EXPORTS AND MANUFACTURING PRODUCTIVITY IN EAST ASIA: A COMPARATIVE ANALYSIS WITH FIRM-LEVEL DATA

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Abstract: This paper uses new plant-level data from five East Asian countries to explore patterns of manufacturing productivity. Domestically-owned firms that export and firms with foreign ownership are significantly more productive than those that produce solely for domestic consumption -- and the productivity gaps are larger the less developed the local market. The possible endogeneity of export orientation is addressed using characteristics at the time of establishment as instruments. It is not simply that more productive firms self-select into exporting; rather, firms that explicitly target export markets make systematically different decisions regarding investment, training, technology and inputs, thereby raising their productivity.

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I. INTRODUCTION

The spread of sustained and rapid economic growth throughout East Asia over the last forty years has attracted much attention from policymakers and economists. Although most agree that the remarkable record of progress has generally been based upon countries exploiting their comparative advantages in manufacturing, there remains much controversy over the patterns of these industrial expansions. One group of observers has contended that these economies not only realized extensive growth by mobilizing underutilized resources from other sectors to support dramatic expansion of export-oriented manufacturing, but that further gains came as competition in broad international markets with elastic demand induced improvements in productivity.[1] Domestic firms that targeted global markets had substantial incentives to invest in improving the efficiency of their operations, and foreign firms had incentives to support technology transfer through a variety of means to economies with favorable factor endowments -- including direct investment. Proponents of this view also suggest that the rates of total factor productivity growth were unusually high because of the great potential for improving productivity that is typically present in early-industrializing economies, where many unproductive firms are insulated from competition by local or otherwise segmented markets. They contend that a substantial one-time increase in productivity can be realized as rapid expansion of markets leads to better utilization of the resources in such firms as better (if not best) practices are adopted in order to survive or take advantage of the radical change in the environment. The breadth of international markets and opportunities for technology transfer offered East Asian economies during the late-20th century were rather unprecedented, and this made possible an exceptional record of industrial development and progress.

[1] See, for example, Pack and Westphal (1998) and Dollar and Sokoloff (1990).

An alternative perspective is that the rapid industrial growth stemmed virtually exclusively from rapid rates of factor accumulation – not of total factor productivity growth. In this view, the East Asian economies were remarkably effective at mobilizing and sustaining high rates of investment, but diminishing returns to, if not misallocation of, capital kept productivity growth at a quite modest pace. Those who share this perspective are typically skeptical of the notions that manufacturing productivity growth benefited particularly from the increased focus of East Asian firms on broad export markets, or from enhanced flows of foreign direct investment and technology transfer more generally. Alwyn Young (1992, 1995), for example, has argued that high rates of capital accumulation accounted for the bulk of the increase in manufacturing labor productivity over time in East Asian Tigers such as Hong Kong, Korea, Singapore, and Taiwan.[2]

Doubts about whether the expansion of exports led East Asian economies to realize more rapid productivity advance in manufacturing have been further reinforced by several recent studies that raise questions about the causal mechanisms underlying the well known empirical association across firms or industries between productivity and export orientation. Working with micro-level panel data from a number of different countries, scholars have found that firms tend to increase their productivity before beginning to export, rather than afterwards. Many have interpreted such findings as implying that it is productivity increase at the firm level that leads to greater export of output, rather than production for export leading to productivity advance.[3]

One of the reasons that this controversy endures is that the available data have not generally been rich enough to conclusively distinguish between the competing views.

[2] Young (1992 and 1995).
[3] See, for example, Clerides, Lach, and Tybout (1998), Bernard and Jensen (1999).

Specifically, most of the empirical work to date on East Asian manufacturing has had to rely on industry-level information over time. A great deal can and has been learned from investigations relying on such evidence, but the inability to directly examine whether and how productivity is related to firm characteristics leads to some uncertainty about the inferences that can be drawn. This problem may be particularly relevant to early developing economies where the initial stages of industrialization are often associated with substantial changes in manufacturing organization and technology, and poorly integrated markets allow firms with quite different levels of productivity to coexist during periods of transition.[4] Another issue that has complicated efforts to study the sources of productivity with aggregate or industry-level time series data is that estimates of rates of growth are quite sensitive to the quality of the price indexes. Obtaining accurate and representative information on prices is always important for scholars of productivity, but the severity of the problem is ameliorated somewhat when the focus of analysis is on cross-sectional variation across firms within the same industry and economy.[5]

Concern with improving knowledge of manufacturing development has stimulated efforts to systematically collect and examine detailed information at the establishment level. Such data are often useful for studying the relationship between characteristics such as export orientation or access to broad markets and productivity. Among the cross-sectional samples of manufacturing establishments that have become available are a new set of surveys conducted across a wide range of countries with the encouragement and support of the World Bank. Although similar surveys have been carried out before, the recent emphasis on

[4] Many examples of this pattern can be drawn from the economic histories of now developed countries. For discussion of a relevant case during the early industrialization of the U.S., see Sokoloff (1984).
[5] This problem is admittedly more relevant to the older literature that focused on estimating productivity growth over time from industry- or sector-level data than it is to the more recent work that employs panel data on firms.

encompassing many countries and on comparability has made them more attractive and useful for researchers concerned with growth. This paper employs the first wave of these surveys, which were administered in five East Asian economies during the late 1990s: Indonesia, Korea, Malaysia, the Philippines, and Thailand.

Although the surveys enumerate establishments from only a limited number of industries within each economy, they are extremely rich in the information they contain. Not only is there extensive detail about the inputs consumed and outputs produced, but the data also include information on the governance of the firm, the ownership of the firm, the year in which the firm was established, the share of outputs exported, the use of outside auditors, the source of technology, and many other characteristics of the firms. There are typically two sorts of problems with cross-sectional studies of factors that might be related to productivity. One is that competition between firms typically limits the amount of variation in productivity that can be observed; hence estimates of systematic differentials in productivity tend to be downward biased in well-integrated markets. The second issue has to do with what is exogenous, what is endogenous, and what can be inferred about the sources and extent of productivity increase from an empirical association between productivity and firm characteristics.

In this paper, we show that, despite the questions that arise in working with such data, these cross-sectional surveys of firms can contribute much to our understanding of manufacturing productivity in East Asia. Although competition in well-integrated markets narrows the range of observed variation in firm performance, we find substantial advantages in productivity associated with firms that are in various senses more "open" to the rest of the world: those that foreigners have a greater ownership share in, those that use outside auditors,

and those that choose to focus on the export market. Strikingly, we find that the magnitude of the differences in productivity related to these characteristics are extremely large in less-developed economies such as Indonesia and the Philippines, but are virtually absent in more-developed South Korea. This pattern is highly robust, and conforms well with the idea that there are major gains in productivity to be realized during the very early stages of industrial development.

We focus particular attention on the question of whether firms self-select to compete in world markets and make the appropriate investments that boost productivity and allow them to be successful in that broader arena, or whether relatively exogenous realizations of higher productivity allow the favored firms to export their output. To explore this issue, we take advantage of information collected by the surveys on whether or not the firm was an exporter during its first year of existence. First, we show that firms that began as exporters not only have higher levels of productivity years later than other classes of firms, but that they also differ systematically in the training of their work forces, the vintage of their capital equipment, the use of auditing, and other aspects of their production processes and operations. However, because it is possible that firms that are able to export during their first year have already been "selected" for exporting by an exogenous realization of high productivity shock, we also employ a two-stage procedure, with the goal of examining whether productivity is related to an exogenous component of the decision of the entrepreneur about the focus of his firm. The first stage estimates the probability of a firm being established as an exporter as a function of a moving average of the growth of the world economy, the growth of world trade, the growth of national exports and the real exchange rate around the year in which the enterprise was established. Our second stage then relates the productivity of the firm to the

predicted likelihood, obtained from the first stage, that a firm had exported in its first year of existence. The key result is that firms that were established in years in which macroeconomic conditions favored exports -- and thus were more likely to have been based on business plans that targeted production for the international market – had higher levels of productivity than did firms established when conditions were less favorable to exporters. The magnitude and significance of these productivity differentials were markedly higher in the least-developed countries. In our view, the evidence supports the idea that access to export markets leads firms to undertake investments that raise their productivity, and that these effects are more powerful in economies with product markets that are less well integrated.

In sections II and III, we describe the manufacturing surveys we employ, and provide some descriptive statistics on what they reveal about the manufacturing sectors in the respective countries. We present our multivariate analyses in section IV. Section V concludes.

II DATA

This paper uses new and comprehensive data from approximately 2700 manufacturing establishments in five East Asian countries: Indonesia, Korea, Malaysia, the Philippines, and Thailand.[6] Instead of being restricted to a single country, this database provides comparable information on a wide set of firm characteristics for all of these five countries during the 1996-1998 period. With the assistance and advice of a World Bank team, similar instruments and sampling procedures (including industries selected for coverage) were employed to

[6] We will use the terms firms, establishments, and plants interchangeably in the course of this paper, but it should be emphasized that the unit surveyed was the establishment – not the overall firm. For a more detailed description of the database, see Hallward-Driemeier (2000).

facilitate the cross-country comparisons. Enumerators personally gathered information from four to seven hundred firms in each country.

The survey questionnaires called for both qualitative and quantitative information. The qualitative section covered topics such as ownership structure, technology acquisition, views on the business environment, and relationships with banks and other financial institutions. The quantitative section included questions on production, financial accounts and human resources. In addition to collecting information on current operations, the survey asked for retrospective reports on the core quantitative variables over the previous year or two. The basic structure of the questionnaire employed was roughly the same across the countries.

The participating governments were particularly interested in issues related to the competitiveness of firms in manufacturing industries where there was potential for exports, and the survey was designed accordingly. In each country a large sample of establishments was selected from five to seven of the following industries or sectors: food processing, textiles, garments, chemicals, machinery, electronics, auto components, and wood products. The selected industries accounted together for more than half of the entire manufacturing value added, and of manufacturing exports, in each of the respective economies. Only registered firms with at least 20 employees were included in the population frame.[7] This restricted population frame, assembled by each national statistical agency with technical assistance from the World Bank, was then used to randomly choose the sample of small, medium and large establishments to be interviewed.

[7] There are two caveats. First, the Malaysian government was interested in building on a previous survey that had used the entire population of industrial firms, regardless of size. To make the sets of firms we worked with more comparable across countries, we excluded firms in Malaysia with less than 10 employees from our analysis. Despite this restriction, small firms account for a much higher proportion of the firms in the data we work with than they do for the other countries. See Table 1. The other point is that the size restriction employed in the design of the original samples was applied using information from the respective industrial registries. Some of the firms that had been listed in the registry as having 20 or more workers evidently experienced decreases in their labor force by the time they were surveyed.

