too early and short, failing to account for lag of the effect of reforms on aggregate economic efficiency.

The Chilean experience is interesting for several reasons. On the one hand, the Chilean economy underwent a deep and extensive trade liberalization reform. Liberalization in Chile started in the mid 1970s. During the 30 years that followed, Chilean exports have grown on average at a 6% rate per year in real terms. This export boom dramatically changed the level of trade as well as its composition, and the productive structure of the economy. On the other hand, although there was a partial reversal of the unilateral tariff reduction process after the early 1980s crisis, trade liberalization continued after 1985. Moreover, policy moved towards bilateral agreements since 1992. As a matter of fact, over the last decade, Chile has signed trade agreements with the US, Canada, the European Union, Korea, and Mexico, among other countries. Thus the data considered in this study cover a period after major reforms had already been under way for over a decade, but at the same time, a period characterized by active bargaining of preferential trade agreements. This change provides a rich environment for a better understanding of the link between trade and industrial and plant dynamics.

¹ See Wagner (2005) for a recent survey of papers analyzing the longitudinal plant level surveys. The evidence indicates that the most productive firms self-select into entering export markets. However, there is mixed evidence on export-driven learning effects.

Our findings are consistent with the predictions of the new heterogeneous firms' trade theories. First, most of the increase in exports came from highly intensive new exporters, rather than from increasing export intensity at existing exporters. Second, we show that productivity and exports have co-moved over the Chilean boom. Moreover, the export expansion is associated to a productivity enhancing reallocation of resources towards more efficient plants.

The next section of the paper overviews trade reforms and the recent trade boom in Chile. In Section 3 we describe the data we use and some basics plant-level facts that characterize Chile's manufacturing exports. Section 4 dissects exports by looking at their main sources of growth. Then, we study the link between export growth and productivity. The final section concludes.

2. Trade reforms and the Chilean exports boom: An overview

In June 2002, Chile signed a Free Trade Agreement with the European Union; a year later, a similar agreement was signed with the US. These negotiations marked the culmination of three decades of free trade policies and have consolidated Chile as one of the more open economies in the world.

Today, few question the significance of the trade liberalization program initiated in the mid 1970s in shaping the economic transformation of Chile over the past few decades.² The scenario was very different three decades ago, however. By the late 1960s, trade restrictions had practically isolated the Chilean economy from the rest of the world, exacerbating its dependence on copper exports and confining imports to intermediate and capital goods. The structure of relative prices was drastically distorted in favor of industrial goods at the expense of agricultural, mining and other tradable activities. Differential import duties exempted capital goods and levied high taxes on final goods, creating a largely inefficient capital-intensive industrial sector.

For instance, import tariffs ranged from 0 percent for capital goods to 750 percent for luxury goods, there was a requirement of a 90-day non-interest bearing deposit of 10,000 percent of the CIF value of imported goods, and all import operations were required administrative approval. In addition, a system of multiple exchange rates prevailed reaching, at the collapse of the economy in 1973, a 52 to 1 ratio.

In the 5 years that followed the 1973 crisis, trade liberalization policies were to be the cornerstone of the transformation of the inward-oriented Chilean economy into a dynamic export oriented country. The initial set of trade reforms were intended to simplify the structure of the economy. Consistently, exchange markets were unified, most non-tariff barriers (quotas and prohibitions) eliminated, and tariffs drastically reduced to a uniform 10 percent by 1979.

²The Chilean economic transformation has been extensively documented by Edwards and Cox-Edwards (1991), de la Cuadra and Hachette (1991), and Bosworth, Dornbusch and Labán (1994), among others.

During the 1976-80 period the economy recovered at high speed: GDP grew at an average rate of 7%. Moreover, the availability of foreign goods expanded markedly, and the government deficit turned into a surplus. In addition, an important number of reforms were initiated to complement and reinforce the change in relative prices induced by trade deregulation. Among them, a large number of public enterprises were privatized, labor markets were deregulated, social security was reformed, and health and public education responsibilities were transferred from the ministries to the county levels. Although reforms advanced in several fronts, two major problem remained unsolved: unemployment levels did not decline in a significant way, and inflation remained stubbornly high. Among the instruments used to control inflation, the fixing of the nominal exchange rate in June, 1979, proved to have a devastating effect. The highly indexed nature of the Chilean economy, in combination with the fixed exchange rate, induced an increasing real exchange rate overvaluation, fostering imports and discouraging exports, and leading to large current account deficits. In 1981, the external deficit reached 14.5% of GDP. Large amounts of foreign loans entered the country to finance the trade imbalance and, as a consequence, the foreign debt increased from US\$6 billion in 1977 to US\$14.8 billion in 1981. Two additional elements also helped inducing the observed rise in the level of indebtedness: the resistance of the real interest rate to converge to world levels, and the deregulation of the financial market in 1981. The former induced a continuous flow of short-term lending; the lack of adequate supervision of the quality of the portfolio of banks in the latter, led to a generalized miscalculation of risk levels, imprudent and related domestic lending (Barandarián and Hernández, 1999).

With such a large trade imbalance, confidence in the Chilean economy faltered and foreign lending ceased. In June, 1982 the authorities were forced to devalue the peso by 19%, but "it was too little, and too late" (Edwards and Cox-Edwards, 1987). The economy fell in a deep recession as GDP dropped by 13.4% in 1982 and a further 3.5% in 1983; unemployment, already high, skyrocketed to 34% of the labor force (including emergency employment programs), and the government deficit increased to almost 9% of GDP when the Central Bank had to rescue the financial sector from bankruptcy. Foreign debt reached 130% of GDP in 1983.

This recession led authorities to partially reverse the openness policies. In particular, the mean tariff was raised up to 26% by 1985. Since then, however, the reduction in tariffs continued. In 1990, with the return to democracy, the commitment to openness was not altered. As a matter of fact, average tariffs continued to be reduced in a gradual manner from around 15% in 1988 to 4% in 2004. Figure 1 reports mean tariffs during the last 3 decades.

One important change defined trade policy during the 1990s: since 1992, bilateral agreements were incorporated into the overall liberalization strategy. A decade later Chile had signed trade agreements with most economies in the world. Today, more than 90% of Chilean exports are subject to some kind of agreement.

