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PARTICIPATION IN EXPORT MARKETS AND PLANT PRODUCTIVITY IN LOS ANGELES, 1987-1997

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Abstract

This paper investigates the relationship between plant productivity and export market participation in the greater Los Angeles area using unpublished plant-level data from the US Census Bureau's Longitudinal Research Database. Two key questions are examined: (i) do plants that export learn in foreign markets and become more efficient and/or (ii) do more efficient plants self-select into export markets. Analytical results support previous claims that more productive plants tend to self-select into export markets. Little support is found for the learning-by-exporting argument.

Keywords: Exports, productivity, micro-data, Los Angeles

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INTRODUCTION

Like other US cities, Los Angeles is increasingly integrated with the world economy. Trade is one of the primary manifestations of this increasing global integration. In 2000, the Los Angeles CMSA produced approximately $60 billion worth of goods and services exported to the rest of the world (Rigby and Breau 2004). This represents more than 40% of California's exports and about 6% of total US exports. Taking into account inter-industry flows and multiplier effects, we estimate that more than 800,000 workers in greater Los Angeles, about 12% of the region's labor force, are employed in export-related production. Since 1990, export-related employment in Los Angeles has climbed by more than 30%.

What does this growth in trade mean for local firms? Are there benefits that can be attributed to exporting? In particular, are local firms able to learn from participation in foreign markets and do they become more competitive as a result? The idea that firms learn or acquire knowledge from their activities within particular geographical locations has garnered much attention from economic geographers over the last decade or so (see, for instance, Malecki 1991, Feldman and Florida 1994, Lundvall and Johnson 1994, Gertler 1995, Storper 1997 and Rigby 2000). In contrast, very little attention has so far been given to the possibility that export market participation is a source of learning and productivity growth despite repeated calls from geographers for more plant-level studies of the impacts of trade (Erickson 1989, Grant 2000, Malmberg et al. 2000).

This paper contributes to the current gap in the literature by examining the linkages between exporting and productivity performance for manufacturing plants in the greater Los Angeles area from 1987 to 1997. We focus our analysis on two key questions:

(i) do plants that enter export markets become more productive

(ii) are the linkages between export activity and productivity the result of a self-selection process whereby the most productive plants are the ones who participate in export markets?

The answers to these questions provide important clues as to the direction of causality between export activity and growth. In turn, these answers have significant policy implications as all levels of government actively promote exports as a means of stimulating regional economic growth and competitiveness. In the US, at the federal level, the Department of Commerce, through its International Trade Administration division, now counts more than 100 Export Assistance Centers across the country. These Centers assist by providing sales information on potential international markets and help entrepreneurs by establishing contacts with potential partners overseas. The US Export-Import Bank also encourages exports by providing financial support to domestic producers looking to foreign markets. At the state level, several programs are designed to assist manufacturers apply for export licenses and navigate the legal waters of international trade. Trade networks are also developing across states to facilitate the sharing of information relating to overseas business contacts and opportunities (e.g. CALTRADE). And at the local level, governments have embarked on major projects to promote the development of vital trade-infrastructure (i.e. airports and ports) in order to facilitate the movement of goods worldwide (Erie 2004).

The paper is organized as follows. In the following section, we review the theoretical and empirical literature on the trade-growth connection, paying special attention to recent work based on longitudinal micro-datasets. Section 3 discusses the data used for the analysis and provides a brief description of export-related manufacturing activity in Los Angeles. Section 4 presents evidence on the causal mechanisms linking exports and productivity growth at the plant level. We summarize our results in Section 5 and offer some final thoughts on where this line of research may be headed.

LITERATURE REVIEW

The Evolution of International Trade Theory

Debate on the relationship between international trade and economic growth is long-standing (Baldwin 2000; Lopez 2005; Rodriguez and Rodrik 2000). The theoretical roots of this discussion can be traced back to Adam Smith (1776) who argued that countries should specialize in the production of goods in which they have an *absolute advantage* and trade with countries specializing in the production of different goods. Through specialization and trade, therefore, Smith argued that more goods could be produced and consumed in each country, in turn allowing for increases in total economic output.

In his classic 1817 treatise on the *Principles of Political Economy and Taxation*, Ricardo refined Smith's analysis. Ricardo argued that the source of specialization and trade among countries stemmed from differences in the relative costs of factors of production. Regardless of whether or not a country has an absolute advantage in the production of certain goods, it will almost certainly have a *comparative advantage* (or relative cost advantage). He went on to claim that countries benefit by specializing in the production of goods in which they have a comparative advantage and trading those goods for others in which they have a comparative disadvantage. Again, specialization and trade should lead to increased total output, at least in a static sense through improved allocative efficiencies within an economy. Theoretically, the gains of trade are available to all trading partners.

To a large extent, Ricardo's notion of comparative advantage remains a staple of more recent theoretical models of international trade. In the early 20th century, Hecksher and Ohlin provided a more sophisticated model of international and interregional trade that abandoned some of the more restrictive assumptions made by Ricardo, namely that countries must possess different conditions of production (i.e. climate, soil, etc.) and that labor is the only factor of production. Instead, the Hecksher-Ohlin model argues more broadly that countries (or regions) will trade because of differences in the endowment of factors of production, both natural and developed, whether in terms of natural resources (land, raw materials), labor (human capital) or capital (financial, machinery and equipment, technology). In the standard Heckscher-Ohlin model, a country should specialize in the production of goods that use its abundant factors of production intensively. With trade, resources will shift towards export sectors that make relatively heavy use of the economy's abundant factors of production, leading to greater allocative efficiency and one-time gains in total output. In terms of the direction of causality between export and economic growth, H-O theory suggests that economic growth (in terms of labor and capital resources) should precede export growth.