Although considerable effort was directed at obtaining representative sets of establishments from the respective countries, there are some issues of sample selection to be considered. In drawing the sample, larger firms were over-sampled relative to their numbers in the overall population. A pure random sample would have resulted in very few observations of large firms, just as coverage of small firms would have been quite limited if the sample was based on the contribution to GDP. The proportions vary somewhat by country, but roughly a third of the sample is from each of the three size categories to allow for a significant number of firms of each size to draw statistically significant inferences about each category. Within each size category, the establishments to be surveyed were selected randomly.[8]

Another caveat is that we did not get full participation from all firms selected to be in our sample. Approximately 10% of sampled firms were either listed with an incorrect address or had failed between the time of the industrial registry and the interview. From the size, location, and information on sector we had from the registry lists, there appears to have been somewhat more attrition among the smaller firms, but no systematic differences across sectors or locations. In addition to this survivorship bias, there is some variation in response rates, particularly with regard to financial information. We were unable to receive outside verification of the accounting information supplied. While we cannot ensure that all firms used the same accounting definitions, particularly among smaller firms, we did provide

[8] The representation of large establishments is of course even greater if evaluated on the basis of their labor force allocation, with 90% of the workers employed by establishments in this largest size category. This result is driven in part of by a very few extremely large firms, i.e. with over 10,000 workers. Another concern is whether our procedures for sampling by size categories captured the full extent of the differences in performance across sizes of firms. It is possible that by restricting our sampling frame to establishments with 20 or more employees, we constructed a sample that would be biased against finding differences in productivity across size. The surveys were completed in early 1999, but the samples of firms to be surveyed were drawn from various industrial registries that had generally been assembled one or two years before. Thus, newly established firms were underrepresented in our sample.

detailed instructions, definitions and examples to those completing the questionnaires and quality controls including follow-up calls from supervisors. While these caveats should be kept in mind, we have been careful in checking for the sensitivity of our qualitative findings and are not aware of any plausible sample selection biases that would lead to the robust results we report below.[9]

Table 1 presents descriptive statistics from the sample, with the upper panel relating the distributions of firms across particular categories and the lower panel providing the distributions of the labor force (firms weighted by the size of their labor forces) across the same categories. Several features of the data stand out. First, although the surveyed firms were drawn from some of the principal tradable goods sectors, many are not exporters. Overall, slightly more than half of all firms in the sample export some of their output, with the figures ranging from 75% in Korea to 39% in Indonesia. Because firms that export tend to be larger than those that do not, the shares of the labor force that work in firms that export some of their output (nearly 83% overall) are correspondingly higher. The proportion of firms that report some foreign ownership is not quite a quarter; of these, foreigners hold a majority share in only 60%. Again, however, since larger firms are more likely to have foreign owners (in all countries but Korea), the prominence of foreign ownership is greater if the gauge is based on where the labor force is employed. In general, there seems to be much less foreign direct

[9] The one systematic test of representativeness we have been able to carry out was to compare the distribution of firms across industries (within each country) in the sample (see Table 1) to the distribution of firms across the same industries in the respective country's aggregate totals. Encouraging results were obtained; by the Mann-Whitney two-sample method, we could not reject the hypothesis that the sample was representative of the underlying population. In addition to the conventional problems of data retrieval and entry, we have also had to be concerned with whether firms followed good or standard accounting procedures, especially with smaller firms. See the data appendix for a detailed description of our treatment of outliers.

investment in Indonesia and Korea, and more in the Philippines (as well as in Malaysia if we consider the size of firms surveyed).[10]

III LEVELS OF DEVELOPMENT AND THE IMPORTANCE OF CONTEXT

The availability of comparable data for a number of developing East Asian economies provides an additional dimension along which to explore hypotheses about how and why conditions such as market size and intensity of competition generally, or export orientation in particular, are related to firm productivity. Simply put, theories that highlight mechanisms through which broader markets lead to higher levels of productivity among surviving firms imply that the gap in productivity between exporting and non-exporting firms should be larger in less developed economies where output markets are typically more segmented and limited in extent. A testable implication, therefore, is that the magnitude of the productivity differentials between firms that are more open (exporters) and less open (non-exporters) to broad international markets should diminish with the level of development. In contrast, the view that productivity improvements at the firm level are exogenous to the breadth of markets the firm faces does not yield a clear prediction about how the productivity differential varies across countries.

Given that context may matter in making sense of the evidence, in Table 2 we try to provide a sense of perspective through a conventional set of macroeconomic indicators and some statistics gleaned from the sample of manufacturing firms. Korea is obviously the most industrialized of the five countries. With a per capita income exceeding $11,000, it qualified

[10] These orderings are not the same as those implied by figures on the overall share of FDI in GDP, but part of the discrepancy may be due to FDI in resource extraction industries (which is especially important in Indonesia and Malaysia).

to join the OECD in 1996. Often heralded as one of the 'miracle economies', the growth of the Korean economy from the 1960s through the mid-1990s was indeed spectacular. With the highest manufacturing share of GDP, as well as the lowest agricultural share, Korea has largely completed the transition from a substantially agricultural economy to a highly industrial urbanized one. There is no doubt that it has the largest and most sophisticated domestic market of the five countries.

Malaysia would seem the second most developed. Although the sectoral compositions of the two economies are similar, Malaysia has a clear edge over Thailand in both GDP per capita and in manufacturing productivity.[11] Despite impressive rates of investment in new machinery and in investment overall, Thailand has lagged in effecting the transition from a focus on low value added manufacturing to one on higher value added activities. The Philippines and Indonesia are clearly the least developed economies of the five, with per capita incomes and investment rates that are much lower than those of their neighbors. These two multi-island countries also have large and geographically dispersed populations, posing additional obstacles to the integration of markets. It is, accordingly, not at all surprising that agriculture accounts for a much larger share (and manufacturing smaller) of national output, nor that the coefficient of variation in manufacturing productivity is much higher, in these economies than in the other three countries.

[11] Another distinctive feature of the Malaysian economy is that, like in Korea, the government has been active in trying to direct the path of development. In recent years, the government has aggressively advocated specific sites as industrial areas, particularly focusing on attracting foreign firms in high technology industries. Another longstanding goal, however, has been to ensure that the indigenous population also benefited. In addition to various other affirmative action measures, the Bumiputras laws mandate that 30% of ownership must be in the hands of native Malays.

While GDP per capita is a reasonable proxy for the extent of markets, we would also call attention to the relevance of the degree of dispersion in manufacturing productivity. When local or regional markets are not well integrated, a circumstance typical of less-developed countries, inefficient firms can survive because they are insulated from competition with more efficient enterprises – leading to greater productivity dispersion. Figure 1 depicts our gauge of the degree of dispersion, the coefficient of variation in manufacturing productivity, within each of the five countries. The dispersion patterns line up as would be expected from our knowledge of the development of the countries, with the highest variation in Indonesia, and lowest in Korea. There are some differences in relative dispersion across sectors, but in general the lower the level of development (as gauged by per capita income), the greater the relative number of less productive firms and the greater the dispersion in total factor productivity.[12] This cross-country pattern is quite consistent with the view that the extent or integration of domestic markets can help understand the variation in manufacturing productivity.

IV. SYSTEMATIC PATTERNS IN TOTAL FACTOR PRODUCTIVITY

The manufacturing surveys are a valuable resource for the study of manufacturing productivity in the newly-industrializing countries of East Asia. Not only do they provide researchers with detailed information at the establishment level, but they also have the advantage of encompassing comparable industries (generally those with a marked potential for export) from a set of economies at much different levels of development. Thus, we can analyze variation in productivity and in other characteristics across firms within a country, as

[12] Haddad and Harrison (1993), Harrison (1994) and Levinsohn (1993) find consistent results that productivity dispersion decreased with greater competition post trade liberalization.

well as employ inter-country comparisons to check for robustness or to test implications of theories that bear on how patterns of productivity might vary across different market environments.

Our measures of total factor productivity (TFP) were derived from a Cobb-Douglas production framework (see Appendix for more details). We estimated a variety of different specifications of production functions in logarithmic form for each country separately. In one basic specification, output (calculated as total sales plus the change in inventories) was the dependent variable and the independent variables consisted of total assets, total employment, material inputs and energy, with dummy variables for sectors and years.[13] Output, inputs and total assets were converted to 1995 constant US dollars. In the other basic specification, value added (calculated as output minus the value of raw materials and energy costs) was the dependent variable and the independent variables were total assets and total employment.

We carried out extensive sensitivity analysis in estimating these production functions, experimenting with different measures of the inputs and outputs as well as with the precise subset of observations over which the functions were estimated. Concerned about possible simultaneity bias, we also followed procedures suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2000) to generate semi-parametric estimates of productivity that would be consistent even in the presence of input shares being influenced by private

[13] The Malaysian questionnaire gathered information on the value of sales of the firm's most important product alone. However, for roughly half of the respondents the figures on total sales could also be retrieved. These four hundred observations were used to estimate the ratio of sales of the most important product to total sales, controlling for sector, size of firm, export status, ownership, and location. These fitted ratios were then used to estimate the values of total sales for the observations where that variable was not reported directly. In estimating the production functions, both the whole sample and the sub-sample for which we knew the total sales were used. The former demonstrated larger scale effects. This would be consistent with smaller firms producing a larger number of products on a made to order basis.

knowledge of a firm's productivity.[14] The basic patterns in the data are so strong that the qualitative results are extremely robust to the use of different procedures or specifications.[15] The production function parameters we employed for the analyses of systematic variation in total factor productivity presented below were estimated over a sub-sample of establishments that employed 10 or more workers and provided the required information; extreme outliers were excluded.[16]

In Table 3, we report the sets of output elasticities obtained from four different specifications of production functions, with each normalized to sum to one.[17] As is clear, they vary across countries, but are generally within ranges suggested by the work of other investigators.[18] These country-specific output elasticities were then used to compute sets of establishment-level estimates of TFP, corresponding to the different specifications of production functions. The basic qualitative results of the multivariate analyses presented

[14] Our use of these procedures was of course confined to the production functions estimated with total output as the dependent variable. Although these procedures have come to be commonly used to adjust for the possible simultaneity bias that conventional methods of production function estimation suffer from, they too are based on strong and somewhat implausible assumptions. For discussion, see Ackerberg (2002).

[15] One concern is that given the timing of the survey, we might get significant variation across years. However, while there are shifts in the average productivity in 1998, the hypothesis that the input coefficients are equal over time cannot be rejected. Thus, we opted to include year dummies in the regressions. We also ran the regressions for each year separately and the qualitative results held.

[16] About 20 firms in each country were excluded on the basis of one or more of the relevant variables, such as the capital to labor ratio or measures of productivity, were more than 4 standard deviations from the mean.

[17] The estimates suggest that there were scale economies in four of the five countries, with their magnitude being greatest in the least-developed economies such as Indonesia and the Philippines. In the lower panel, we report the point estimates of the scale coefficient for each country, as derived from the series estimator.

[18] These output elasticities were estimated from production functions that included dummy variables for industries. We did not employ output elasticities that varied across industries, because inclusion of such interaction variables did not significantly increase the explanatory power of the production functions. We also explored the use of estimating output elasticities from income shares, but found that the qualitative results were unaffected. In presenting our analysis, we favor the production-function-based estimates, because of the difficulty of identifying comprehensive measures of labor compensation. Overall, the qualitative results we report below were highly robust to how we treated this issue.

below are again highly robust to the selection of production function specification the respective measure of TFP is based on.[19]

In order to explore the systematic patterns in manufacturing productivity, we estimated a variety of multivariate regressions across the firms within each country, with different measures of the log of total factor productivity as the dependent variable, and a set of dummy variables controlling for sector, year, firm size, whether the firm was located in the capital city, the extent of foreign investment in the firm, whether output was exported during the year the firm was established, whether the firm was not established as an exporter but became an exporter later, and a variety of other characteristics included as independent variables. We report, in Tables 4a and 4b, the results from the regressions based on TFP measures derived from the two different production function specifications: the series estimator (based on the Levinsohn-Petrin procedure for dealing with simultaneity) and the more conventional OLS Cobb-Douglas specification with value added as the measure of output. What is immediately striking about the results of these regressions is how similar they are across the five countries, as well as how sensible the empirical regularities are.