Summing up, only during the late 1980s and early 1990s the Chilean economy fully reaped the benefits from the changes in economic incentives and productive structure that came

with trade reforms. Overall, exports evolved consistently, booming during most of the period. Figure 2 shows that from 1975 to 2004, total exports rose almost six-fold, much faster than GDP. Manufacturing exports followed a similar pattern. During the 1990-2001 period, manufacturing exports as a fraction of manufacturing sales almost doubled from 14% to 24%.³

3. Exporter facts

Since Bernard and Jensen (1995), several regularities describing exporters have been established. In particular, only a small fraction of firms sell their output in foreign markets. Moreover, they tend to be more productive and larger, and they usually export a small proportion of their sales.⁴

Data from U.S. plants studied by Bernard et al. (2003) provide empirical support for these facts. First, only 21% of plants in the U.S. Census of Manufactures, report some exports. Of those, most sell less than 10% of their output abroad. Fewer than 5% of the exporting plants export more than 50% of their production. Second, exporters are larger, shipping on average 5.6 times more than non-exporters. Finally, the productivity of exporters is substantially higher than the productivity of non-exporting firms. Eaton, Kortum and Kramarz (2004) show a similar pattern using French manufacturing firm-level data.

Recent theoretical models of international trade with heterogeneous firms and fixed and variable costs can account for these facts. In Melitz (2003), the economy is characterized by intra-industry selection through productivity heterogeneity across firms producing in monopolistic markets. Firms face initial uncertainty concerning their future productivity when making an irreversible investment decision that allows them to enter the domestic market. In addition to the sunk entry cost and per period fixed costs, firms face both fixed and per-unit export costs. Along the same line, Bernard et al. (2003) develop a model of Ricardian differences in technological efficiency and imperfect competition with variable markups. Both models predict that only a subset of relatively more productive firms export, whereas the remaining, less productive firms serve the domestic market only.

In this section we analyze these exporter facts for Chilean plants using the data from the *Encuesta Nacional Industrial Anual* (ENIA), an annual survey of manufacturing conducted by the Chilean statistics agency, the *Instituto Nacional de Estadísticas* (INE). The ENIA covers all manufacturing plants that employ at least ten individuals. Thus, it includes all newly created and continuing plants with ten or more employees, and it excludes plants that ceased activities or reduced their hiring below the survey's threshold. We observe plants and not firms in our data set. In other words, we are unable to distinguish single-plant firms from multi-plant firms.⁵

The ENIA extends from 1979 to 2001, and contains detailed information on plant characteristics, such as manufacturing sub-sector at the 4-digit ISIC level, sales,

³ We have considered all sectors but copper. See below for a discussion.

⁴ See Bernard and Jensen (1995 and 1999), and Clerides et al. (1988).

⁵ According to Central Bank statisticians, about 3.5% of plants belong to a multi-plant firm in our data set.

employment, investment, intermediate inputs and location. Data on plant-level exports were collected starting in 1990 only. Thus, our analysis will consider the 1990 – 2001 period. All nominal variables were deflated at the 3-digit ISIC level, using deflators constructed from the wholesale price indices compiled by the INE. Capital series were constructed using information on investment and depreciation (Bergoeing et al., 2005). Our analysis considered all 29 3-digit ISIC sectors but copper – sector 372 – since national accounts include some copper exports within the manufacturing sector, and not within mining as in most countries. Moreover, copper has always been a relevant exporting commodity, since long before trade was liberalized. Over the 12 years considered, sector 372 represents on average 17% of total value added in the ENIA.

The data show that Chilean plants display many similarities to their US counterparts. Table 1 summarizes our findings. On the one hand, the fractions of manufacturing plants that export are almost the same. According to the ENIA, 79.2% of plants sell all their production in domestic markets, whereas 20.8% sell some output abroad. Their export intensity is much higher in Chile, however. For instance, more than 25% of Chilean plants sell more than 50% of their output abroad, whereas only 5% of US plants do so. This fact suggests that local market size plays a role in shaping the distribution of export intensity but not for the number of exporters. At first, this seem a counter-intuitive results but it may be explained by higher exports fixed costs and the lack of a well developed financial markets that increases the number of firms that cannot finance the inicial export costs.

On the other hand, as in the US, labor productivity of Chilean exporters is much larger than non exporters' labor productivity. However, the efficiency gap between these plants is much larger in Chile (57% on average). This difference is consistent with the existence of higher export costs in Chile. Figure 3 shows that the distribution of plant-level productivity (relative to sector/year averages) of exporters is located to the right of their non exporter counterparts.

Table 1 additionally shows that exporters are also larger than non-exporting firms. Moreover, exporters have higher capital/labor ratios and lower shares of wages in total value added. Chile is a low wage country; thus, one would expect exporters to be more labor intensive. Several explanations may account for this anomaly. First, manufacturing goods are being mostly sold to other Latin American countries. Therefore, it is not necessarily the case that, in this context, Chile is a labor abundant country. Second, non-exporters are more likely to be liquidity constrained, and thus might face higher capital costs. Third, as explained in Treffer (1993), one should measure labor in effective units. If not, human capital, a scarce resource in Chile relative to developed economies, is included in total labor.

Finally, the table shows that all of these firm's characteristics are correlated with plant export intensity, as plants that export a larger share of their sales, tend to be more productive, larger, and more capital intensive.

4. The micro dynamics of Chilean exports

The recent theories of international trade predict that increasing exposure to foreign markets due, for instance, to a fall in transport costs, lead to a reallocation towards most productive firms. As the cost of entering export markets falls, most efficient firms, within those that used to sell its output only in domestic markets, find now profitable to pay the costs of selling abroad and therefore increase their share in sectoral output. If variable costs fall, then old exporters increase their export intensity and therefore their share in sectoral output, whereas if fixed costs fall, these firms do not change their sales pattern. In any case, the least productive firms are forced to exit, as the increased demand for domestic inputs bids up real production costs. The reallocation driven by the increased exposure to trade delivers gains in terms of aggregate productivity growth.

A number of recent papers have looked at the effects of trade on productivity dynamics. Bernard, Jensen and Schott (2004) show that, using US manufacturing data, productivity growth is faster in industries with falling trade costs. Low productivity plants in these industries are more likely to exit, whereas high-productivity non-exporters are more likely to start selling abroad. Their results, thus, are consistent with the existence of productivity enhancing reallocation effects associated to trade.⁶

Bernard and Jensen (2004) studied the recent export boom in the U.S. by examining the role of entry, firm expansion, and export intensity. They found that most of the increase in manufacturing exports came from increasing export intensity at existing exporters rather than from new entry into exporting. They also find that changes in exchange rates and rises in foreign income drove most of the export boom, while plant productivity increases played a smaller role.

However, other evidence is mixed. For example, Kehoe and Ruhl (2003) examine the bilateral trade patterns, by commodity, of countries involved in significant trade liberalization processes, finding a striking relationship between a good's pre-liberalization share in trade and its subsequent growth. The goods that were traded the least before liberalization account for a disproportionate share in trade following the reduction of trade barriers.