Stolper and Samuelson (1941) develop a more formal model to assess the impact of trade on relative factor prices, in a framework consistent with Heckscher-Ohlin. The Stolper-Samuelson Theorem relates changes in input prices to changes in output prices, assuming technology is fixed. The basic idea is that as trade alters the supply and demand for different commodities within a country, so the demand for different factor inputs will shift, driving relative price changes. For example, if the prices of goods that are unskilled labor intensive fall, perhaps because of the import of such goods into a country, then the demand for unskilled labor in that country will fall, lowering the wages of unskilled workers relative to the wages of skilled workers. Thus, tracking the relative prices of commodities produced with different bundles of skilled and unskilled labor has been one of the principal means of assessing the impact of trade on wage inequality (Lawrence and Slaughter 1993; Leamer 1998).

By the late 1970s, the limitations of the H-O framework were becoming increasingly apparent. The notion that countries (or regions) should trade solely because of relative differences in factor endowments does not account for the fact that most trade continues to occur mainly between developed economies with similar endowments (Balassa 1979, Baldwin 1979, Krugman 1980). Imperfect competition (intra-firm and intra-industry trade), transactions costs and the existence of economies of scale complicate the standard arguments of the H-O model.

These inconsistencies sparked a 'theoretical renaissance' in international economics in the early 1980s leading to the development of New Trade Theory (NTT). Two broad strands of NTT can be identified. The first was spearheaded, to a large extent, by the work of Paul Krugman (Krugman 1979, 1980; Helpman and Krugman 1985). Instead of relative factor abundance, the motivation for specialization and trade under this brand of NTT focused on increasing returns and imperfect competition. Because of increasing returns and costs associated with transacting across space, production will tend to concentrate in certain locations, likely in areas where local demand for a particular good or supply of input is large and convenient (i.e. the so-called 'home market' effect, Krugman 1991). As external backward and forward linkages develop between certain industries in a location (with specialized suppliers, services etc.), a cumulative and self-reinforcing dynamic will set in furthering the pattern of interdependent industry location (NTT here follows on the ideas of Myrdal 1957, Hirschman 1958 and Kaldor 1970). Regions (or countries), therefore, will specialize and trade because of scale and cost advantages. In such NTT models, greater emphasis is placed on the importance of geography and the causality between trade and growth is seen as bi-directional: on the one hand, exports should lead to greater regional growth via economies of scale; on the other hand, local agglomeration should also lead to greater exports.

The second strand of NTT draws from work on endogenous growth theory (Romer 1986, Lucas 1988 and Grossman and Helpman 1991). Whereas externalities in the previous brand of NTT hinged on the scale and cost advantages of locating production activities in close proximity, this second perspective argues that industrial proximity and location matter because of the existence of technological spillovers. In other words, export – and more broadly growth – opportunities are created in certain centers of innovation, where knowledge tends to flow more easily between firms and workers. However, in these endogenous growth models the impacts of trade on growth are harder to pinpoint. For instance, in the Grossman and Helpman (1991) model, the influence of trade on growth is conditional upon trade induced movements in the relative prices of domestic factors. Changes in relative prices ultimately affect the cost of R&D activity (i.e. innovation), one of the key factors behind economic growth. Suppose we have the special case where a small economy produces and trades two final products at prices that are determined exogenously on global markets. These products use intermediate inputs (that are non-traded) as well as unskilled labor and skilled labor (the supplies of which are assumed to be fixed). Product A is unskilled-labor-intensive while product B is skilled-labor intensive and both products use the same amount of non-traded intermediate inputs. On the one hand, if the economy exports product A, the price of unskilled labor will increase relative to skilled labor (via Stolper-Samuelson), which means that R&D activity can expand as the costs of innovation (which relies on skilled labor) decrease. Trade therefore indirectly – via innovation – stimulates growth. On the other hand, if the economy imports product A, the relative price of unskilled labor will decrease; as the salaries of skilled labor increase, so will the costs of innovation. The expansion of trade, in this case, slows growth as innovation generating activities lag.

Empirical Evidence and Policy Applications

Understanding the links between trade and growth has significant policy implications. Throughout the last half-century, national governments have experimented with different trade policies in an effort to stimulate industrialization and economic growth (Baldwin 2000 provides a detailed history). The key question is whether protectionist policies or free trade will fuel growth and long-run development? For much of the early post-WWII era, economists and policy-makers favored inward-looking import substitution policies as a means of achieving greater economic growth, based on the idea that over the short-term nascent industries must be protected and nurtured. During the 1960s, however, the economic success of newly industrializing countries appeared to have been fueled, in large part, by aggressive export-oriented policies; this in turn prompted a general shift in policy towards outward-looking approaches to domestic economic development.

The long history of disagreement on the relationship between trade and growth is also manifest at the empirical level. Table 1 below summarizes some of the key recent empirical studies on trade-growth linkages.

[Table 1 about here]

One of the most well-known papers is that of Dollar (1992), who analyzes estimates of comparative price levels across a sample of 95 developing countries between 1976 and 1985 to construct an index of outward orientation. Dollar's measure of outward orientation is positively correlated with per capita GDP growth, suggesting that greater trade openness is critical for economic growth. Sachs and Warner (1995) use different indicators of trade openness across a panel of 79 countries to test whether or not more "open" countries (i.e. defined as meeting five specific "openness" criteria) over the 1970-89 period experienced faster economic growth. They conclude that on average more open countries grow 2.5 percentage points faster than "closed" economies. Edwards (1998) is critical of a number of measures of economic openness. He develops nine alternative measures of trade policy and tests each of them in relation to total factor productivity (TFP) growth in 93 countries over the 1960-90 period. Edwards finds that six of the nine trade openness policy measures are positively and significantly related to TFP growth. Looking at income growth across another sample of 98 countries, Frankel and Romer (1999) also argue that trade has a large and robust positive effect on income.