First, the evidence is broadly consistent with the notion that there are substantial economies of scale during the earliest stages of industrial development. As foreshadowed by the scale coefficients we reported in the lower panel of Table 3, even when we control for many other characteristics, the estimated coefficients on the dummy variables for establishment size suggest that smaller firms are far less productive than their larger

[19] While the basic qualitative results are robust, the sizes of the coefficients do vary. In particular, as is typical in production function estimation, the use of specifications with output rather than value added as the dependent variable reduce the estimates of the extent of scale economies as well as differences in productivity between classes of firms substantially. Intuitively, this results from there being relatively limited variation in the output to materials ratio over firms, because the scope for producing a unit of output without certain raw materials is limited. The difference can be seen in the contrast between Tables 4a, where the regressions use estimates of TFP based on gross output, with those in Table 4b, where the regressions are based on estimates of TFP with value added as the measure of output.

counterparts in the less-developed economies such as Indonesia and Thailand, but are essentially just as productive in more-developed Korea.[20] This contrast is perhaps not surprising, in that the more extensive and competitive product markets associated with higher levels of development would be expected to be more effective at selecting out firms with markedly lower productivity, and accordingly reduce the range of observed productivity differentials across size and other firm characteristics. Presuming the reasonableness of drawing inferences from comparisons of cross-sectional results over economies at different stages of development, the implication seems to be that there may be a substantial one-time gain in manufacturing productivity during the early stages of development, associated with the shift of resources out of traditional small-scale establishments to larger enterprises operating with more modern organizations and technologies.

Another factor that has been suggested as an important source of manufacturing productivity growth in developing countries is the involvement of foreigners. The basic logic is that when foreign individuals and companies, who are thought to be more familiar with technological opportunities, have direct interests in the performance of a firm, they will have a greater ability or incentive to invest in diffusing or implementing improvements in technology or management. These stimuli to technology transfer lead firms that have closer associations with foreigners to raise their productivity above the level at which they would otherwise operate. Our data make it possible to examine this hypothesis directly, and we

[20] This qualitative result held across virtually all specifications we estimated. It does not hold for the Philippines when we use the measure of TFP obtained from the series estimator, and also control for other establishment characteristics (such as whether the firm has foreign owners and exports), but it is robust to the series estimator if one doesn't control for these other variables that are highly correlated with size (see the lower panel of Table 3). As noted above, the surprisingly extensive scale economies estimated for Malaysia may be related to problems in the way output was reported in that country. See footnote 13.

find that even after controlling for sector, size, and export orientation, firms in which foreigners have a substantial ownership share have markedly higher productivity than those that are domestically owned in four of the five countries surveyed.[21] Moreover, comparing the coefficients on the two variables reflecting different extents of foreign ownership implies that firms with foreign ownership shares of over 50 percent stand out especially in productivity. That this discontinuity in the estimated relationship between foreign ownership and productivity conforms so well with the intuition that foreigners would be more inclined, and capable, of investing in transfer of technology where they have a controlling share in the firm bolsters confidence in the interpretation that the result is not an artifact, and that the principal line of causation went from foreign ownership to productivity. Moreover, that the estimated productivity differentials are largest in the least developed countries of Indonesia and the Philippines, where the estimates are around 40 percent by the series-estimator measure of TFP (as compared to 15 to 20 percent in Korea and Thailand), is generally consistent with this idea.[22]

One of the most controversial potential sources of productivity growth in developing countries is the orientation toward the export market. There is a longstanding view in economics that firms serving more extensive markets are more productive. Several mechanisms have been proposed, including economies of scale, notions that more extensive markets put more competitive pressure on firms to keep up with the technological edge, and the idea that larger markets, with presumably more elastic demand, offer greater returns to

[21] Malaysia deviates from this pattern somewhat in that the result that firms with foreign ownership are more productive is not robust. In some specifications, and especially if all firms with any foreign ownership are grouped together, the point estimate of the association with productivity is positive. It may be the case that the relationship is different in Malaysia because of the special programs there to obtain a significant ownership share for native Malays.

[22] The data contain information about the nationality of the foreign owners, but we find no significant relation between any particular nationality and firm productivity.

investment in invention or in other means of increasing value per unit cost. Based on this intellectual tradition, as well as abundant evidence from developing countries of general associations between the importance of exports and productivity across industries or firms, many have argued that firms that focus on the export market do realize increases in their productivity. Indeed, additional reasons for why orientation towards exports might promote higher productivity have been suggested, such as it making it easier to learn about advanced technologies employed elsewhere.[23] Proponents of this school contend further that developing economies should specialize in those goods in which they enjoy a comparative advantage, to boost rates of productivity and economic growth.

Although intuitively appealing, it has been difficult to substantiate the view that if firms focus more on exports they will come to realize higher productivity. Skeptics have noted how a reverse path of causation might be able to account for an empirical association between exports and productivity. For example, a recent study by Clerides, Lach, and Tybout (CLT) (1998), uses firm-level panel data from Colombia, Mexico, and Morocco to make the case that productivity may be higher among exporters because firms are better able to export after they increase productivity. In other words, the empirical pattern follows from higher productivity to exports, not from involvement in the world or export to higher productivity.[24] In these panels, CLT found a roughly constant differential in productivity over time between firms that exported throughout the period covered by the data and those who never exported during those years. Hence these groups had roughly the same rate of

[23] Prominent among them are that firms might raise productivity over time through learning by doing, or through advice or technical assistance provided by foreign customers – directly or through intermediaries. Kraay (1999) and Bigsten et. al. (2000) provide evidence of the importance of learning by exporting in China and several African economies. Also see Pack and Westphal (1998) and Westphal (2001).

[24] Similar conclusions of the importance of the selection of higher productivity firms into export markets are found in Bernard and Jensen (1999) and Aw, Chung and Roberts (2000).

productivity growth. The only firms that appeared to register higher average rates of productivity growth over the sample periods were those that moved from being non-exporters to exporters; moreover, most of the relative productivity increase (or decrease in costs of production) preceded the shift to exporting. Similarly, the firms that transitioned from exporting to not exporting manifested a decrease in productivity before changing status.

Clerides, Lach and Tybout were especially concerned with exploring whether exporting affects the productivity of firms through learning-by-doing. They reasoned that if so, firms should "exhibit a change in the stochastic process that governs their productivity growth" after beginning to export, and thus their analysis focused on a comparative examination of the productivity trajectories of different classes of firms. Although their treatment was meticulous and richly informative, the more general question of whether there is an impact of a firm exogenously choosing to focus on exports may not be fully resolved by their findings. There are two issues we have in mind. First, there may be constraints on the ability to observe persistent differences in productivity trajectories when the samples are confined to surviving firms. More specifically, the productivity trajectory of the low-productivity firms that survive in competition with the high-productivity firms may be determined by the rate at which the latter increase their productivity. Low-productivity firms that lag further and further behind will eventually fail --and that process of attrition puts bounds on the magnitude of the productivity differentials revealed by the data. The second issue is how to date the effect of a firm deciding to export. If a firm must make preparations or investments beforehand in order to compete in the world market, the effects of exporting

on productivity may begin early, and indeed might be evident before any goods are actually exported.[25]

The information the East Asia enterprise surveys contain on the year when firms were established and on the year -- if any -- they began to export provide us with leverage to help sort out the different paths of causation behind the association between exporting and productivity. A first approach is to take the orientation of the firm at the time of its establishment (whether or not they exported within a year of beginning operations) as exogenous, and to compare domestic firms that began as exporters with both domestic firms that began as non-exporters but made the transition to exporting, and domestic firms that never exported. The logic is that firms that export during their first year in existence were likely established with the intention of competing in the broader international market, and thus the choice of their orientation would be exogenous with respect to productivity.[26] These firms that began to export soon after commencing operations account for a dominant share of exports years later. Figure 2 presents the distributions, for each country, of the length of time that passed between the year the firm was established and the year it first exported. Overall, two-thirds of the firms that export in our sample began exporting within two years of beginning operations, and the proportion would be much higher if we weighted the firms by the amount of their exports. Moreover, consistent with our perspective, the relative shares of exporting firms and exports accounted for by firms that had originally been established as exporters are lowest in the most-developed Korea. Thus, the bulk of exports come from firms

[25] In other words, we are asking whether it is more reasonable to think of firms deciding to focus on the export market and then making investments that would allow them to compete in that market, or to think of the improvements that CLT observe prior to exporting as being realized exogenously with respect to involvement in the export market. See Westphal (2001) for a discussion of how exporting firms often are established with commitments from foreign buyers already in hand.

[26] Although the logic seems compelling, it must be admitted that the success at carrying through on that orientation – actually exporting during the first year of operations – may not be strictly exogenous with respect to productivity.

that likely made the decision to focus on the international market before any realization of productivity.

One of the reasons why firms that were established as exporters loom so large among current exporters is because of the high degree of persistence in export status that is manifested in the less-developed economies especially. Virtually all of the firms that were established as exporters continued to export during the survey period, while a much smaller fraction of the firms that had not been established as exporters were consistently doing so.[27] Another reason, however, is that firms that were established as exporters remain much more specialized toward the international market. In Figure 3 we present the distributions of firms by the shares of output that are exported in the year of the survey for three classes of establishments: domestic firms that were originally established as exporters ; domestic firms that were originally non-exporters but exported at some point before the survey; and firms that had foreign owners. As is evident, domestic firms established as exporters resemble foreign-owned firms in having higher export shares or being much more specialized at the export market than those that transitioned to exporting later in their histories. This evidence strongly supports the idea that a substantial proportion of the exports come from domestically-owned firms that were intended right from their initial organization to focus on the international market.[28]

[27] While overall there is little moving out of export markets once firms have entered, this pattern varies somewhat over countries. Korean firms are the most likely to move in and out of export markets, while almost all Indonesian and Philippine firms that ever reported having exported part of their output were exporting at the time of the surveys.

[28] There are, of course, several potential problems with our interpretation. First, we are not actually observing all of the firms that were organized with the intent of focusing on the export market, but rather firms that were so organized and were successful. Second, there is an unobserved heterogeneity problem in that owners of firms organized to aim for the export market may be more talented than those that are content to target the domestic market. In principle, these issues may help account for our results. Our efforts to address these concerns are discussed below.