The connection between trade liberalization and plant dynamics using firm level data for Chile has been studied by Pavcnik (2002) and Irarrazabal and Opromolla (2005). Using a difference-in-difference approach and data for the year 1979-86, Pavcnik shows that plants in export-oriented and import-competing sector became more productive by the end of the sample period. Pavcnik does not analyze the relative relevance of reallocation-driven productivity gains due to liberalization. An important caveat of Pavcnik's work is that, as Figure 1 shows, tariffs were much higher in 1986 than in 1979: the actual direction in trade openness is opposite to that assumed by the study.

Irrarrazabal and Opromolla use the Bernard et al. (2003) model to simulate the effects of the Chilean liberalization. The model predicts that a 50% reduction in trade barriers leads to a 24% change in aggregate productivity. About 72% of the gains are due to within plant

⁶ It is worth noting that Bernard et al. (2004) use US import costs, rather than export costs, as their measure of trade costs. These do not necessarily change in a symmetric manner.

gains, and 26% due to the exit of less efficient plants. Reallocation and entry effects are quantitatively unimportant. Their simulation results do not disentangle the effects due to entry into export markets, or the reallocation towards the most productive exporters – it focuses on aggregate market effects without distinguishing exporter from non exporter behavior. Thus, one of the predicted channels of productivity gains –entry into export markets-- cannot be accounted for from their results. Moreover, the model is calibrated to account for the 1992 exporter facts (productivity and sales advantage of exporters relative to non exporters). Thus, it is implicitly assumed that 1992's productivity structure is a good characterization of the pre-liberalization structure. The model is then simulated, to study the effects of trade barriers reduction, mimicking the falling trade costs between 1975 and the early 1980s. Trade barriers --and thus the advantage of exporters--were likely much lower in 1992 than in the early 1980s. So their results might underestimate the true gains from intra-firm reallocation that were driven by the liberalization of Chilean trade⁷.

In this section we use Chilean manufacturing data for the 1990-2001 period to dissect the evolution of exports by disentangling the relevance of the different margins. In particular, we consider entry-exit, plant growth, and export intensity. To do so, we look at the contribution of continuing exporters, new exporters – both from new plants and from previous non-exporters, and exiters.

Table 2 shows the annual average growth rates by sector, and the change in export intensity at the sector level. According to the ENIA, manufacturing real exports grew at a 7.4% annual rate. There is wide heterogeneity in growth rates: for instance, footwear exports – sector 324 – fell dramatically (almost by 20% per year), whereas the exports of professional and scientific equipment – sector 385 – grew at almost 40% per year⁸. For most sectors, these export growth rates were much larger than sales growth rates, a fact that is reflected in the rising export intensity. Overall, in only ten years, the ratio of manufacturing exports over sales grew from 13.3% to 22%.

4.1 Entry and export intensity effects

The bold line in Figure 3 depicts the evolution of aggregate manufacturing exports in the ENIA over our sample period.⁹ The graph shows that exports rose steadily at an annual growth rate of almost 11% between 1990 and 1997, despite the Tequila crisis that hit many Latin American economies during the mid 90s. After dropping in 1998 and 1999, at the timing of the Asian crisis, total exports quickly recovered.

The figure also shows the evolution of the fraction of firms that export, and of the aggregate export intensity. The fraction of exporting firms grew steadily until 1995. It then stayed almost constant, with a slight decline by the end of the sample period. In 1992 and in 2001, the fractions of exporting firms were nearly identical. Additionally, exports and the proportion of sales sold abroad evolve similarly. Table 3 presents the export intensity

⁷ The authors are forced to calibrate based on 1990s data, as the ENIA covers export behavior only since 1990.

⁸ According to WTO data, footwear imports are within the highest growing 25th percentile of all Chilean imports in the recent years.

⁹ Natural log of exports in 1992 US dollars.

distribution. Clearly, the distribution shifted to the right over the decade, suggesting intensity may be relevant to account for the sharp increase in exports in Chilean manufacturing. The fraction of total firms exporting did also increase during the period, although only marginally, from 17.8% in 1990 to 20.3% in 2001.

Table 4 provides some striking evidence on the importance of net entry into export growth. Total exports increased 90% between 1990 and 2001. Of the total change in the real level of exports, 96.7% is accounted for by new exporters. That is, plants that were either not in the market or not exporting in 1990, contribute to the total increase in exports with an amount similar to the total observed rise. Continuing plants contribute with 37% of this increase. Finally, since exiting plants generate a reduction of 33.7% of the total increase in exports, net entry contributes with 63%.

This finding contradicts the evidence reported by Bernard and Jensen (2004) for the export boom in the US. They report that most of the US boom in exports is explained by existing exporters rather than by entry. Bernard and Jensen define new exporters as plants that are exporting in 1992 and were not producing in 1987, not even for the domestic market. We believe that classifying new exporters that were previously producing as continuers, underestimates the relevance of entry into export markets. Once one corrects this misclassification, entry accounts for 62% of the US export boom, instead of the 29% reported in their paper. That is, both economies display the same regularity.

In fact, Table 5 disentangles the total growth of exports into the percent growth of the number of exporters, and the growth of average exports per firm. Columns (2)-(4) present this decomposition for total real sales (in 1992 US dollars), whereas columns (5)-(7) show the real export figures. Total sales grew only by a 25% over the whole period. This growth is mostly explained by the average sale per firm, as the number of firms decreased during the period. The results for export growth are significantly different. First, total export grew much more: 90%. Second, more than 80% of this growth is explained by the expansion of exports per firm, whereas only less than 20% is due to the number of firms that export. The rapid growth of exports per firm relative to sales per firm, confirms the fact that exporters are much larger than average.

These facts, however, do not allow for differences across plants according to their export status (new, old and failing exporters). To estimate their relative contribution we measure the significance of each margin as a source of the export boom. That is, we look not only at the number of firms and the fraction of sales exported, but also at the contribution of continuing, exiting, and new exporters. For instance, if new exporters export a larger share of their sales than previous exporters, even a small entry of firms may end up contributing largely to export growth. To examine this decomposition, we disentangle the increase in aggregate exports into three components:

$$\Delta X_{90-01} = \left(\frac{X_{c,01} - X_{c,90}}{C} \right) C + \left(\frac{X_{EN}}{EN} - \frac{X_{EX}}{EX} \right) EN + \frac{X_{EX}}{EX} (EN - EX)$$

where X is the aggregate change in exports during the period; C , EN and EX denote the number of continuing exporters, new exporters and failed exporters, respectively; and X_i is exports by type i , $i = \text{old, new and failed exporters}$. Thus, exports may rise because continuous plants get bigger on average, because new exporters are bigger than failed exporters, and because the number of firms increases.