If the consensus emerging from the above studies is that there is a positive and significant relationship between exports and growth, others remain more skeptical arguing that many of these cross-country analyses suffer serious empirical and methodological limitations. In replicating the work of some of the authors reviewed above, and using the same datasets, Rodriguez and Rodrik (2000) find the results are extremely sensitive to minor changes in the analytical framework adopted. Changes in model parameters, different measures of openness or study of different time periods, are shown to yield different, often contradictory results. Poon (1994) also highlights some of the conceptual pitfalls associated with aggregate cross-country studies of the links between exports and growth. She argues that many studies fail to take adequate account of other macro-economic factors that influence a country's growth.

Besides measurement and methodological issues, most of the macro-level studies based on cross-country analyses say little about the underlying causal mechanisms linking trade and growth (Aw et al. 2000; Bernard and Jensen 2004). Leichenko and Coulson (1999) and Leickenko (2000) are among the few that directly examine the direction of causality between exports and growth. Here, a combination of vector autoregressive (VAR) models and Granger causality tests are used to look at manufacturing exports and output growth for US states from 1980 to 1991. Results indicate that the causality between the two variables runs both ways, in-line with the predictions of Krugman's New Trade Theory. However, these tests of causality are not without their own limitations. Granger causality is based on the predictability of observed correlations; as such, a direct cause-effect relationship cannot be inferred from such correlations (Jacobs et al. 1979; Griffiths et al. 1993).

An altogether different approach to the study of trade-growth linkages has recently emerged using newly available micro-datasets. These micro-data allow researchers to control for a variety of plant, firm and industry characteristics that influence performance measures such as productivity growth (see Baily et al. 1992 and Bartelsman and Doms 2000). In this respect, the micro-data represent a significant advance over the aggregate, cross-country studies reported above. Those studies force plant heterogeneity into the straitjacket of an aggregate production function, usually quite limited in the number of its arguments, that is theoretically incapable of isolating the myriad factors that drive productivity growth within individual economic units (Mairesse and Griliches 1990; Tybout 1992, 1996).

The micro-datasets have been used increasingly to study the links between trade, often measured by exposure to import competition or to export markets, and economic performance. The impetus for a good deal of this work stems from the analysis of Bernard and Jensen (1995) who revealed the existence of significant differences between manufacturing plants that export and those that do not. Exploring manufacturers across the US in the 1970s and 1980s, they report that exporting plants were, on average, larger (both in terms of employment and shipments), more capital intensive, paid higher wages and more productive than non-exporting plants. Similar findings subsequently emerged from plant-level studies in Korea and Taiwan (Aw et al. 2000), Columbia (Isgut 2001), Canada (Baldwin and Gu 2003), Sweden (Hansson and Lundin 2003), the UK (Greenaway and Kneller 2004), Chile (Alvarez and Lopez 2005) and Sub-Saharan Africa (Van Biesebroeck 2005).

Within this literature are two competing views of the relationship between exporting and plant performance. The first view is that exposure to foreign markets and competition improves firm performance through learning after exposure to new technologies, new methods of organizing production, or new market possibilities. This is a learning-by-exporting hypothesis that, if correct, should reveal itself by gains to plant productivity following entry to export markets (*ex post*). The second view holds that only the most productive firms can become exporters because of the sunk costs associated with entry into international markets and/or because of more intense levels of competition. If this second view is correct, more efficient manufacturers will self-select into export markets. In this case, we should find evidence that plants entering export markets are more productive than non-exporters even before they begin to export (*ex ante*).

So far, empirical evidence based on studies using longitudinal micro-datasets favor the self-selection argument. There is evidence of a learning-by-exporting effect, but in general it is not very strong (Lopez 2005).

The present paper extends the analyses carried out in previous studies using plant-level data by examining the linkages between exports and productivity at the local level, something that to the best of our knowledge has not been done before. Several geographers have recently called for more in-depth investigation of the local impact of globalization and international trade (Bridge 2002, Dicken 2004, Parr 2005, Shin et al. 2006). This study is designed to answer that call as well as contributing to recent research that explores the geographical aspects of knowledge flows (Jaffe et al. 1993; Gertler 1995; Baldwin et al. 2007). Much of this work emphasizes the place-bound character of learning and knowledge flows. Our results support those claims, suggesting that arms-length relationships that span international borders convey little by way of competitive advantage, at least in the relatively short-term.

EXPORTERS IN LOS ANGELES

Empirical studies of the impacts of trade at the local level in the US are rare because of the lack of sub-national economic data on commodity imports and exports. The Foreign Trade Statistics Division (FTSD), of the US Bureau of the Census, does collect export data through the shipper's export declaration (SED). Since the mid-1980s, SEDs have been used to create an origin of movement (OM) trade series that tracks the movement of products from the US to foreign countries, based on the state from which a particular product begins its journey to the actual port of export. The OM data do not, however, necessarily record the "production origin" of US merchandise exports given that goods are often sold from a producing firm in one state to a firm in another state before a SED is filled out and the commodity is earmarked for export. As such, the OM data really reflect the "transportation origin" of exports. The same holds true for the FTSD's exporter location (EL) series, available from 1993 to 2002. The EL series allocated exports to states and sub-state locations through the address of the export sale or the exporter of record. Again, the export sales location does not necessarily coincide with the actual location of production, for the exporter location might be that of a freight forwarder or a consolidator.