Given the logic of our approach to getting at the impact of involvement in export markets, and because most of the theories about the export-productivity linkage relate to domestically-owned firms, we interact export orientation during the first year and whether the firm is domestically owned in the total factor productivity regressions. Table 4a presents the results of the regressions where this interaction term is included (with the measure of TFP derived from the production functions with the series estimator). It is striking in that four of the five countries (all but relatively-advanced Korea), the coefficients imply that the domestically-owned firms that exported during their first year of operations were much more productive than their counterparts that had not begun as exporters, with the differentials generally largest in the least-developed economies: the Philippines and Indonesia, followed by Thailand and Malaysia. Moreover, the qualitative results are quite robust and hold across alternative measures of TFP or whether or not we distinguish between the firms that eventually made the transition to exporter status from the persistent non-exporters. In this latter case, the point estimates of the productivity advantage for the original exporters (see Tables 4b and 4c) consistently exceed those for the firms that made the transition from non-exporters to exporters, although they are not quite always significantly different from each other.[29]

It should be noted that these results are not inconsistent with those of CLT. The data are organized a bit differently, but in both studies the early exporters are markedly more productive than the non-exporters, and those firms that began exporting later have an

[29] Korea is the exceptional case. As has been suggested before, one would expect to observe smaller differentials in productivity across classes of firms in a relatively more developed economy such as Korea. Thus, the small and insignificant difference between original exporters and other domestically-owned firms is not surprising. The pattern across countries also helps to assuage doubts about the effect of the crisis driving our results. In Korea, a country that did experience the crisis in 1998, exporters were not more productive than non-exporting firms. In the Philippines, however, a country that largely escaped the crisis, the same pattern holds as in Thailand and Indonesia.

average productivity that falls between the two extreme groups. Our interpretation of this pattern is different, however, in that we suggest that firms choosing to export tend to change the manner of operating so as to be able to compete effectively in the more competitive wider market. In our view, producing for the export market can lead to higher productivity through mechanisms other than learning (or the form of learning as specified in CLT), such as through inducing firms that seek the potentially higher rewards available to exporters to make the investments necessary to compete in these broader international markets.

The substantial differences in total factor productivity between domestic firms that were established as exporters and domestic firms that were not (and especially those that have never exported) are certainly consistent with our view that entrepreneurs that decide to focus on the export market make a conscious decision to operate differently from those that rely on the domestic market, and thus realize greater value per unit of input. Before accepting this interpretation, however, there are several fundamental issues that must be resolved. First, there is the question of how the evident co-existence of firms in the same industry with such radically different levels of productivity can be explained. If these firms were competing directly against each other, the less productive firms would not have been able to survive and we should not be able to observe such a dramatic gap. If the less productive firms were insulated from competition, and thus able to survive despite much lower productivity, what factors could have accounted for that protection? Conditions such as poor infrastructure and high transportation costs, which are generally recognized as obstacles to integrated product markets in less-developed economies, surely play some role, especially in making sense of the extensive scale economies observed in the least-developed societies. However, the most important barrier or source of market segmentation may be in the quality of specifications of

the product items. The textile goods produced for export in Indonesia, for example, are likely to be very different from those produced for the domestic market. If the more productive of the available technologies is linked to producing the higher quality of product demanded in the international market (but not to the same degree in the home market), as might be expected when the new technologies were developed abroad, then it would be quite reasonable to observe a difference in productivity between firms focusing on the export market and those producing for the domestic market.[30]

Few would dispute the idea that the quality or specifications of products could be a powerful factor in accounting for segmented product markets in less-developed economies. Skeptics might ask, however, whether it is reasonable to compare the productivity of classes of firms producing very different products, even if they are nominally classified as being within the same industry. We argue that it is in this context, particularly because the differences in the character or nature of the inputs being utilized in the respective production processes are either small or captured in market prices (such as the evaluation of the capital stock). In our view, given that different products are assessed and aggregated with market prices, comparisons of the amount of total value produced per unit of input are very useful indicators of relative productivity in manufacturing – just as they are in agriculture. This perspective rests to some degree on the inputs, at least those not evaluated at market prices, being rather similar in nature. The composition of the labor force is the obvious subject of concern here, but (as shown in Table 5), although foreign-owned firms employ a markedly more educated workforce, domestic firms established as exporters have a labor force much

[30] Indeed, Eileen Brooks has recently argued that Engel Effects lead in less-developed countries to differences between the quality of the products manufactured by exporters and the quality of the products produced by firms that sell their to domestic consumers. Moreover, she suggests that this explanation helps account for why the extent of such differences between exporters and non-exporters might vary inversely across economies with the level of development. See Brooks (2002), as well as Helpman and Krugman (1985).

like that of those that were not established as exporters (in the four countries where this information was collected). Such evidence that the inputs being used are comparable supports the logic of drawing inferences about relative productivity from information about how much value the respective classes of domestic firms generate per unit of input.[31]

Even accepting that the inputs being used by the firms that export are quite similar, or appropriately evaluated by market prices, another problem about the comparability of the productivity estimates could be raised. It might be argued that the technologies employed by the two classes of firms are so different that in computing total factor productivity, the use of the output elasticity estimates for capital and labor obtained from a single production function is a source of bias and could affect the qualitative results. Specifically, given that the export-oriented firms were more capital intensive than those directed at the domestic market, our procedures could make the former seem relatively more productive than they actually were if they led to an underestimation of their output elasticity of capital relative to that of labor. This possibility might seem plausible if the different technology that exporters employed was capital-augmenting in some way, and if our measures of the value of the capital stock were inadequate. We explored the significance of this potential problem in two ways. First, we estimated production functions over domestically-owned firms with interaction terms between the inputs they employed and a dummy variable for whether they were exporters; the estimated coefficients on these terms were very small and insignificantly different from zero in statistical terms. We also reran the same regressions with TFP

[31] We were able to run TFP regressions with controls for the proportions of the labor force that had different levels and types of education (i.e. primary, secondary, vocation, or tertiary) in the four of the five countries that reported such information (all but Indonesia). The coefficients on the variables controlling for the education of the workers had the expected signs and were statistically significant, but the effects were small in magnitude. The qualitative results concerning the relative productivity of foreign-owned, domestic exporters, and domestic firms focused on the domestic market were not at all sensitive to such controls.

measures based on the value added conception of output we reported above, but with much higher elasticities or weights (0.8 and even 0.9) on the capital input than is feasible. Employing such unrealistically high weights on capital definitely biases the productivity estimates against the more capital-intensive export-oriented firms, yet the basic qualitative results we reported hold. The clear implication is that the amounts of output produced by the domestically-owned firms relative to inputs are so high, as compared to the same ratio among those firms geared toward the domestic market, that the qualitative findings are extremely robust to reasonable variation in the ways the estimations and comparisons are carried out.

Thus far, both evidence and theory seems quite consistent with our view that after choosing to focus on exports, entrepreneurs made investments to raise the productivity of their plants and the quality of the goods they produced so as to be able to compete effectively in the potentially more lucrative international market. Another obvious test of our hypothesis, however, is to examine whether firms that export conduct themselves very differently from those that do not. If our perspective is to offer any explanatory power, we should see evidence that exporting firms were distinctly different in their mode of operations. One of the most basic elements of how a firm operates is the types and amounts of inputs it employs, and we accordingly examined how different classes of enterprises, as defined by their export status and whether they are domestic, varied along this dimension. As is evident from the regressions presented in Table 6a and 6b, domestic firms that export are substantially different in their capital intensity and vintage of capital equipment from their counterparts that do not, and indeed more closely resemble the enterprises that are foreign owned. After controlling for the age of the firm, size, sector, year, and

establishment-level reports of their rate of capacity utilization, we find in Table 6a that in all five countries domestic firms that exported as well as foreign-owned firms are both markedly more capital intensive (as judged by the ratio of assets to the number of workers) than domestic firms that do not export. Moreover, as demonstrated in Table 6b the same classes of firms are generally (though not in Indonesia) also distinguished by having larger shares of their capital stock composed of equipment of recent vintage (0-4 years old), even after controlling for the age of the firm. Foreign-owned firms typically went even further than domestically-owned exporters in pursuing both of these types of investments, which would normally be thought of as conducive to increasing productivity. What is more relevant here, however, is that even after controlling for size and other firm characteristics, domestic firms that export make significantly different choices about their production techniques than those that do not. They more closely resemble the foreign-owned firms in both these decisions, as well as in realizing significantly higher levels of productivity.

In Table 7, we examine in more detail the differences in practice across classes of firms by presenting descriptive statistics for two industries, textiles and electronics, surveyed in each of the five countries. Reported are the median number of workers, the median capital per worker, the share of firms using outside auditors to review accounts, the share with formal training programs, and the share of firms using technology obtained from abroad. The figures again suggest that even within the same industry, domestic firms that export resemble foreign firms in being much more likely than non-exporters to pursue strategies associated with boosting productivity. Moreover, these contrasts are greatest in the less developed economies like Indonesia, the Philippines, and Thailand, and smallest in Korea. In Thailand's textile industry, for example, the proportions of domestically-owned exporters

that use outside auditors and employee training programs are roughly the same (indeed slightly higher) as that for firms with foreign owners, and both are much higher than for enterprises that confine themselves to the domestic market. The only country that deviates from this pattern is the more developed Korea (especially with electronics). Overall, the evidence suggests that domestic enterprises producing for the export market make systematically different choices about how to operate, and that their choices lead them to function more like foreign-owned firms, realize higher productivity, and more effectively compete in an international market.

Some might question whether differences in practices such whether outside auditors or training programs are used could really be significant in accounting for the higher productivity of domestic-owned exporters. Although the productivity differentials at issue are unlikely to be fully explained by them, we would suggest that these particular operational decisions are representative of a variety of progressive technological policies (most of which we lack data on) that firms aiming for the international market are more likely to undertake than firms producing for the domestic market. This interpretation is consistent with the regressions reported in Tables 8a-b, where the results indicate that even after controlling for size and a wide range of other characteristics, enterprises that use outside auditors and employee training programs generally have higher productivity than their peers that did not. The significant association of these practices with productivity is all the more remarkable in that there is no consistent relationship (see regressions in Table 9a and 9b) between productivity and the variables reflecting the ownership structure (such as whether the firm is a partnership, publicly listed corporation, or whether its shareholders have limited liability). Given the recent emphasis by many economists on corporate governance issues, the contrast

between the relative insignificance of these variables in explaining differentials in productivity across firms relative to other factors is impressive.[32] What is of course also important, however, is that even after adjusting for both sets of characteristics, the same patterns of higher productivity among firms established as exporters, and of the differential varying inversely with the level of development hold.

We have, up to now, given only limited attention to the conditions or individual characteristics behind the decisions by entrepreneurs to aim at the export market, and to carry out investments to boost productivity and prepare for competition in that arena. Our treatment, however, has presumed that more entrepreneurs would tend to move in this direction as fundamental factors associated with the process of growth as well as national policies improve the effective degree of access of domestic producers to foreign markets. Our analysis suggests that such changes in the orientation toward exports lead to increases in the productivity of resources employed in manufacturing, but this effect would depend to some degree upon the supply of entrepreneurial talent. For example, it might be argued that individuals with the talent and other characteristics necessary for great success as entrepreneurs are particularly scarce in the less-developed East Asian economies, and that the relatively high productivity of domestically-owned exporters we find in such countries was due entirely to the concentration of scarce entrepreneurial talent in those firms. If this were true, our interpretation of the cross-sectional patterns might change, and implications for the growth over time of manufacturing productivity of a country encouraging exports would depend on how elastic, in both the short- and long-run, the supplies of entrepreneurial talent were.

[32] It is unclear why Thailand seems to depart from this pattern, largely due to its single proprietorships being markedly less productive than other types of firms.