Moreover, we decompose the increase in exports into changes in intensity and changes in sales of continuing exporters, and net entry -- new exporters minus failed exporters --. That is,

$$\Delta X_{90-01} = \left(\frac{X_{01}}{S_{01}} - \frac{X_{90}}{S_{90}} \right) S_{90} + \left(\frac{X_{01}}{S_{01}} \right) (S_{21} - S_{90}) + \left(\frac{X_{EN}}{S_{EN}} \right) S_{EN} - \left(\frac{X_{EX}}{S_{EX}} \right) S_{EX}$$

where S_t denotes sales in period t . The first and second terms represent the contribution of the changes in the intensity and sales of continuing plants, respectively; the third term is the contribution due to new exporters and the final terms the (negative) contribution of the failed exporters.

Tables 6 and 7 display these decompositions. When the total export change is decomposed into the contribution of changing size, intensity and number of exporters, net entry contributes 63.3% of export expansion. The contribution of new exporters net of failed exporters accounts for a similar fraction of total sales change.

Looking at exports per plant, only 36.7% of the change in average exports is explained by continuous plants getting larger, whereas, as already presented in Table 4, 63.3% of the change in exports is due to the contribution of net entry. For sales, the findings are similar, although the contribution of net entry due to changes in the number of producers is 19.8 percentage points, twice as big as for exports. The net entry contribution is the combined result of two elements. First, entering plants are larger (average exports per firm) than failing exporters, accounting for 53.7 out of 63.3 percentage points. Second, there is a positive net entry of plants, an effect that accounts for the remaining 9.6 percentage points.

Finally, Table 7 provides further support for our regularity: New exporters are the most relevant source of the exports rise, because they are more intensive on average. In the data, continuing plants increased their export intensity from 20.4% in 1990 to 30.5% in 2001, whereas new exporters in 2001 sold abroad 41.2% of their sales. Exiting plants only exported 27.5% of their sales. Thus, again, net entry contributes 63.3% of manufacturing export growth during the 1990 – 2001 period in Chile.

4.2. Productivity gains

The new trade theories stress that the exposure to foreign competition induces productivity enhancing resource reallocation across economic units. In this section we analyze the

relevance of reallocation in generating productivity gains over the Chilean export boom. This hypothesis is contrasted to the role of within-plant productivity gains that may result from international competition. Knowledge flows from international markets, and the exposure to more intense competition, both may induce exporting firms to become more productive. In addition, better access to financial markets implies that exporters have higher capital labor ratio and therefore a higher labor productivity.

In what follows we generate aggregate industry measures of labor productivity, as weighted average of plant level labor productivity; i.e.,

$$prod_t = \sum_{j=1}^J f_{jt} prod_{jt}$$

where $prod_t$ is aggregate labor productivity in period t, and f_{jt} is the share of plant j's employment out of sectoral employment at the plant-level in year t.

We quantify changes in productivity due to reallocation by using Olley and Pakes (1996) cross-sectional decomposition. This decomposition allows us to disentangle the contribution of reallocation from less to more productive plants and mean productivity into actual productivity. The decomposition of $prod$ is given by

$$prod_t = \overline{prod}_t + \sum_{j=1}^J (f_{jt} - \overline{f}_t) (prod_{jt} - \overline{prod}_t)$$

The first term of the decomposition is the average cross-sectional (unweighted) mean of productivity across all plants in sector j at year t. The second term is intended to know whether employment (production) is disproportionately located at plants with higher productivity.

Table 8 depicts the evolution of cross industry average $prod$, with $prod$ normalized in 1990 to 1. The table also shows the relative importance of the evolution of the sample average and the cross term. The figures indicate that reallocation towards more productive firms has become more relevant over the decade, in a similar way as exports have becomes more relevant for manufacturing. In fact, the simple correlation between the relative importance of the cross term and the total exports in manufacturing is .75.

In Table 9 we study the correlation between exports and these productivity measures at the sector level. In order to do so, we run regressions such as

$$\ln X_{st} = \alpha_s + \beta * \ln prod_{st} + \delta * trend_t + \varepsilon_{st}$$

where X_{st} denotes exports in sector s at period t , α_s is a sector fixed effect, $prod_{st}$ is a measure of productivity, and $trend_t$ is a time trend. Column 1 of Table 9 shows that elasticity of $prod$ to exports is equal to 0.052. Thus growth in exports is actually correlated with growth in aggregate labor productivity. Column 2 uses the simple average of labor productivity to find an elasticity of 0.04. This finding indicates that export growth is correlated within firms' productivity gains. The third column replicates the exercise of column 1 controlling for the log of the simple average of productivity. Thus, the estimated elasticity of weighted productivity to exports captures the covariance term in the decomposition. Our result shows that this reallocation term is indeed significantly correlated with export growth. Column 4 uses the relative importance of the covariance term as the dependent variable. We find a weak evidence of a significant elasticity. The second panel of the table repeats these exercises using a robust regression framework to down-weight outliers. Now we find that all elasticities are positive and statistically significant. In particular, we find that the relative importance of the covariance term is increasing with export level (significant at the 5 percent level).

Summing up, our results suggest that productivity and exports have co-moved over the Chilean boom. Moreover, as exports have expanded, there has been a productivity enhancing reallocation of resources towards the more efficient plants. These facts are consistent with the predictions of the new heterogeneous firms' trade theories.

5. Concluding remarks

We have used a decade of Chilean plant-level manufacturing data to empirically investigate the relationship between exports, plant dynamics, and productivity. We have found that 63.3% of the increase in exports is due to new exporters – both, previously producing and not -- net of failed exporters. Moreover, 53.7 percentage points of the net entry contribution result from changes due to the larger size – average exports per firm – of new exporters and only 9.6 percentage points from the increase in the number of exporters. Additionally, the export intensity (exports over sales) of new exporters is much higher than that of continuing and failing exporters. Thus, increasing export intensity at existing exporters accounts for close to one third of total export rise. When defining all margins consistently, results for the 1987-1992 US export boom are strikingly similar.

Finally, we show that productivity and exports have co-moved over the Chilean boom. Moreover, the exports expansion is associated to a productivity enhancing reallocation of resources towards more efficient plants.

Our findings provide support for the predictions of the new heterogeneous firms' trade theories, and highlight the connection between exports and productivity growth.