The data used in this study come from the US Census Bureau's Longitudinal Research Database (LRD) for 1987, 1992 and 1997. The LRD is a large unpublished panel dataset containing establishment level data collected from the Census of Manufactures (CM) and the Annual Survey of Manufactures (ASM). In addition to information on each manufacturing establishment's inputs (i.e. labor, capital, materials) and outputs (i.e. products, services), the LRD also reports the value of direct exports from each establishment. McGuckin and Pascoe (1988) provide more information on the LRD. The LRD is the only source of real export data at the sub-national level, for the US. Since it provides data on exports, along with other plant characteristics, the LRD is a valuable tool for analysis of the linkages between exports and plant performance.

The LRD is not without its limitations, however. The LRD only reports as foreign exports those goods shipped directly from the manufacturing plant to foreign consumers. These numbers tend to undercount actual exports as many manufactured commodities are sold to other manufacturers, to wholesalers and other concerns, such as freight forwarders and consolidators, before they are finally exported. To illustrate the magnitude of under-reporting, the 1992 Census of Manufactures lists total direct manufacturing exports for the US at $249 billion, whereas the Federal Trade Commission reports total manufactured exports of $440 billion.

While the LRD contains data for the population of US manufacturing plants in Census years, those ending in 2 or 7, data for some small, single establishment firms are imputed. These Administrative Record plants are removed from our sample. Consequently, the sample of plants that we examine is biased toward larger plants and toward plants that are part of multi-establishment firms.

Table 2 shows the characteristics of exporting plants and non-exporting plants in the Los Angeles CMSA for the periods 1987, 1992 and 1997. Columns 2 and 3 report mean values of those characteristics, while column 4 shows the difference in mean value between exporters and non-exporters, along with t-scores from difference of mean tests. All monetary values are expressed in1987 dollars.

[Insert Table 2 about here]

Over all years examined, exporting and non-exporting manufacturing plants are significantly different from one another. Exporting plants are more productive (defined as value added per worker) than non-exporting plants, they are also larger in terms of employment and shipments, they pay higher wages, are more capital intensive, have higher shares of non-production workers, and are more likely to be part of a multi-establishment firm. Table 2 reveals some interesting trends between 1987 and 1997. First, the difference in the average size of exporters and non-exporters drops dramatically over the period of study, driven mostly by a steep decline in the average size of exporting plants. Likewise, the proportion of exporting plants that are part of a multi-establishment firm decreases from 1987 to 1997. In contrast, the gap between the mean productivity levels of exporters and non-exporters increases over time (by more than 56%) and so does the value of shipments exported. On average, plants also become much more export intensive over time: the export to total shipments ratio increases from 10.8% in 1987 to 16.8% in 1997.

Variations in export intensities across industries are reported in Table 3. The electronics and other electric equipment, industrial machinery and equipment and the instruments and related products industries are consistently among the most export intensive industries in Los Angeles. Late in the 1990s, export intensity in the apparel and other textile products industry increases dramatically as plants in this sector rely more heavily on foreign markets (see also, Scott 2002).

[Insert Table 3 about here]

Figure 1 maps of the distribution of export activity across the greater Los Angeles area for 1987 and 1997. The inset in the upper-right hand corner of the figure shows California and the Public Use Micro-Data Areas (PUMAs) that constitute the 5-county Los Angeles CMSA. PUMAs contain a minimum population of 100,000 and are the smallest spatial units researchers are allowed to use to produce maps meeting the Census Bureau's confidentiality and disclosure criteria. To be consistent over time, we used Census 2000 Boundary Files for both maps. The different shades represent export intensity ratios (i.e. value of exports/value of total shipments) for manufacturing establishments within each PUMA. Lighter shades represent PUMAs with lower than average values of export intensity while darker shades represent PUMAs with higher than average export intensity ratios.

The figure shows some interesting differences across PUMAs and changes over time. In 1987, lower than average values of export intensity are recorded in the outlying PUMAs of the Los Angeles CMSA and in a concentrated band around the NW side of the region stretching from Santa Monica through Hollywood and into Glendale, and then moving south through downtown Los Angeles. PUMAs with the highest levels of export intensity in 1987 are Burbank, still associated with aircraft production at that time, Long Beach, Gardena and Venice. Relatively high values of export intensity are also found on the fringes of Los Angeles and Ventura counties and in Orange county around Irvine.

Ten years later, we see that the Burbank PUMA has declined markedly in significance, following the movement of aircraft production north to Palmdale. The region around the port complex of Los Angeles-Long Beach has expanded in terms of its export intensity, along with the Camarillo and Simi Valley PUMAs near the Los Angeles-Ventura county border, both of which are closely associated with aerospace and biotech activity (Scott 1990). The PUMAs of El Segundo and Hawthorne, along with their close neighbors, are also prominent in terms of their export intensity at the end of the 1990s, as are Irvine and Tustin. These have consistently been strongholds of the aerospace defense industries, electronics and medical devices technologies (Scott 1993).

[Insert Figure 1 about here]

If exporting does affect a plant's productivity, it is likely that its impact will be greater the higher the plant's level of exposure to foreign markets. To test this hypothesis, we pool our observations for 1987, 1992 and 1997 and run a regression of the following form:

$$RVAWORKER_{it} = \alpha + \beta_j EXPINT_{it} + \delta_1 Year_{it} + \varepsilon_i, \quad (1)$$

where $RVAWORKER_{it}$ represents real value-added per worker in plant *i* at time *t*. $EXPINT_{it}$ is a categorical variable where $j = 0$ represents plants that do not export, $j = 1$ represents low intensity exporters (plants that export less than 10% of their shipments), $j = 2$ represents medium intensity exporters (plants that export between 10 and 25% of their shipments), and $j = 3$ represents high intensity exporters (plants that export more than 25% of their exports). The model also includes a dummy variable for the years 1987 through 1997. The base category in the model, $\beta = 0$ and $\delta = 0$, identifies the productivity of non-exporting plants operating in 1987. Table 4 reports the regression results for equation 1.