We are unable to measure the quality of entrepreneurs directly, but we have sought to investigate the significance of the relative scarcity of such talent in the less-developed countries by using information from the surveys on whether the founder of the firm had previous experience in the industry, and whether the experience was with a local or domestically-owned firm, a foreign-owned firm, or a joint venture. In Table 10, we report TFP regressions (based on the series estimator), with dummy variables for the backgrounds of the founders of the firms employed, in addition to the basic variables included above, as the independent variables. The results indicate that firms with founders that had previous experience in the industry, and especially experience at joint ventures, were significantly more productive than their counterparts in all countries except for Korea.[33] This pattern is quite consistent with the notion that the scarcity of entrepreneurial talent is greater in less-developed economies. Despite this evidence that the experience of the founder is related to the productivity in the least-developed economies, it is perhaps even more striking that the qualitative finding of productivity being higher among firms established as exporters is robust to such controls for the characteristics of the entrepreneur. As before, the productivity gap between the domestic firms that began as exporters and those that did not is: large, positive, and statistically significant in Indonesia, the Philippines, and Thailand; positive but only marginally significant in Malaysia; and essentially zero in most-developed Korea. Although there are many other relevant characteristics we are unable to discern, the lack of sensitivity of the cross-sectional patterns to this control for heterogeneity in the quality of entrepreneurs provides further support for our interpretation.

[33] This association between the experience of the founder and the productivity of his firm is suggestive of there being positive externalities stemming from foreign investment.

As a further check of whether selection among the entrepreneurs establishing manufacturing firms may account for our finding, we also employed an instrumental variables approach to control for the possibility that the more capable entrepreneurs were able to achieve higher productivity at their enterprises, and thus export, right from the beginning. In our first stage, we estimated for each country the probability that the domestic firm exported during its first year of existence, using as exogenous variables moving averages of the growth rate of the world economy, the growth rate of world trade, the growth of the country's total exports and the real exchange rate for the respective country around the year the firm was established.[34] The predicted probability that a firm would export during its first year was accordingly a function of the current macroeconomic conditions that would be relevant to whether an entrepreneur would choose to focus a new business on the export market. As these predicted probabilities were then substituted in the second stage for the actual outcome of whether the firm exported or not, our approach essentially gets at whether firms established during years more conducive to exports continued to be more productive years later than firms established during years less conducive to exports. Although there may have been complicated processes of selection among the most capable entrepreneurs in choosing the years in which they established firms, the likelihood that less productive firms would have found it easier to survive during the periods most favorable to exports should tend to bias the results against our view. As seen in the second-stage regressions presented in Table 11, however, the use of an instrument for exporting during the first year of establishment yields the same qualitative results. After controlling for other variables, domestically-owned firms predicted -- on the basis of macroeconomic conditions during

[34] Data comes from the World Bank's Development Indicators database. Three-year moving averages were constructed for the world growth and trade variables. For each country the set of instruments passed the test of over-identifying restrictions.

their year of establishment -- to have exported during their first year of existence were much more productive at the time of the surveys than domestically-owned enterprises that were established in years less conducive to exports. Moreover, the magnitude of this productivity differential again varies inversely with the level of development: high in Indonesia, the Philippines, and Thailand and smaller and statistically insignificant in Korea and Malaysia.[35] These results tend to undercut the idea that our basic qualitative result can be explained by differences in the quality of the entrepreneurs, and bolster our interpretation that improved access for less-developed countries to foreign markets stimulates the establishment of firms that are more productive and able to compete for the higher returns available in the international arena.[36]

V. Conclusion

Our results suggest strongly that in early-industrializing Asian economies total factor productivity has generally been much higher among firms that are integrated into broader markets. This pattern is reflected in the estimation of economies of scale, as well as in the higher productivity among firms that export, firms that foreigners have a significant ownership stake in, and among firms that employ outside auditors. These findings are all the more striking in that no other variables, including those that many have speculated about --

[35] The use of the instrumental variables has increased the point estimates on the coefficient for being established as an exporter, but sharply increased the standard errors; hence the level of statistical significance is modest even for Indonesia, the Philippines, and Thailand. Although this is a matter of concern, the use of instrumental variables commonly has these effects. For further discussion, see Angrist, Imbens, and Rubin (1996).

[36] The factors that lead some entrepreneurs to choose to establish firms focused on the international market are undoubtedly complex, and there may well be systematic patterns to this selection. What matters for our interpretation, however, is whether those entrepreneurs that are selected for exporting right from the beginning are more capable of organizing enterprises with high productivity than those that decide to produce for the domestic market. Given that industries in many less-developed economies are constrained by export quotas, a study of how these export quotas are allocated among entrepreneurs might shed light on the general issue.

such as whether the firm is organized as a sole proprietor, partnership, or corporation – had a consistent relationship with productivity.

Another feature of the evidence that lends further support to our interpretation is that the magnitude of the estimated differentials in productivity are generally largest in the least developed economies of Indonesia and the Philippines, still substantial in Thailand, and smallest in the most developed economies of Malaysia and especially South Korea. That is, it is in the least developed economies, where less-integrated markets protect less productive firms from competition and allow them to survive, that scale economies are most evident and foreign firms and exporters most distinctive. In the more industrialized countries such as South Korea, however, where domestic markets are likely already quite integrated with the rest of the world, firms focused on the domestic market are roughly equivalent in productivity to their peers producing for the broad international market. One implication drawn about changes over time from these cross-sectional patterns, is that the early industrializers of East Asia, such South Korea, may have realized a substantial (if one-time) advance in productivity as their markets expanded and became more integrated during their initial stages of industrial development. To those concerned with the design of policy (whether in countries such as Indonesia or in the U.S.), the message would be that it is the least developed economies that have the most to gain from measures that would broaden the markets they face.

Skeptics have often objected to drawing inferences about the beneficial effects of broader markets on productivity from observations of an empirical association between productivity and a proxy for involvement in broader markets such as the export of output. They have correctly pointed out that the causation underlying such an association can work in either direction. Recognizing the importance of this point, we tackled this problem by

exploiting information contained in the surveys on the year the firm was established and the year the firm first exported part of its product. Although very few, if any, phenomena are ever purely exogenous, we have argued that it is reasonable to treat firms that exported from their time of establishment as having focused on preparing to compete in the broad international market before their productivity was realized. Finding that this class of firms was more productive than those that came to export later or never exported is consistent with causation operating from an entrepreneur's decision to effectively compete in the international markets to making the investments that would allow his firm to realize higher productivity. Our data do not allow us to probe very deeply into the circumstances that led some entrepreneurs to aim for the export market while others did not. Nevertheless, the robustness of our findings to controlling for the backgrounds of the firm founders, as well as to our use of macroeconomic conditions to instrument for the decision to aim for the export market, provides strong support to our argument that access to broader international markets is itself a spur to increases in overall manufacturing productivity.

Appendix: Estimation Procedures

Productivity is assumed to be an unobserved plant-specific effect that can be recovered from an estimated production function as the difference between actual and predicted output. Such an approach raises econometric issues regarding the possible bias of coefficients on input variables due to simultaneity bias. The concern is that the productivity of the firm itself affects the input decisions, introducing correlation between the plant effect and the input coefficients. If there is simultaneity bias, simply running OLS will lead to biased estimates of the input coefficients[37]. Three means of addressing this problem are examined here.

The most common approach is to assume that the unobserved firm heterogeneity is time-invariant so that a fixed effects estimators is appropriate. However, such an approach dispenses with all variation between firms. With a short panel, and with an expectation that the cross-sectional variation will be more important (and better measured) than the time series dimension, we do not have much confidence in this approach. Indeed a number of authors have pointed out the shortcomings of such an estimator.

A second approach is to use instrumental variables, selecting variables that would be correlated with the factor's share, but not with the productivity shock. Additional assumptions regarding the nature of the productivity shock have to be made. Firms would have to have some advance private knowledge of their productivity shock and adjust their fixed factors accordingly. Thus, recognizing the needed lead time to invest, firms may increase their capital stock in anticipation of a positive productivity shock. The instrument we use is the lagged share of energy costs. This will be correlated with the capital stock, but not with any change in expected productivity. Such a technique is also justified to address the possible concern of measurement error in the capital stock. However, if productivity shocks are correlated over time, the instrument is no longer valid.

An alternative approach is one advanced by Olley-Pakes (1996) and modified by Levinsohn-Petrin (2000). Productivity can be thought of as having two components $\omega_{it} + \eta_{it}$. η_{it} is truly random each period, but ω_{it} could be known to the firm, although unobserved to the econometrician. In such a situation, firms could adjust their inputs based on their knowledge of the anticipated or known productivity component, introducing the simultaneity bias. Olley-Pakes assume that labor and materials are freely variable inputs, but capital is treated as a state variable, affected by the distribution of the productivity shock, $\omega_{it,}$ conditional on the information at t-1 and past values of ω_i. Their insight is that other observable firm decisions will be a function of the productivity of the firm, and that inverting such a function allows for the anticipated but unobserved productivity shock to be conditioned out using the observed variables. They argue that investment is a function of the anticipated productivity shock and provided a monotonicity assumption holds, they can invert the function, with productivity as a function of investment.

[37] While the bias on labor and on capital could go either way, most commonly, there would be an upward bias on the labor coefficient and a downward bias on the capital coefficient. That selection cannot be controlled for could exacerbate the biases.

One drawback of the approach is simply practical. The technique requires non-zero investments by firms, a criteria that would imply half our observations be dropped. Noting this likely difficulty, Levinsohn-Petrin instead argue that intermediate input demand functions can play the same role. They use the demand for electricity to illustrate their point. It is an input used by all firms. And as it cannot be stored, it closely tracks the productivity term over time. We follow their example here[38].

Thus, the regression (l = labor, m = materials, e=energy, k = capital) is:

$$(1) \quad y_{it} = a + \beta_l l_{it} + \beta_m m_{it} + \beta_e e_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it}$$

The productivity shock ω_{it} is unobserved, but is assumed to be correlated with e_{it} and k_{it} so that estimates of β_e and β_k are biased. However, as the demand for electricity is a function of ω_{it} and k_{it}, $e(\omega_{it}, k_{it})$, and assuming it is invertible, ω_{it} can be rewritten as a function of e_{it} and k_{it}.[39]

$$(2) \quad \omega_{it} = h(e_{it}, k_{it})$$

Substituting (2) in (1), one can estimate the following equation in the first stage of the procedure:

$$(3) \quad y_{it} = a + \beta_l l_{it} + \beta_m m_{it} + \beta_e e_{it} + \beta_k k_{it} + h(e_{it}, k_{it}) + \eta_{it}$$

Not knowing the functional form of $h(e_{it}, k_{it})$ -- in particular not knowing if it also has a linear terms in e_{it} and k_{it} -- one cannot sort out the coefficients β_e or β_k. We included a fourth-order polynomial expansion in e_{it} and k_{it} (including all the interaction terms) to approximate the form of h(.). The inclusion of the polynomial removes the difficulty in estimating the coefficients on variable inputs; β_l and β_m will be consistent. From this stage we also have an estimate of the fourth order polynomial in e_{it} and k_{it}, call it φ_{it}.

$$(4) \quad \varphi_{it} = \beta_e e_{it} + \beta_k k_{it} + h(e_{it}, k_{it})$$

Rearranging, $h(e_{it}, k_{it}) = \varphi_{it} - \beta_e e_{it} + \beta_k k_{it}$

Looking at the expectation of $y_{i,t+1} - \beta_l l_{i,t+1} - \beta_m m_{i,t+1}$ and assuming ω_{it} is serially correlated, one can then rewrite ω_{it+1} as a function of ω_{it} (i.e. of $h(e_{it}, k_{it})$). As $h(e_{it}, k_{it})$ is a function of e_{it} and k_{it} instead of e_{it+1} and k_{it+1}, one no longer has $\beta_e e_{it}$ and $\beta_k k_{it}$ in both the main and the h(.) parts of the equation. Not knowing the functional form, we again used a fourth

[38] While we follow the logic of Levinsohn and Petrin's paper and use electricity demand rather than the investment equation, our estimation procedures are closer to those suggested by Olley-Pakes. Levinsohn and Petrin favor local least squares and a GMM estimator in the last stage, while we found the series estimator to be easier to implement. However, Olley-Pakes suggest both a kernel and series estimator, favoring the former as its limiting distribution is known. They note that the two estimates are very similar. Following Pavcnik's (2000) example, we also use the series estimator and boot-strap the standard errors.