6. References

- Barandiarán, E. and L. Hernández. (1999), "Origins and Resolution of a Banking Crisis: Chile 1982-86," Banco Central de Chile, Working Paper 57.
- Bergoeing, R. P. J. Kehoe, T. J. Kehoe and R. Soto. (2002), "A Decade Lost and Found: Mexico and Chile in the 1980s." *Review of Economic Dynamics*, 5(1), pp. 166-205.
- Bergoeing, R., A. Repetto, and R. Soto. (2004), "Unveiling the Micro-Dynamics of Sustained Growth in Chile." Documento de Trabajo 248, Instituto de Economía, Universidad Católica de Chile.
- Bernard, A. B. and J. B. Jensen. (1995). "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987." *Brookings Papers on Economic Activity: Microeconomics*. 67-119.
- Bernard, A. B. and J. B. Jensen. (1999).
- Bernard, A. B., J. Eaton, J. B. Jensen and S. Kortum. (2003). "Plants and Productivity in International Trade." *American Economic Review* 93, 1268-1290.
- Bergoeing, R., A. Hernando y A. Repetto (2003). "Idiosyncratic Productivity Shocks and Plant-Level Heterogeneity". Documento de Trabajo # 173, Centro de Economía Aplicada, Universidad de Chile.
- Camhi, A., E.Engel, and A.Micco. (1997) . "Employment and Productivity Dynamics in Chilean Manufacturing: Micro Evidence and Macro Consequences." In F.Morandé and R.Vergara (eds.), *Empirical Analysis of Growth in Chile*, Santiago: CEP and ILADES, 197-225.
- Clerides et al. (1988)
- Corbo, V. and S. Fischer (1994), "Lessons from the Chilean Stabilization and Recovery," in B. Bosworth, R. Dornbusch, and R. Labán, editors, *The Chilean Economy: Policy Lessons and Challenges*. Washington, DC: The Brookings Institution, 29-67.
- Davis,S., J. Haltiwanger and S. Schuh.(1996). *Job Creation and Destruction*. MIT Press.
- De la Cuadra, S. and D. Hachette (1991), "Liberalizing Foreign Trade, The Experience of Chile," in D. Papageorgiou, M. Michaely, and A. Choksi, editors, *Liberalizing Foreign Trade*. Oxford: Basil Blackwell, 169-231.
- Edwards, A. and S. Edwards, (1991), *Monetarism and Liberalization: The Chilean Experiment*. Second edition. Cambridge, MA: Harper and Row.
- Foster, L., J.C. Haltiwanger, and C.J. Krizan (1998), "Aggregate Productivity Growth: Lessons from Microeconomic Evidence", *NBER Working Paper* # 6803.

Kehoe, T. and K. Ruhl (2003). "How Important is the New Goods Margin in International Trade?"

Liu, L. (1993). "Entry-Exit, Learning and Productivity Change: Evidence from Chile." *Journal of Development Economics* 42, 217-242.

Micco, A. (1995). "Creación, Destrucción y Reasignación de Empleos en Chile." M.A. Thesis, Universidad de Chile.

Olley, S. and A. Pakes. (1996). "The Dynamics of Productivity in the Telecommunication Equipment Industry." *Econometrica* 64 (6), 1263-1298.

Pavcnik, N. (2002). "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants." *The Review of Economic Dynamics*, 69 (1), 215-242.

Roberts, M.J. and J.R. Tybout. (1997). "The Decision to Export in Colombia: An Empirical Model of Entry and Sunk Costs." *American Economic Review*, 87 (4), 545-64.

Trefler, D. (1993), "International Factor Price Differences: Leontief was Right!" *Journal of Political Economy*, 101, 961-987.