[Insert Table 4 about here]

Confirming observations in Table 2, plants that export have higher productivity levels than plants that do not export and this "export productivity premium" increases from 1987 to 1997. Table 4 also shows that the impact of exports on productivity varies with a plant's level of exposure to foreign markets: the difference in productivity between exporting and non-exporting plants more than doubles when we compare non-exporters to exporters with low and high levels of foreign market exposure. However, before we can infer any direction to the relationship between exporting and productivity, we need to take a closer look at the characteristics of individual plants over time. It is to this question that we turn next.

EXPLORING THE EXPORT PRODUCTIVITY PREMIUM: A TALE OF TWO QUESTIONS?

In the previous section we mapped out some general spatial patterns in export related activity across the greater Los Angeles area and we documented the existence of significant differences in the characteristics of exporting and non-exporting manufacturing establishments. In this section, we focus attention on the causal linkages between trade and productivity growth. We follow the approach pioneered by Bernard and Jensen (1995, 1999) using microdata for the US as a whole, and later adopted by a number of other researchers in different countries. Our investigation of the "export productivity premium" asks two questions: (i) do more productive plants become exporters and (ii) does exporting lead to increased productivity growth? We answer these questions by exploiting the time series dimension of our panel dataset that allows us to track the performance of plants over time, in particular as they enter export markets.

(i) Pre-Exporting Plant Productivity Performance

The first of these two questions, do more productive plants become exporters, relates to the so-called self-selection hypothesis that asserts more productive plants self-select into export markets because they are the only ones capable of absorbing the additional costs associated with such entry (Clerides et al. 1998). To examine whether this hypothesis is supported for manufacturing establishments in the greater Los Angeles area, we examine the levels and growth rates of a number of characteristics (including productivity) of plants that are non-exporters at time t. Of these plants that continue in business t+1 years later, some will remain non-exporters, while some will have entered the export market. We employ a regression model, with a somewhat different format, to explore whether there is a significant difference in plant characteristics at time t, between plants that are exporters at time t+1 and those that are not exporters at time t+1.

The first of the models that we use examines differences in levels of plant characteristics prior to the export decision. This model is run for two time periods 1987 to 1992 and 1992 to 1997.

$$\ln X_{it} = \alpha + \beta \, EXPORT_{it+1} + \delta \ln SIZE_{it} + \gamma \, IND_{it} + \varepsilon_{it} \qquad (2)$$

where X_{it} represents the productivity level (or other characteristic) of plant i in the initial year and $EXPORT_{it+1}$ is the export status of the plant in the sub-period's final year. The model includes controls for plant size $(SIZE_{it})$ and industry fixed-effects (IND_{it}). The coefficient β on the export status dummy measures the productivity (or other characteristic) difference of future exporters in the period before they begin to export.

Bradford and Jensen (1999) refer to this as the "exporter premium". Note that this regression model has a dependent variable that is measured for a year prior to observation on one of the independent variables. We are not here trying to establish a causal relationship, merely trying to outline *ex ante* differences between plants that later become exporters and those that do not.

Equation (3) is similar in form to equation (2) but looks at *ex ante* growth rates. The dependent variable ($\%\Delta X_i$) measures the annual average compound growth (AACG) rate of plant performance (productivity or other characteristic) between year t-2 (1987) and t-1 (1992). The influence of plant size and industry controls are incorporated in this model. Once more, attention focuses on the EXPORT variable measured at time t (1997) as the coefficient on this variable reveals the average difference in growth rates between plants that later become exporters and those whose sales are restricted to the domestic market.

$$\%\Delta X_i = \frac{\ln X_{it-1} - \ln X_{it-2}}{(t-1)-(t-2)} = \alpha + \beta\, EXPORT_{it} + \delta \ln SIZE_{it-2} + \gamma\, IND_{it-2} + \varepsilon_{it-2} \qquad (3)$$

The estimation results for equations (2) and (3) are presented in Table 5. The models were estimated using Ordinary Least Squares and the results have been corrected for heteroskedasticity using the Huber-White sandwich estimator. Heteroskedacity is a common property of cross-sectional data. The sandwich estimator allows us to produce a robust covariance matrix of parameter estimates even if there is some heteroskedasticity, such that our least square estimators remain consistent (White 1980).

[Insert Table 5 about here]

In Table 5, columns (a), (c) and (e) control for industry-fixed effects and columns (b), (d) and (f) also control for plant size (measured as the log of total employment). The differences in initial productivity levels for plants that become future exporters versus those that remain non-exporters are significant. On average, 1987 plants that eventually became exporters in 1992 are approximately 14% more productive than non-exporters. They are also, on average, 31% larger in terms of employment, 15% to 46% larger in terms of shipments and pay their workers 3% to 6% higher wages. The results for the period 1992 to 1997 are broadly similar. In terms of growth, plants that become exporters by 1997 tend to have enjoyed significantly faster productivity growth rates, faster output and employment growth rates than non-exporters in the five-year period before these plants moved into different categories of export status. Clearly, therefore, exporters in Los Angeles have a range of performance characteristics (productivity and size and growth rates thereof) that sets them apart from their non-exporting counterparts before any of these firms engage foreign markets.