[39] A second assumption is that markets are competitive so that all firms face the same prices.

order polynomial expansion in h(.) and substitute in $h(e_{it}, k_{it}) = \varphi_{it} - \beta_e e_{it} + \beta_k k_{it}$. Using non-linear least squares, the coefficients β_e and β_k can then be estimated.

$$(5) \qquad y_{it+1} - \beta_l l_{it+1} + \beta_m m_{it+1} \quad = \quad c + \beta_e e_{it+1} + \beta_k k_{it+1} + h(\cdot) + h^2(\cdot) + h^3(\cdot) + h^4(\cdot) + \eta_{it}$$

Thus, following on these two papers, we use a semi-parametric estimator that provides a plant-specific, time-varying productivity measure. It does not require a specific functional form, requiring few restrictive assumptions. The coefficients are unbiased, providing a tractable solution to the simultaneity problem.

An additional source of potential bias regards the selection of firms that remain in the sample. While the data covers three years, all firms were in operation in the last year so we do not have information on firms that would have been in operation but exited during the time covered by the study. While the available data will not allow us to estimate and control for selection bias, we note that it is an issue, and that the capital coefficient could likely be biased downward and the labor coefficient biased upwards.

The production function is run separately for each country. We did not want to make assumptions that technology used across countries was the same or to restrict input coefficients to be the same across countries. For each country, we have 5 to 7 sectors. We did pool the sectors within a country and run a single production function for each country. We then tested the restriction that the input coefficients were the same across sectors.[40] While the null hypothesis that such a restriction was valid was not rejected in Indonesia, Thailand and Korea, it was rejected for Malaysia and the Philippines. While we reported the pooled results, we also reran the equations separately for each sector within each country. One drawback of such a procedure is that the sample size for some sectors is quite small, decreasing the confidence in some of the estimates. For the second stage of the paper, where the productivity measures are then regressed on a number of firm characteristics, the overall qualitative results still hold whether or not one uses the constrained or unconstrained regressions.

Input variables are expressed in logarithms so the coefficients can be interpreted as elasticities.

[40] Such tests were made using the OLS regressions.

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Table 1. Descriptive Statistics

Share of firms with Different Characteristics

	Indonesia	Korea	Malaysia	Philippines	Thailand	TOTAL
Export Orientation						
Non-Exporter	61.7	25.0	52.5	47.1	43.4	46.1
Exporter	38.3	75.0	47.5	52.9	56.6	53.9
of which: Domestic	67.3	80.9	52.1	43.7	55.7	62.6
FDI	32.7	19.1	47.9	56.3	44.3	37.4
Foreign Owned						
No (<10% of equity)	84.2	83.1	73.5	64.7	69.5	76.0
Yes (≥ 10% of equity)	15.8	16.9	26.5	35.3	30.5	24.1
of which: Minority (<50%)	6.9	51.1	29.8	33.5	70.7	38.8
Majority (≥50%)	93.1	48.9	70.2	66.5	29.3	61.2
Size						
Small (<50 workers)	26.6	23.1	47.4	23.0	31.5	30.6
Medium (50-149 workers)	26.7	42.2	25.3	24.0	30.8	30.2
Large (≥ 150 workers)	46.7	34.8	27.3	53.0	37.7	39.1
Industries						
Food	31.7		22.1	23.9	10.1	18.0
Textiles	12.7	23.2	7.0	15.1	22.2	15.7
Garments	13.9		19.4	23.2	31.8	16.6
Const. Materials			14.4			3.1
Chemicals	29.2	28.4	16.7	17.3		19.5
Machinery		17.6	7.1			5.3
Electronics	12.6	16.9	9.8	20.5	16.4	14.9
Autoparts		13.9	3.5		19.5	6.9

Distribution of Labor Force

	Indonesia	Korea	Malaysia	Philippines	Thailand	TOTAL
Export Orientation						
Non-Exporter	27.6	7.5	15.9	14.6	15.5	17.3
Exporter	72.4	92.5	84.1	85.4	84.5	82.7
of which: Domestic	64.8	54.7	33.1	31.8	41.5	48.4
FDI	35.2	45.3	66.9	68.2	58.5	51.6
Foreign Owned						
No (<10% of equity)	69.4	56.8	40.0	40.3	46.2	54.0
Yes (≥ 10% of equity)	30.7	43.3	60.0	59.7	53.9	46.1
of which: Minority (<50%)	5.4	87.8	20.1	29.0	66.9	42.6
Majority (≥50%)	94.6	12.2	79.9	71.0	33.1	57.5
Size						
Small (<50 workers)	1.8	2.0	3.6	1.4	2.7	2.1
Medium (50-149 workers)	5.2	10.4	12.2	5.1	9.1	7.9
Large (≥ 150 workers)	93.1	87.5	84.3	93.6	88.1	90.0
Industries						
Food	25.4		8.6	21.1	21.7	16.0
Textiles	18.6	20.1	14.5	7.7	15.2	16.0
Garments	22.5		7.2	21.7	25.6	15.6
Const. Materials			12.7			1.6
Chemicals	19.3	23.1	14.7	10.3		15.2
Machinery		11.6	7.8			3.7
Electronics	14.2	34.0	28.5	39.3	22.5	26.4
Autoparts		11.2	6.1		15.1	5.6
Total number of firms	587	694	607	424	406	2,718

Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999.

Table 2. Indicators of Level of Development

	Indonesia	Korea	Malaysia	Philippines	Thailand
Macro					
GDP per capita	$1,105	$11,467	$4,625	$1,122	$3,017
Gross Domestic Investment,% GDP	31.8	34.2	42.8	24.8	33.3
Manufacturing Value Added, % GDP	25.6	28.9	27.8	22.8	28.2
Agricultural Value Added, % GDP	16.7	5.8	11.7	20.6	11.1
Urban Population, % of total	37.7	79.7	55.2	20.6	55.8
Micro					
Share of New Machinery & Equip-t (less 4yr old)					
in 10-19 yr old firms	18.1	36.4	23.8	24.4	21.7
in 20-29 yr old firms	15.1	29.3	22.1	19.9	22.4
Median Value Added/worker ($'000 ppp)	3.1	39.2	10.0	5.0	6.7
Coefficient of variation of TFP	5.03	0.20	0.70	1.84	0.92

Source: World Bank, 2001 World Development Indicators, Washington DC (data refer to 1997) and World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 3

Normalized Output Elasticities Obtained from Different Production Function Specifications

	Indonesia	Korea	Malaysia	Philippines	Thailand
OLS with Value Added Measure of Output					
Labor	0.49	0.38	0.74	0.56	0.61
Capital	0.51	0.62	0.26	0.44	0.39
OLS with Gross Output Measure of Output					
Materials	0.49	0.21	0.40	0.51	0.64
Labor	0.21	0.28	0.30	0.23	0.19
Capital	0.20	0.43	0.16	0.13	0.09
Energy	0.10	0.08	0.14	0.13	0.09
Fixed Effects					
Materials	0.44	0.31	0.31	0.43	0.67
Labor	0.21	0.21	0.30	0.25	0.07
Capital	0.19	0.40	0.15	0.09	0.03
Energy	0.16	0.09	0.24	0.23	0.23
Series Estimator					
Materials	0.46	0.22	0.33	0.46	0.58
Labor	0.19	0.23	0.32	0.20	0.18
Capital	0.28	0.49	0.32	0.18	0.23
Energy	0.07	0.06	0.03	0.16	0.02

Scale Effects

	Indonesia	Korea	Malaysia	Philippines	Thailand
Series Estimator	1.18	1.01	1.09*	1.16	1.12

* Calculated using subsample of firms which report total sales and just not sales of most important product.
See Appendix for discussion on production function estimation.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 4a
Pooled Cross-Section Variation in Total Factor Productivity Across Firms, by Countries: Regressions using TFP Measures from Series Estimator Production Functions

	(1)	(2)	(3)	(4)	(5)
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	0.206	-0.005	0.149	0.228	0.133
	(3.26)**	(0.15)	(1.62)	(3.23)**	(2.38)*
Minority Foreign Ownership[2]		0.078	-0.030	0.074	0.012
		(1.89)	(0.30)	(1.56)	(0.35)
Majority Foreign Ownership[3]	0.375	0.158	-0.012	0.352	0.221
	(6.16)**	(4.42)**	(0.13)	(6.99)**	(3.67)**
Medium (50-149)	0.082	0.004	0.342	0.046	0.092
	(1.83)	(0.16)	(5.57)**	(1.07)	(2.64)**
Large (150 plus)	0.332	0.014	0.233	0.062	0.083
	(7.47)**	(0.47)	(2.46)*	(1.49)	(2.29)*
Capital city	0.041	0.072	0.155	0.102	0.047
	(0.96)	(2.98)**	(2.28)*	(2.94)**	(1.31)
Age Dummy[4]	-0.043	0.006	0.240	0.019	-0.065
	(1.15)	(0.17)	(3.86)**	(0.51)	(1.95)
Observations	842	1644	967	780	748
R-squared	0.26	0.39	0.35	0.54	0.30

The dependent variable is the productivity measure constructed using the sector by sector series estimator. Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[3] Dummy variable: 1=firm with 50% or more of equity foreign owned.
[4] Dummy variable: 1=firm established 10 or more years ago; 0=otherwise
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 4b
Pooled Cross-Section Variation in Total Factor Productivity Across Firms, by Countries: Regressions using TFP Measures from Series Estimator Production Functions

	(1)	(2)	(3)	(4)	(5)
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	0.236	0.012	0.218	0.285	0.121
	(3.71)**	(0.30)	(2.31)*	(3.90)**	(1.96)
Domestic, Became Exporter[2]	0.082	0.024	0.151	0.146	-0.023
	(1.69)	(0.79)	(1.96)	(2.94)**	(0.61)
Minority Foreign Ownership[3]		0.096	0.040	0.134	0.002
		(2.01)*	(0.39)	(2.57)*	(0.05)
Majority Foreign Ownership[4]	0.408	0.175	0.060	0.409	0.212
	(6.45)**	(4.10)**	(0.62)	(7.64)**	(3.35)**
Medium (50-149)	0.061	0.002	0.308	0.020	0.096
	(1.38)	(0.08)	(4.83)**	(0.45)	(2.64)**
Large (150 plus)	0.299	0.009	0.195	0.028	0.090
	(6.25)**	(0.31)	(2.02)*	(0.65)	(2.25)*
Capital city	0.044	0.073	0.152	0.096	0.049
	(1.03)	(2.99)**	(2.20)*	(2.74)**	(1.34)
Age Dummy[5]	-0.047	0.002	0.238	0.023	-0.064
	(1.26)	(0.06)	(3.83)**	(0.59)	(1.92)
Observations	842	1644	967	780	748
R-squared	0.26	0.39	0.35	0.55	0.30