Figure 1: Average Nominal Tariffs

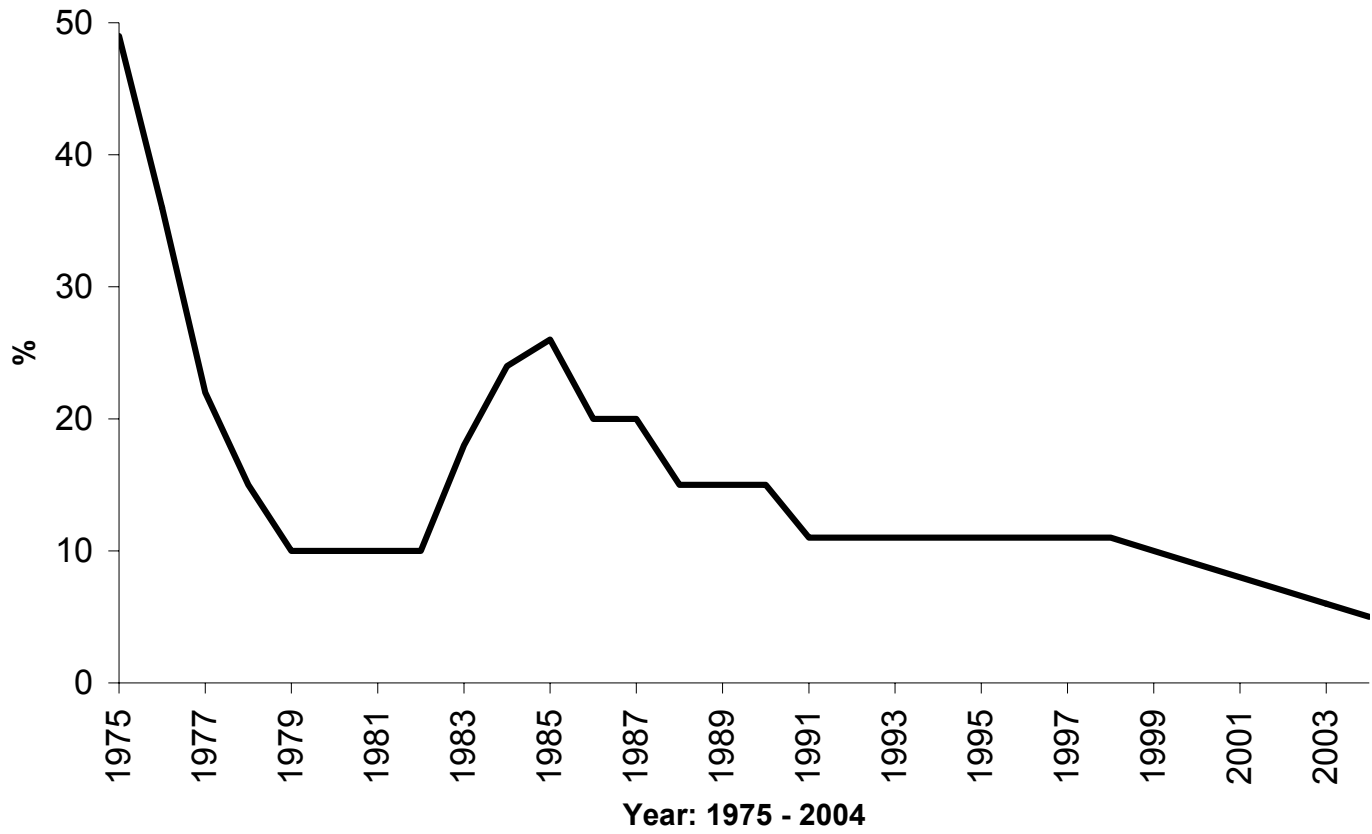


Figure 2: GDP and Total Exports

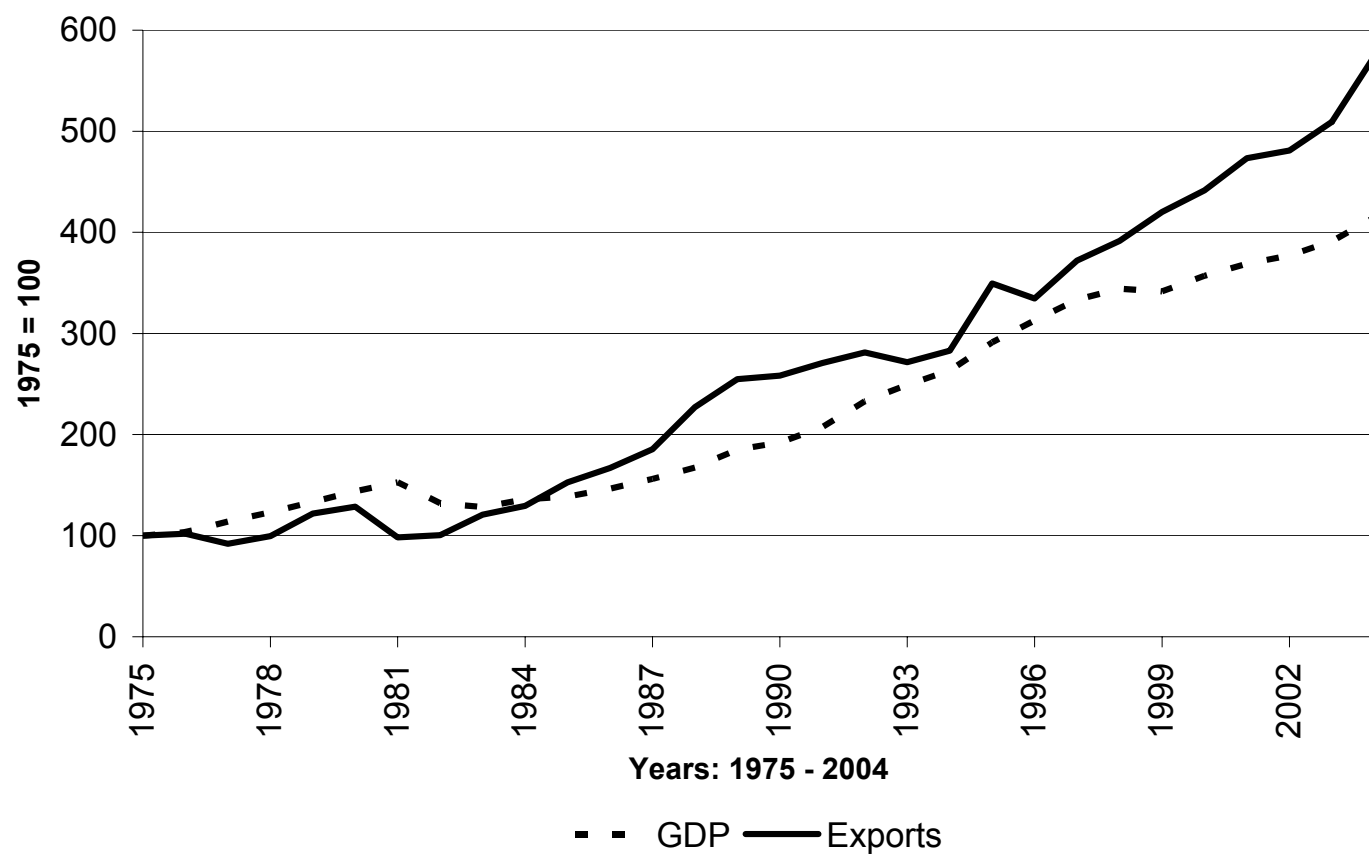


Figure 3: Distribution of Plant-Level Productivity

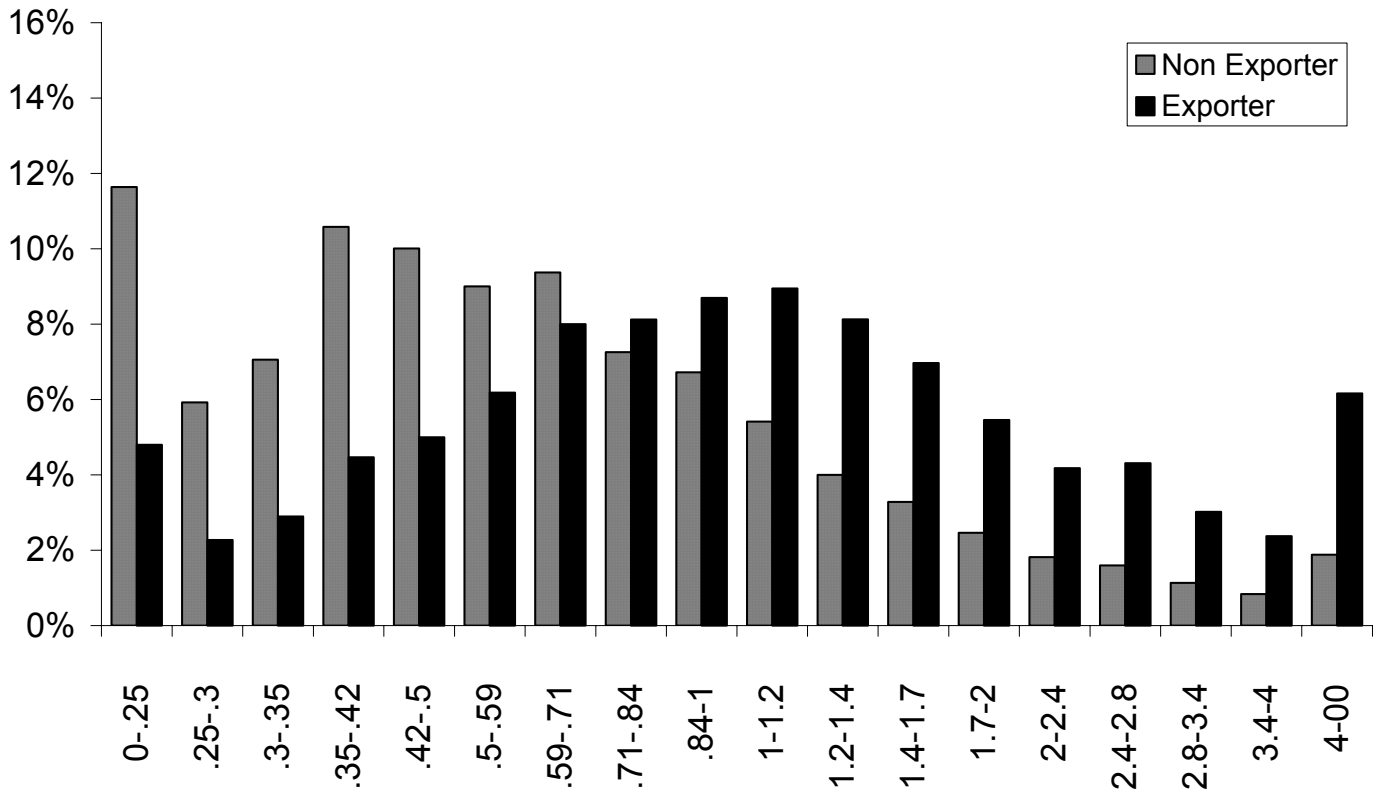


Figure 4: Number and Intensity of Exporters

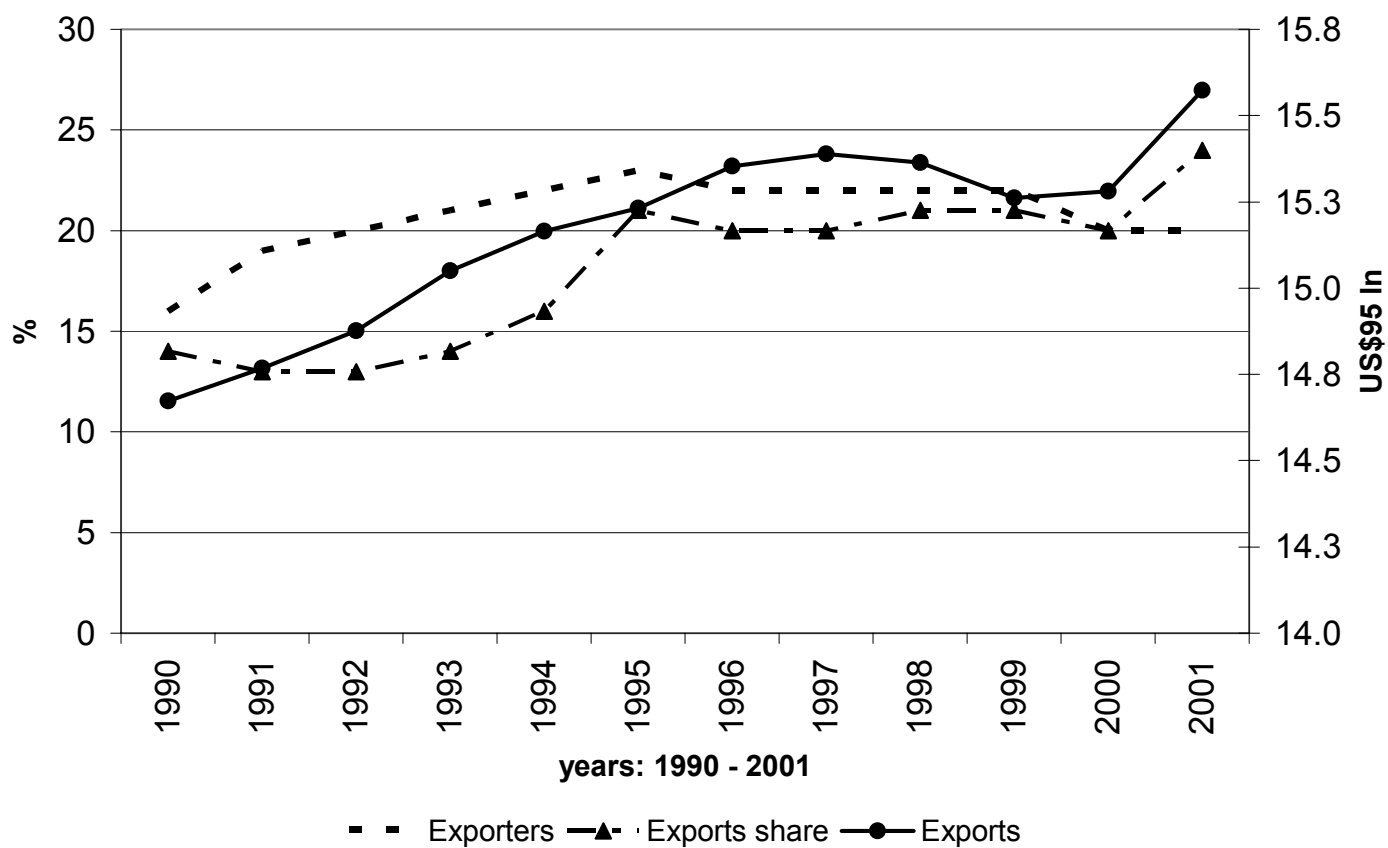


Table 1: Plant-Level Export Facts in Chile during the 1990 - 2001 period

Sectors	Plants	Labor Productivity Relative to Sector	Capital per emp. Simple Average (3dig ISIC)	Labor Share	Size Employees
No Exports	79.2%	-12%	-21%	1.02	-25%
Positive Exports	20.8%	45%	82%	0.93	93%
Export Intensity of Exporters (percent)	% of Exporting	Relative to Sector Simple Average			
0 to 10	47.7%	46%	61%	0.91	84%
10 to 20	11.1%	37%	67%	0.94	93%
20 to 30	5.7%	40%	80%	0.95	94%
30 to 40	4.6%	35%	84%	1.00	90%
40 to 50	4.0%	49%	104%	0.91	105%
50 to 60	3.9%	44%	106%	0.97	117%
60 to 70	3.9%	43%	111%	0.98	111%
70 to 80	4.2%	46%	125%	0.94	117%
80 to 90	5.5%	54%	125%	0.89	118%
90 to 100	9.3%	47%	111%	0.98	98%
Authors' calculation					