A different way of investigating whether or not plants that start exporting already possess higher labor productivity levels than non-exporting plants is to investigate the probability of a plant's entry into export markets based on prior characteristics. This more directly addresses the issue of causation, that is not clarified in equations (2) and (3). Roberts and Tybout (1997) used a dynamic discrete-choice model to track the behavior of exporting plants over time in Colombia and study the effects of prior exporting experience. They find that sunk costs and previous export experience are significant factors in a firm's decision to export. More recently, Bernard and Jensen (2004) applied a similar dynamic framework to look at the factors affecting a plant's decision to export in the US. We use logit and probit models to assess whether a plant's decision to enter the export market is related to plant characteristics prior to export. Thus, equation (4) is specified as

$$EXPORT_{it} = \alpha + \beta\, EXPORT_{it-1} + \delta \ln PROD_{it-1} + \gamma_1 CHAR_{it-1} + \gamma_2\, IND_{it} + \varepsilon_{it} \qquad (4)$$

Here, the binary dependent variable $(EXPORT_{it})$ is the export status of plant *i* at time *t*, set as a function of the plant's previous export experience $(EXPORT_{it-1})$, its previous productivity level $(PROD_{it-1})$ and other plant characteristics $(CHAR_{it-1})$ such as size, average wages, capital-labor ratio and share of non-production employees. IND_{it} represents a vector of 4-digit (SIC) industry controls.

[Insert Table 6 about here]

Table 6 reports the results for both logit and probit estimations of equation (4) for 1992 and 1997. Once more, the results are consistent with the hypothesis that plants with superior performance characteristics are more likely to enter export markets at some future time. In general, a plant's decision to become an exporter is conditioned by its prior exporting experience. In addition, larger, more productive plants with higher shares of non-production workers tend to enter export markets. These results strongly support the self-selection hypothesis.

(ii) Post-Exporting Plant Productivity Performance

The second question we examine looks at plant performance following experience in export markets. It has been surmised that exposure to foreign markets acts as a form of external economy that is commonly seen as positive. Participation in larger, more competitive markets is supposed to open firms to new technological, organizational and institutional possibilities, a so-called learning by exporting hypothesis. In addition, larger markets also permit firms to achieve economies across a range of operations. Whatever the precise mechanics might be, if exporting does improve performance, we should be able to see this through comparisons of manufacturing plants that export and those that do not.

This comparison is made by rewriting equation (3) such that future growth rates of plant performance are regressed against a series of plant characteristics at some time *t*, including a measure of export activity. Specifically,

$$\%\Delta X_{it+1} = \frac{\ln X_{it+1} - \ln X_{it}}{(t+1) - t} = \alpha + \beta\, EXPORT_{it} + \delta \ln CHAR_{it} + \gamma\, IND_{i} + \varepsilon_{it} \qquad (5)$$

where the dependent variable $(\%\Delta X_{it+1})$ represents the annual growth rate of plant productivity (or the change in another plant characteristic). $EXPORT_{it}$ is an export status dummy such that the coefficient β measures the difference in the annual growth rate of the performance measure of exporters relative to non-exporters. In other words, it captures the performance (productivity or otherwise) premium enjoyed by exporters after they begin to export. Other variables are explained earlier.

[Insert Table 7 about here]

Results for equation (5) are presented in Table 7. We identify two medium-term horizons (1992-97 and 1987-92) and one longer-term horizon (1987-97) for investigation. For each, we also specify the results of OLS regressions with only the export dummy on the right hand side and then with other plant characteristics. The results show that the *ex post* impacts of exporting on plant productivity, and other characteristics, are rather difficult to locate. Over the 1987-92 medium-term horizon, the future productivity growth of exporting plants is barely 1% higher than that of non-exporting plants. For all other time periods studied, we find no evidence pointing to significant differences between the future productivity growth rates of exporters compared to that of non-exporters. Productivity growth does not appear to be faster within exporting plants. Once additional plant characteristics are added as controls, we do find that exporters typically experience faster growth of employment and shipments and that they tend to pay higher average wages in the future compared to non-exporters. These results are somewhat more mixed when looking at growth over the 1987-92 and 1987-97 periods, where workers at exporting plants do not enjoy significantly higher wage growth.

The evidence presented for Los Angeles, therefore, is generally in-line with that of previous studies conducted at the national-level. It is difficult to substantiate the learning-by-exporting argument as we find only weak indications for the (*ex post*) benefits of exporting on productivity and mixed evidence across other performance measures.

CONCLUSION

What lessons can we take from our study of the export behavior of plants in the greater Los Angeles? First, the use of micro-datasets has allowed us to document the existence of various exporter premia for manufacturers across Los Angeles. We find that plants that export are on average more productive, larger, pay their workers higher wages and tend to employ a larger share of non-production workers than non-exporting plants. Moreover, over the 1987 to 1997 period, the evidence suggests that exporting plants become more export intensive and the difference between the mean productivity levels of exporters and non-exporters increases by more than 56%.

Second, in terms of the causal links between exports and growth, our analytical results suggest that “better” plants – that is plants with higher productivity and other favorable performance characteristics – are indeed the ones that eventually become exporters. In other words, we find clear evidence that exporters tend to self-select into export markets. In contrast, although we do find some evidence that exporting is associated with *ex post* improvements in the growth of certain plant characteristics (i.e. employment and shipments), there is little evidence of any significant impact of export market participation on productivity growth *per se*. As such, our results for Los Angeles add to national level micro-data studies supporting the importance of the self-selection argument. In this regard, it is particularly interesting to see that our findings replicate those of Bernard and Jensen (1999) for the US as a whole. One might expect such results given the size and diversity of Los Angeles' manufacturing basis, which really provides a snapshot of the US economy. But this also leads us to believe that future research should target other American city-regions with perhaps more specialized and concentrated industrial activity to see how export-productivity linkages might differ over space. Future research efforts should also include decomposing productivity growth to identify possible reallocation effects and examine how aggregate metropolitan productivity growth might be attributed to productivity growth within- and across- exporting and non-exporting plants. Again, identifying possible significant differences with the help of comparative metropolitan and regional level analysis to this effect would be most interesting.