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned; 0=otherwise.
[5] Dummy variable: 1=firm established 10 or more years ago; 0=otherwise
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 4c
Variation in Total Factor Productivity across Firms: Pooled Cross-Section Regressions with TFP Measures Based on OLS Value Added Production Functions

	(1)	(2)	(3)	(4)	(5)
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	0.579	0.061	0.387	0.594	0.343
	(4.58)**	(1.25)	(2.92)**	(4.16)**	(2.48)*
Domestic, Became Exporter[2]	0.308	0.084	0.229	0.236	0.167
	(3.12)**	(2.37)*	(1.95)	(2.23)*	(1.85)
Minority Foreign Ownership[3]		0.172	0.266	0.378	0.173
		(3.46)**	(1.74)	(2.70)**	(1.98)*
Majority Foreign Ownership[4]	0.836	0.305	0.093	0.971	0.497
	(6.88)**	(6.56)**	(0.67)	(7.90)**	(4.01)**
Medium (50-149)	0.069	-0.024	0.398	0.191	0.258
	(0.74)	(0.89)	(4.19)**	(1.90)	(3.28)**
Large (150 plus)	0.414	-0.013	0.233	0.175	0.320
	(4.47)**	(0.38)	(1.51)	(1.74)	(3.91)**
Capital city	0.090	0.114	0.306	0.277	-0.009
	(0.98)	(4.02)**	(3.00)**	(3.54)**	(0.11)
Observations	846	1651	1118	798	755
R-squared	0.14	0.04	0.07	0.15	0.14

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 5

Composition of the Work Force By Level of Education

		Domestic Not Estab. as Exporter	Domestic Estab. as Exporter	Foreign Owned
		(%)	(%)	(%)
Indonesia		na	na	na
Korea				
	Primary	14.2	10.4	7.1
	Secondary	54.3	59.7	50.1
	Vocational	na	na	na
	Tertiary	31.6	30.0	42.8
Malaysia				
	Primary	49.8	54.8	43.3
	Secondary	34.7	35.6	40.8
	Vocational	8.6	7.6	9.8
	Tertiary	9.6	7.0	10.1
Philippines				
	Primary	6.7	4.6	2.5
	Secondary	46.2	39.9	44.8
	Vocational	11.0	11.0	9.9
	Tertiary	28.9	26.2	23.8
Thailand				
	Primary	56.4	54.6	37.9
	Secondary	38.0	39.9	50.6
	Vocational	10.6	10.8	14.0
	Tertiary	4.5	4.4	6.3

Notes: The categorization of schooling levels are useful for examination of differences across firms within countries, but are not strictly comparable across countries.

Table 6a

Regressions with Log of Capital-Labor Ratio as Dependent Variable

	(1)	(2)	(3)	(4)	(5)
	Indonesia	Korea	Malaysia	Philippines	Thailand
FDI[1]	1.320	0.279	0.679	0.569	0.861
	(8.53)**	(4.64)**	(4.26)**	(4.41)**	(7.26)**
Domestic Exporter[2]	0.540	0.153	0.299	0.308	0.477
	(5.01)**	(3.28)**	(2.44)*	(2.48)*	(4.88)**
Capacity Utilization	-0.001	0.001	-0.001	-0.006	-0.004
	(0.68)	(0.76)	(0.42)	(2.40)*	(2.04)*
Age[3]	0.009	0.007	0.008	0.015	0.020
	(0.78)	(1.63)	(0.66)	(1.66)	(1.26)
Age^2	-0.000	0.000	0.000	-0.000	-0.000
	(0.59)	(1.04)	(0.40)	(0.59)	(0.16)
Large	0.379	0.373	-0.071	0.425	0.484
	(3.39)**	(8.92)**	(0.60)	(3.93)**	(5.13)**
Observations	806	1615	1141	780	766
R-squared	0.25	0.18	0.12	0.17	0.30

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm has at least 10% of equity foreign owned, 0=otherwise.
[2] Dummy variable: 1=exporter with less than 10% of equity foreign owned; 0=otherwise.
[3] Number of years since establishment
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 6b

Regressions with Fraction of Assets in Recent Vintage of Capital as Dependent Variable

	(1) % of equipment < 4 yr	(2) % of equipment < 4 yr	(3) % of equipment < 4 yr	(4) % of equipment < 4 yr	(5) % of equipment < 4 yr
	Indonesia	Korea	Malaysia	Philippines	Thailand
FDI[1]	1.450	3.174	4.695	15.933	-3.101
	(0.38)	(1.33)	(1.96)	(5.33)**	(1.15)
Domestic Exporter	-2.444	2.253	4.171	6.465	6.150
	(0.98)	(1.24)	(2.18)*	(2.34)*	(2.77)**
Capacity Utilization	0.083	-0.016	0.189	-0.061	0.042
	(1.75)	(0.34)	(5.10)**	(0.94)	(0.90)
Age[2]	-1.163	-1.620	-0.706	-1.024	-1.694
	(4.13)**	(8.00)**	(3.21)**	(4.93)**	(3.92)**
Age^2	0.012	0.021	0.008	0.011	0.024
	(2.94)**	(6.13)**	(2.31)*	(3.80)**	(2.73)**
Size Dummy[3]	-1.942	1.206	8.164	4.536	7.039
	(0.73)	(0.77)	(4.22)**	(1.85)	(3.19)**
Observations	763	1541	1122	710	743
R-squared	0.08	0.08	0.09	0.16	0.12

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%

Note: [1] Dummy variable: 1=firm has at least 10% of equity foreign owned, 0=otherwise.
[2] Number of years since establishment.
[3] Dummy variable: 1=firm with 150 or more employees; 0=otherwise.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

TABLE 7

Characteristics of Firms by Export and Ownership

	TEXTILES			ELECTRONICS			
	FDI	Domestic Exporters	Domestic No Exports		FDI	Domestic Exporters	Domestic No Exports
Median Employment							
Indo	711	422	85	Indo	739	265	55
Korea	132	111	80	Korea	239	96	89
Malaysia	187	152	17	Malaysia	352	110	156
Philippines	212	99	51	Philippines	345	246	47
Thailand	138	161	46	Thailand	392	92	55
Median Capital per Worker							
Indo	27.64	15	3.57	Indo	29.33	13.53	11.11
Korea	117.75	133.47	75.57	Korea	141.95	100.37	109.83
Malaysia	45.23	29.9	9.74	Malaysia	25.54	44.64	7.01
Philippines	10.02	19.32	16.3	Philippines	17.51	8.86	12.24
Thailand	36.66	18.57	12.61	Thailand	39.08	19.45	9.83
Share of Firms with Outside Auditors							
Indo	0.69	0.54	0.25	Indo	0.89	0.69	0.28
Korea	0.73	0.62	0.52	Korea	0.91	0.64	0.71
Malaysia	0.8	0.75	0.12	Malaysia	0.67	0.56	0.3
Philippines	0.97	0.77	0.71	Philippines	0.97	0.85	0.81
Thailand	0.48	0.56	0.27	Thailand	0.51	0.53	0.27
Share of Firms Using Foreign Technology							
Indo	0.58	0.37	0.09	Indo	0.58	0.59	0.15
Korea	0.5	0.22	0.14	Korea	0.61	0.45	0.43
Malaysia	0.3	0.33	0.04	Malaysia	0.56	0.44	0.4
Philippines	0.47	0.45	0.33	Philippines	0.73	0.7	0.45
Thailand	0.46	0.28	0.17	Thailand	0.63	0.38	0.2
Indo	0.8	0.54	0.14	Indo	0.73	0.44	0.33
Korea	0.5	0.07	0.04	Korea	0.44	0.14	0.14
Malaysia	0.67	0.38	0.08	Malaysia	0.72	0.33	0.1
Philippines	0.39	0.5	0.21	Philippines	0.65	0.59	0.23
Thailand	0.61	0.45	0.18	Thailand	0.79	0.23	0.25

Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 8a
Regressions of Total Factor Productivity on Firm Characteristics and Practices: TFP Measures Obtained from Series Estimator

	(1) TFP	(2) TFP	(3) TFP	(4) TFP	(5) TFP
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	0.203	-0.007	0.224	0.253	0.156
	(3.12)**	(0.17)	(2.26)*	(3.44)**	(2.58)*
Domestic, Became Exporter[2]	0.041	0.004	0.157	0.139	0.003
	(0.85)	(0.13)	(2.06)*	(2.77)**	(0.07)
Minority Foreign Ownership[3]		0.057	0.023	0.127	0.017
		(1.15)	(0.23)	(2.38)*	(0.41)
Majority Foreign Ownership[4]	0.337	0.141	0.047	0.382	0.264
	(4.90)**	(3.18)**	(0.47)	(7.22)**	(3.84)**
Size Dummy[5]	0.150	0.010	0.034	-0.003	0.051
	(3.68)**	(0.39)	(0.49)	(0.08)	(1.43)
Capital city	0.057	0.074	0.135	0.100	-0.007
	(1.38)	(3.07)**	(1.92)	(2.97)**	(0.17)
Audited by outside firm	0.171	0.076	0.085	-0.055	-0.054
	(3.94)**	(2.80)**	(1.49)	(0.91)	(1.84)
Training program	0.044	0.003	0.131	0.116	-0.031
	(1.07)	(0.14)	(1.90)	(3.48)**	(0.91)
Observations	846	1631	980	758	732
R-squared	0.27	0.40	0.32	0.55	0.28

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned.
[5] Dummy variable: 1=firm with 150 or more employees; 0=otherwise.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999.

Table 8b
Regressions of Total Factor Productivity on Firm Characteristics and Practices: TFP Measures Obtained from Value Added

	(1) TFP	(2) TFP	(3) TFP	(4) TFP	(5) TFP
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	0.469	0.040	0.460	0.514	0.418
	(3.71)**	(0.81)	(3.55)**	(3.56)**	(3.08)**
Domestic, Became Exporter[2]	0.208	0.062	0.224	0.208	0.214
	(2.13)*	(1.73)	(2.08)*	(1.92)	(2.32)*
Minority Foreign Ownership[3]		0.129	0.222	0.329	0.196
		(2.50)*	(1.54)	(2.32)*	(2.20)*
Majority Foreign Ownership[4]	0.602	0.260	0.115	0.916	0.575
	(5.03)**	(5.46)**	(0.84)	(7.24)**	(4.23)**
Size Dummy[5]	0.164	-0.022	-0.092	0.162	0.126
	(1.96)	(0.77)	(0.87)	(1.80)	(1.63)
Capital city	0.111	0.112	0.287	0.295	-0.022
	(1.25)	(3.96)**	(2.77)**	(3.74)**	(0.26)
Audited by outside firm	0.415	0.105	0.306	-0.004	0.092
	(5.03)**	(3.26)**	(3.71)**	(0.03)	(1.27)
Training program	0.162	0.007	0.229	0.165	-0.007
	(2.07)*	(0.27)	(2.16)*	(2.11)*	(0.09)
Observations	846	1631	1118	769	736
R-squared	0.17	0.05	0.07	0.15	0.13

Sector dummies and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned.
[5] Dummy variable: 1=firm with 150 or more employees; 0=otherwise.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 9a
Regressions of Total Factor Productivity on Firm Characteristics with Ownership: With TFP Measures Obtained from Series Estimator