Table 2. Dynamics of Total Exports and Export Intensity

Sector	Exports Growth	Export Intensity			
	Annual Rates ^a	% of Sales Exported		Difference	
	1990/91-2000/01	1990-91	2000-01	Perc. Points	%
311	4.8	20.4	26.2	5.8	28.4
312	15.3	3.3	7.9	4.5	135.2
313	11.5	8.9	24.4	15.5	173.7
314	-8.6	3.2	6.4	3.2	99.5
321	9.2	5.2	18.8	13.6	261.5
322	-4.4	6.3	7.3	1.0	15.8
323	33.2	1.1	29.5	28.3	2512.7
324	-19.8	9.7	1.8	-8.0	-81.7
331	10.2	33.3	50.3	17.0	51.1
332	7.3	6.9	14.3	7.4	106.3
341	10.3	30.4	39.3	8.9	29.3
342	1.4	3.7	6.5	2.8	76.6
351	5.6	37.8	38.9	1.1	2.9
352	4.9	7.2	12.2	5.0	69.5
353	8.5	3.3	7.5	4.2	127.2
354	-12.8	3.4	1.4	-2.0	-59.0
355	12.0	15.0	43.3	28.4	189.7
356	20.9	1.7	7.8	6.1	348.2
361	8.6	14.2	33.4	19.2	135.8
362	18.4	2.6	7.2	4.6	180.5
369	8.9	1.3	2.0	0.8	58.9
371	-0.9	32.0	24.4	-7.6	-23.7
381	11.6	2.9	6.8	3.9	137.1
382	26.4	1.8	17.4	15.6	851.5
383	29.6	2.3	19.9	17.6	764.4
384	21.3	8.4	50.5	42.2	504.8
385	38.9	3.8	34.9	31.1	826.5
390	31.0	3.0	23.1	20.1	669.8
All	7.4	13.3	22.0	8.7	65.1
Mean	10.8	9.8	20.1	10.4	106.3
25th pertl.	4.9	3.0	7.3	4.3	144.4
50th pertl.	9.7	4.5	18.1	13.6	304.2
75th pertl.	19.0	10.9	30.5	19.6	180.7

a. Nominal Chilean Pesos were converted in 1995 US dollars deflating by the annual average nominal exchange rate and the US CPIU.

Table 3: Export Intensity and Exporters

Period	1990-2001	1990-1991	2000-2001
Plants:			
No Exports	79.2%	82.2%	79.7%
Some Exports	20.8%	17.8%	20.3%
<hr/>			
Export Intensity of Exporters (percent)	Percentage of Exporting Plants		
0 to 10	47.6%	50.1%	41.5%
10 to 20	11.1%	8.9%	12.8%
20 to 30	5.6%	5.3%	5.8%
30 to 40	4.6%	4.0%	5.0%
40 to 50	4.0%	3.1%	5.0%
50 to 60	3.9%	4.1%	3.9%
60 to 70	4.0%	4.3%	5.0%
70 to 80	4.2%	4.7%	4.4%
80 to 90	5.6%	6.4%	5.4%
90 to 100	9.4%	9.1%	11.2%
<hr/>			
Authors' calculation			

Table 4: Export Decomposition

	1990 (th. US\$92)	2001 (th. US\$92)	Difference (th. US\$92)	Contribution (%)
All Sectors				
All	2358	5803	3444	163.3
Continuing	1207	2472	1264	36.7
Entering		3331	3331	96.7
Exiting	1151		-1151	-33.4
Net Entry	1151	3331	2180	63.3

Note: Exports and sales were deflated by sectoral deflators (1992=100) and divided by 1992's exchange rate.

a Only plants with export and sales data are included.

b Total sales for exporters only.

Table 5: Sales, Exports, and Exporters

Year	Total Sales	Sales per Firm	Total Firms	Total Export	Export per Firm	Firms that Export
1990	18154329	4055	4477	2358497	3209	735
1991	19826227	4291	4620	2593126	2937	883
1992	22223025	4633	4797	2888187	3024	955
1993	24137356	4962	4864	3438834	3345	1028
1994	24721347	5022	4923	3855032	3560	1083
1995	21079458	4314	4886	4119156	3735	1103
1996	23145286	4451	5200	4653533	4115	1131
1997	23719177	4732	5012	4823368	4365	1105
1998	22556345	4900	4603	4704122	4644	1013
1999	20475007	4989	4104	4246728	4788	887
2000	21881410	5206	4203	4325653	5042	858
2001	23275094	5512	4223	5802857	6811	852
Δ1990-2001	25%	31%	-6%	90%	75%	15%

Nominal exports and sales were deflated by 3-digit ISIC deflators (1992=100) and then divided by the 1992 exchange rate.

Table 6: Contribution of Average Exports and Exporters

	Exports	Sales
Continuing exporters		
Total change	3444360	6056057
Amount per firm		
1990	4521	22234
2001	9257	30394
Number of firms	267	267
Net entry into export markets		
Amount per firm		
Entering	5461	13201
Exiting	2429	8808
Number of firms		
Entering	610	610
Exiting	474	474
Contribution (% of total change)		
Continuers	36.7	36.0
Net entry	63.3	64.0
Due to Δ in average exports - sales	53.7	44.2
Due to Δ in number of exporters	9.6	19.8

Table 7: Contribution of Export Intensity and Exporters

	Export intensity		Sales (th. US\$92)		Contribution to Export Rise (%)		
	1990	2001	1990	2001	Δ Intensity	Δ Sales	Total
Continuing	20.3	30.5	5936	8115	17.4	19.3	36.7
New exporters		41.4		8052			96.7
Failed exporters	27.6		4175				-33.4
Net entry	-27.6	41.4	-4175	8052			63.3

Table 8: Labor Productivity OP Decomposition
Simple Average by Sector

Year	Total	Simple Avg.	Cross Term
1990	1.00	0.87	0.13
1991	1.08	0.85	0.15
1992	1.16	0.83	0.17
1993	1.27	0.81	0.19
1994	1.31	0.82	0.18
1995	1.40	0.80	0.20
1996	1.56	0.78	0.22
1997	1.58	0.79	0.21
1998	1.67	0.80	0.20
1999	1.79	0.79	0.21
2000	1.84	0.74	0.26
2001	1.85	0.78	0.22

Table 9: Exports and Labor Productivity

	Labor Productivity (Deflated)		Cross Term	Fraction	Labor Productivity (Deflated)		Cross Term	Fraction
	Weighed	UnW			Weighed	UnW		
Exports (ln)	0.052 (3.70)**	0.040 (2.73)**	0.025 (2.46)*	0.004 (0.41)	0.026 (2.20)*	0.052 (4.94)**	0.017 (2.44)*	0.011 (2.39)*
LP UnWeighed			0.679 (17.72)**				0.809 (29.89)**	
Year	0.049 (18.51)**	0.041 (14.94)**	0.021 (8.51)**	0.007 (3.61)**	0.051 (22.75)**	0.039 (19.64)**	0.013 (7.73)**	0.004 (4.62)**
Observations	336	336	336	336	336	336	336	336
R-squared	0.98	0.98	0.99	0.76	0.98	0.99	0.99	0.93
Regression	OLS				Robust Regression			

Absolute value of t statistics in parentheses

* significant at 5%; ** significant at 1%