The evidence brought forth by micro-data studies poses challenges to existing theories of international trade and macro-level evidence that suggests greater trade openness does lead to increased productivity and economic growth. The results, shown here and elsewhere, also question the usefulness of export promotion as a strategy for raising the competitiveness of firms and, in aggregate, regions. A much more difficult task now is to understand why some firms become more productive than others.

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Table 1 – Key Empirical Studies of the Relationship between Trade and Growth

Author(s) (year of publication)	Area of Study (period)	Unit of observation	Main Results
Dollar (1992) [173]	95 countries (1976-1985)	Cross-country	Outward orientation and GDP growth are positively correlated
Sachs & Warner (1995) [64]	79 countries (1970-1898)	Cross-country	More open economies grow faster
Edwards (1998) [80]	93 countries (1960-1990)	Cross-country	Relationship between trade openness and productivity (TFP) growth is positive.
Frankel & Romer (1999) [151]	98 countries (1985)	Cross-country	Trade has a positive effect on income.
Rodriguez & Rodrik (2000)		Cross-country	Argue that results of past studies are sensitive to minor measurement and methodological modifications.
Poon (1994) [5]	61 countries (1975-1986)	Cross-country	Macroeconomic "reality" is much more complicated.
Leichenko & Coulson (1999) Leichenko (2000) [7]	US states and regions (1980-1991)	Plant-level; cross-state	Granger causality tests point to bi-directional relationship between exports and state economic growth.
Bernard & Jensen (1999) [99]	US (1984-1992)	Plant-level; country specific	Self-selection.
Aw et al. (2000)	Korea, Taiwan	Plant-level; country specific	Self-selection and some learning-effect.
Isgut (2001)	Columbia	Plant-level; country specific	Self-selection.
Baldwin & Gu (2003) [5]	Canada (1973-1997)	Plant-level; country specific	Self-selection and learning-effect.
Hansson & Lundin (2003)	Sweden (1990-1999)	Plant-level; country specific	Self-selection and learning-effect.
Greenaway & Kneller (2004) [5]	UK (1989-2002)	Plant-level; country specific	Self-selection and some learning-effect.
Alvarez & Lopez (2005	Chile	Plant-level; country specific	Self-selection and learning-effects in plants entering export markets.
Van Biesebroeck (2005)	Sub-Saharan African Countries	Plant-level; country specific	Self-selection and learning-effect.

Note: [] Indicates "times cited" in the *Social Sciences Citation Index* as of February 2006.

Table 2 – Characteristics of Exporting and Non-Exporting Manufacturing Plants in the Greater Los Angeles Area, 1987, 1992 and 1997

Plant characteristic	Exporters	Non-exporters	Difference / (t-values)
1987			
Total employment (workers)	226	51	175 / (18.93)
Total value of shipments	29574791	5415050	24159741 / (17.81)
Value of shipments per worker	130891	96686	34205 / (10.13)
Value of export shipments	3297067	0	---
Export to shipments ratio (%)	10.8	0	---
Value added per worker	71927	50566	21361 / (11.31)
Wages per worker	25224	20838	4386 / (19.46)
Benefits per worker	5877	4330	1547 / (25.92)
Capital-labor ratio	38726	27529	11197 / (7.66)
Non-production workers (%)	36.7	26.3	10.4 / (22.32)
Multi-plant establishments (%)	50.1	22.4	27.7 / (27.44)
Number of observations (plants)	2073	13559	---
1992			
Total employment (workers)	135	42	93 / (14.90)
Total value of shipments	19422332	5046596	14375736 / (12.25)
Value of shipments per worker	130193	95801	34392 / (13.08)
Value of export shipments	2427852	0	---
Export to shipments ratio (%)	11.4	0	---
Value added per worker	69638	51181	18457 / (13.76)
Wages per worker	24323	19312	5011 / (26.33)
Benefits per worker	5856	4241	1615 / (29.18)
Capital-labor ratio	34448	26167	8281 / (6.60)
Non-production workers (%)	36.6	26.8	9.8 / (22.95)
Multi-plant establishments (%)	38.7	18.0	20.7 / (25.88)
Number of observations (plants)	3134	14036	---
1997			
Total employment (workers)	109	41	68 / (17.20)
Total value of shipments	22884504	6407764	16476740 / (8.78)
Value of shipments per worker	162609	101477	61132 / (15.60)
Value of export shipments	5112593	0	---
Export to shipments ratio (%)	16.4	0	---
Value added per worker	87779	54427	33352 / (16.04)
Wages per worker	23932	18499	5433 / (26.87)
Benefits per worker	5465	3918	1546 / (29.80)
Capital-labor ratio	52689	30961	21728 / (4.35)
Non-production workers (%)	32.6	22.4	10.2 / (25.73)
Multi-plant establishments (%)	35.6	15.3	20.3 / (27.28)
Number of observations (plants)	3302	14316	---

Note: Unless otherwise indicated, values represent plant means and are in constant 1987 dollars. The reported t-values test the hypothesis of equal means between exporters and non-exporters (all are statistically significant at the .01 level).

Table 3 – Export Intensities across Industries

1987 2-digit SIC	Export intensities (exports / shipments) 1987	1992	1997	Change
20. Food and Kindred Products	11.28	9.73	12.13	0.85
21. Tobacco Products*	---	---	---	---
22. Textile Mill Products	3.91	3.57	8.51	4.60
23. Apparel and Other Textile Products	4.78	6.40	22.76	17.98
24. Lumber and Wood Products*	---	---	---	---
25. Furniture and Fixtures	6.10	6.36	9.80	3.70
26. Paper and Allied Products	6.01	5.44	5.09	-0.92
27. Printing and Publishing	7.24	6.44	13.29	6.05
28. Chemicals and Allied Products	12.11	9.56	13.03	0.92
29. Petroleum and Coal Products	16.55	11.4	9.30	-7.25
30. Rubber and Misc. Plastics Products	6.19	9.45	11.66	5.47
31. Leather and Leather Products*	---	---	---	---
32. Stone, Clay and Glass Products	6.41	7.03	13.18	6.77
33. Primary Metal Industries	7.69	8.32	8.32	0.63
34. Fabricated Metal Products	7.77	7.58	10.09	2.32
35. Industrial Machinery and Equipment	13.96	16.3	22.32	8.36
36. Electronic and Other Electric Equipment	10.87	14.36	28.07	17.2
37. Transportation Equipment	11.84	11.37	12.67	0.83
38. Instruments and Related Products	15.90	17.13	19.40	3.50
39. Misc. Manufacturing Industries	11.24	12.06	13.95	2.71

Note: * Information for these industries was withheld for confidentiality purposes.

Table 4 – Plant Productivity and Export Intensity Levels

Independent Variables	Dependent Variable: Real Value Added per Worker
Low Export Intensity (β_1)	20.8
	(16.65)*
Medium Export Intensity (β_2)	27.3
	(14.01)*
High Export Intensity (β_3)	46.1
	(15.18)*
Year 1992	-.1
	(.13)
Year 1997	5.7
	(5.902)*
Intercept	50.2
	(70.43)*
Number of Observations	50086

Note: T-statistics are shown in parentheses.
* denotes significance at the .01 level.

Table 5 – Plant Performance Prior to Exporting, 1987-92, 1992-97, 1987-97

Dependent variable	1987 levels		1992 levels		1987-97 growth rates	
	(a)	(b)	(c)	(d)	(e)	(f)
Total employment	.312	---	.327	---	.012	---
	(9.37)**		(9.20)**		(2.96)**	
Total value of shipments	.460	.154	.462	.145	.025	.031
	(12.10)**	(7.76)**	(10.88)**	(6.31)**	(5.27)**	(6.60)**
Value added per worker	.138	.146	.104	.119	.017	.014
	(6.65)**	(6.97)**	(4.70)**	(5.36)**	(3.39)**	(2.90)**
Wages per worker	.033	.060	.076	.072	.006	.005
	(4.76)**	(4.69)**	(5.59)**	(5.19)**	(2.36)*	(1.82)

Note: Robust t-statistics are shown in parentheses. * denotes significance at the .05 level, ** significance at the .01 level. Columns (a), (c) and (e) control for 4-digit industry SICs; columns (b), (d) and (f) also control for plant size (log of total employment).

Table 6 – Probability of Entering into Export Markets, 1992 and 1997

Plant characteristics	1992		1997	
	Logit	Probit	Logit	Probit
Exported *T-1*	1.551	.933	1.747	1.045
	(19.82)**	(20.42)**	(25.26)**	(25.84)**
Log productivity *T-1*	.345	.200	.155	.091
	(5.17)**	(5.37)**	(2.62)**	(2.74)**
Log employment *T-1*	.383	.216	.246	.138
	(11.65)**	(11.90)**	(7.58)**	(7.65)**
Log average wages *T-1*	.076	.032	.330	.176
	(.66)	(.50)	(3.02)**	(2.93)**
Log capital-labor ratio *T-1*	-.037	-.019	.029	.016
	(.91)	(.85)	(.87)	(.83)
Percentage non-production work *T-1*	.204	.116	.142	.082
	(3.29)**	(3.37)**	(2.43)*	(2.51)*
Industry dummies	Yes	Yes	Yes	Yes
Number of observations	8208	8208	8058	8058

Note: Robust z-statistics are shown in parentheses; * denotes significance at the .05 level; ** significance at the .01 level. The dependent variable in these models is the export status of a plant at time *t*.

Table 7 – Plant Performance After Exporting, 1992-97, 1987-92 and 1987-97 (Annual Growth Rates)

Dependent variable	1992-97		1987-92		1987-97	
	without controls	with controls	without controls	with controls	without controls	with controls
Total employment	-.009	.005	-.006	.011	-.016	.010
	(2.65)***	(1.66)*	(1.39)	(2.63)***	(2.94)***	(1.90)*
Total value of shipments	-.002	.007	.006	.020	-.004	.015
	(.42)	(1.77)*	(1.44)	(4.44)***	(.68)	(2.29)**
Value added per worker	.006	.001	.009	.007	.006	0.000
	(1.38)	(.32)	(1.96)**	(1.48)	(1.00)	(.08)
Wages per worker	.001	.003	.006	.007	.002	.002
	(.32)	(1.64)*	(3.02)***	(3.81)***	(.80)	(1.01)

Note: Robust t-statistics are shown in parentheses. All models controls for 4-digit SICs. The value reported is for the dummy on exports at *t* whereas the dependent is *t+1*. * denotes significance at the .1 level; ** significance at the .05 level and *** significance at the .01 level.

Figure 1 – Hotbeds of Export Activity Across Los Angeles, 1987 and 1997 (PUMAs)