	(1) TFP Indonesia	(2) TFP Korea	(3) TFP Malaysia	(4) TFP Philippines	(5) TFP Thailand
Domestic, Established as Exporter[1]	0.221	0.003	0.119	0.271	0.143
	(3.45)**	(0.07)	(1.20)	(3.66)**	(2.21)*
Domestic, Became Exporter[2]	0.060	0.030	0.088	0.140	-0.023
	(1.21)	(0.98)	(1.10)	(2.82)**	(0.60)
Minority Foreign Ownership[3]		0.079	-0.048	0.116	0.008
		(1.59)	(0.45)	(2.21)*	(0.20)
Majority Foreign Ownership[4]	0.404	0.182	-0.065	0.393	0.205
	(6.26)**	(4.19)**	(0.65)	(7.52)**	(3.28)**
Capital city	0.048	0.070	0.140	0.096	0.021
	(1.13)	(2.87)**	(2.04)*	(2.87)**	(0.59)
Partnerships	-0.205	0.133	-0.073	0.081	0.213
	(1.44)	(1.67)	(0.64)	(0.43)	(3.77)**
Cooperatives		0.034		0.160	
		(0.51)		(0.87)	
Limited Liability	0.121	-0.033	0.139	0.035	0.210
	(2.19)*	(0.68)	(1.46)	(0.46)	(2.86)**
Publicly Listed	0.114	-0.033	0.513	-0.006	0.206
	(1.61)	(1.12)	(0.95)	(0.07)	(1.39)
Observations	846	1596	980	787	741
R-squared	0.26	0.39	0.33	0.55	0.30

Sector, size and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 9b
Regressions of Total Factor Productivity on Firm Characteristics with Ownership: With TFP Measures Derived from OLS Value Added Specification

	(1) TFP Indonesia	(2) TFP Korea	(3) TFP Malaysia	(4) TFP Philippines	(5) TFP Thailand
Domestic, Established as Exporter[1]	0.537	0.058	0.312	0.584	0.372
	(4.22)**	(1.16)	(2.20)*	(4.03)**	(2.52)*
Domestic, Became Exporter[2]	0.278	0.094	0.168	0.245	0.152
	(2.80)**	(2.59)**	(1.40)	(2.25)*	(1.66)
Minority Foreign Ownership[3]		0.177	0.169	0.343	0.157
		(3.40)**	(1.08)	(2.38)*	(1.75)
Majority Foreign Ownership[4]	0.798	0.306	0.019	0.948	0.451
	(6.54)**	(6.45)**	(0.13)	(7.70)**	(3.62)**
Capital city	0.101	0.111	0.278	0.279	-0.000
	(1.10)	(3.83)**	(2.73)**	(3.60)**	(0.00)
Partnerships	-0.331	0.047	0.132	-0.108	0.357
	(1.07)	(0.47)	(0.81)	(0.34)	(2.61)**
Cooperatives		-0.033		-0.007	
		(0.41)		(0.01)	
Limited Liability	0.212	-0.086	0.293	-0.003	0.180
	(1.86)	(1.41)	(2.04)*	(0.02)	(1.00)
Publicly Listed	0.041	-0.029	0.718	-0.197	0.143
	(0.29)	(0.85)	(0.78)	(1.10)	(0.51)
Observations	846	1596	1118	798	745
R-squared	0.15	0.05	0.08	0.16	0.15

Sector, size and year dummies were included, but not reported.
Robust t-statistics in parentheses; * significant at 5%; ** significant at 1%
Note: [1] Dummy variable: 1=firm with less than 10% of equity foreign owned and that started exporting within the first year of establishment; currently is exporter. 0=otherwise.
[2]Dummy variable: 1=firm with less than 10% of equity foreign owned and that which started exporting sometime after the first year of establishment; currently is exporter. 0=otherwise.
[3] Dummy variable:1=firm with 10% to 49% of equity foreign owned; 0=otherwise.
[4] Dummy variable: 1=firm with 50% or more of equity foreign owned.
Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Table 10

The Significance of the Experience of the Founder:

Regressions using TFP Measures from Series Estimator Production Functions

	Indonesia TFP	Korea TFP	Malaysia TFP	Philippines TFP	Thailand TFP
Prior Experience Local Firm	0.191 (3.39)**	-0.013 (0.50)	0.160 (2.24)*	0.142 (2.78)**	0.089 (2.59)**
Prior Experience Foreign Firm	0.245 (2.67)**	0.073 (0.92)	-0.335 (3.86)**	0.091 (1.43)	0.093 (1.42)
Prior Experience Joint Venture	0.394 (4.65)**	-0.066 (0.91)	0.258 (2.06)*	0.300 (3.52)**	0.134 (2.47)*
Domestic, Estab. as Exporter	0.204 (3.13)**	0.001 (0.02)	0.139 (1.47)	0.182 (2.42)*	0.140 (2.35)*
Minority Foreign Ownership		0.081 (1.90)	-0.038 (0.39)	0.006 (0.11)	-0.009 (0.21)
Majority Foreign Ownership	0.289 (3.66)**	0.144 (3.90)**	0.272 (2.59)**	0.301 (4.76)**	0.200 (2.92)**
Medium Size (50-149)	0.085 (1.87)	0.014 (0.54)	0.344 (5.58)**	0.037 (0.84)	0.104 (2.81)**
Large Size (150 plus)	0.313 (6.66)**	0.008 (0.26)	0.249 (2.63)**	0.067 (1.47)	0.082 (2.12)*
Capital City	0.001 (0.03)	0.082 (3.11)**	0.176 (2.64)**	0.075 (2.11)*	0.65 (1.57)
Observations	778	1526	965	699	676
R-squared	0.27	0.39	0.37	0.57	0.30

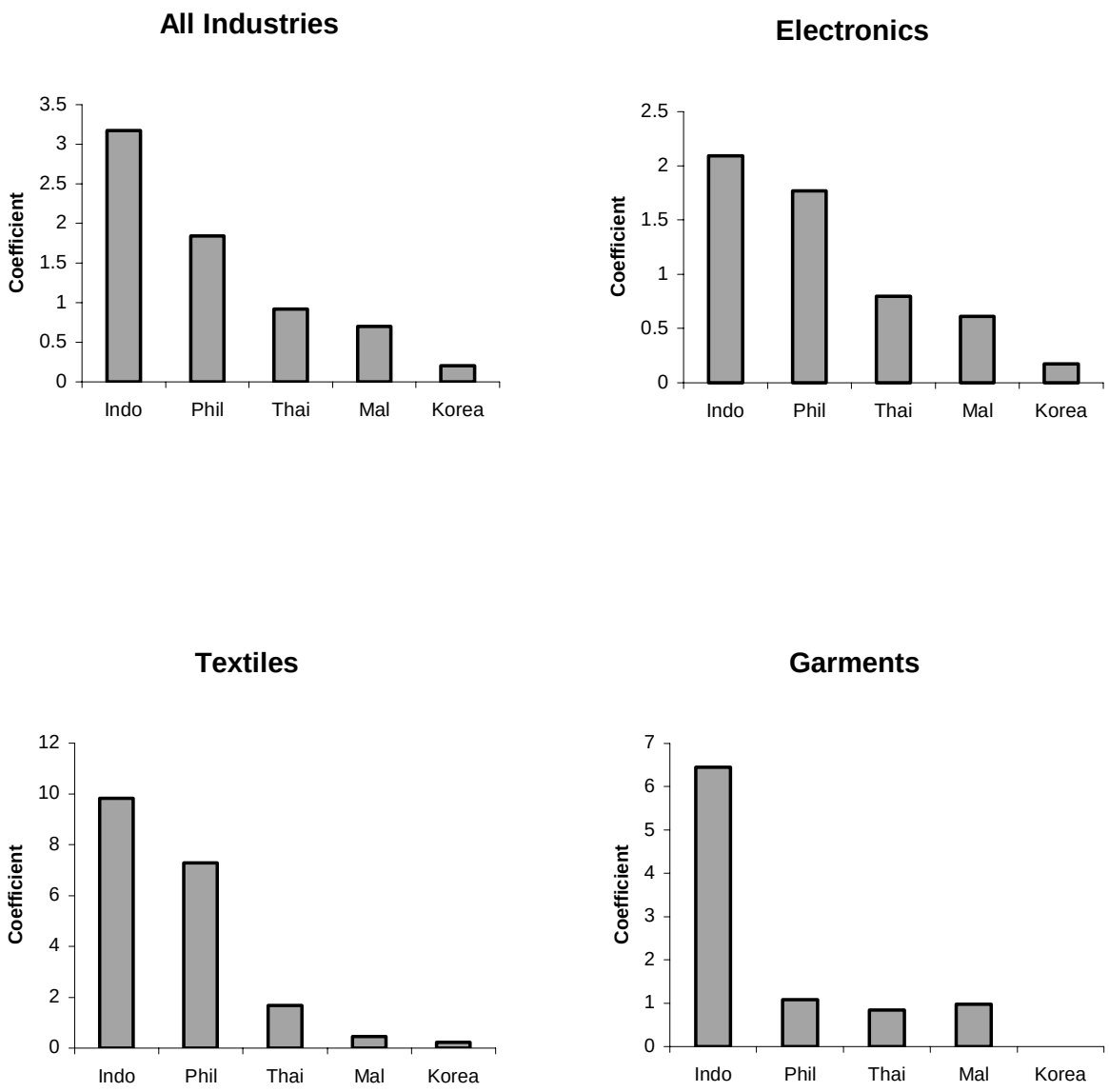
Notes: Dummy variables for the sectors, years, and age of firm were included, but are not reported. Robust t-statistics are reported within parentheses: *significant at 5%; and **significant at 1%. See the notes to Table 4. The dummy variables pertaining to the experience of the founder of the firm pertain To the question n the survey as to whether he or she had previously worked at a firm in the same industry, and who had owned that firm. The excluded category are small, locally-owned firms that Are located outside of the capital city district and were established as non-exporters by a founder with no experience.

Table 11
Instrumental Variable Approach With Macroeconomic Variables Employed in First Stage: TFP Measures Based on Series Estimator

	(1) TFP	(2) TFP	(3) TFP	(4) TFP	(5) TFP
	Indonesia	Korea	Malaysia	Philippines	Thailand
Domestic, Established as Exporter[1]	1.035	-0.237	0.357	0.567	0.594
	(1.65)	(0.63)	(0.46)	(1.81)+	(1.85)+
Minority Foreign Ownership[3]		-0.002	-0.241	0.141	0.189
		(0.02)	(0.96)	(1.65)	(1.88)+
Majority Foreign Ownership[4]	0.536	0.092	-0.204	0.348	0.386
	(4.53)**	(0.96)	(0.75)	(3.53)**	(3.49)**
Medium (50-149)	0.038	0.008	0.494	0.097	0.012
	(0.70)	(0.19)	(2.41)*	(1.87)+	(0.19)
Large (150 plus)	0.173	0.073	0.303	0.043	-0.112
	(1.57)	(0.85)	(1.50)	(0.68)	(0.86)
Dummy for Firm Established	-0.014	-0.006	0.152	0.037	0.033
10 or More Years Ago	(0.28)	(0.09)	(1.25)	(0.84)	(0.42)
Capital city	0.115	0.081	0.310	0.090	-0.068
	(1.49)	(1.87)+	(2.42)*	(2.14)*	(0.71)
Observations	633	1401	673	672	721
R-squared	0.12	0.37	0.33	0.51	0.27

Robust t-statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

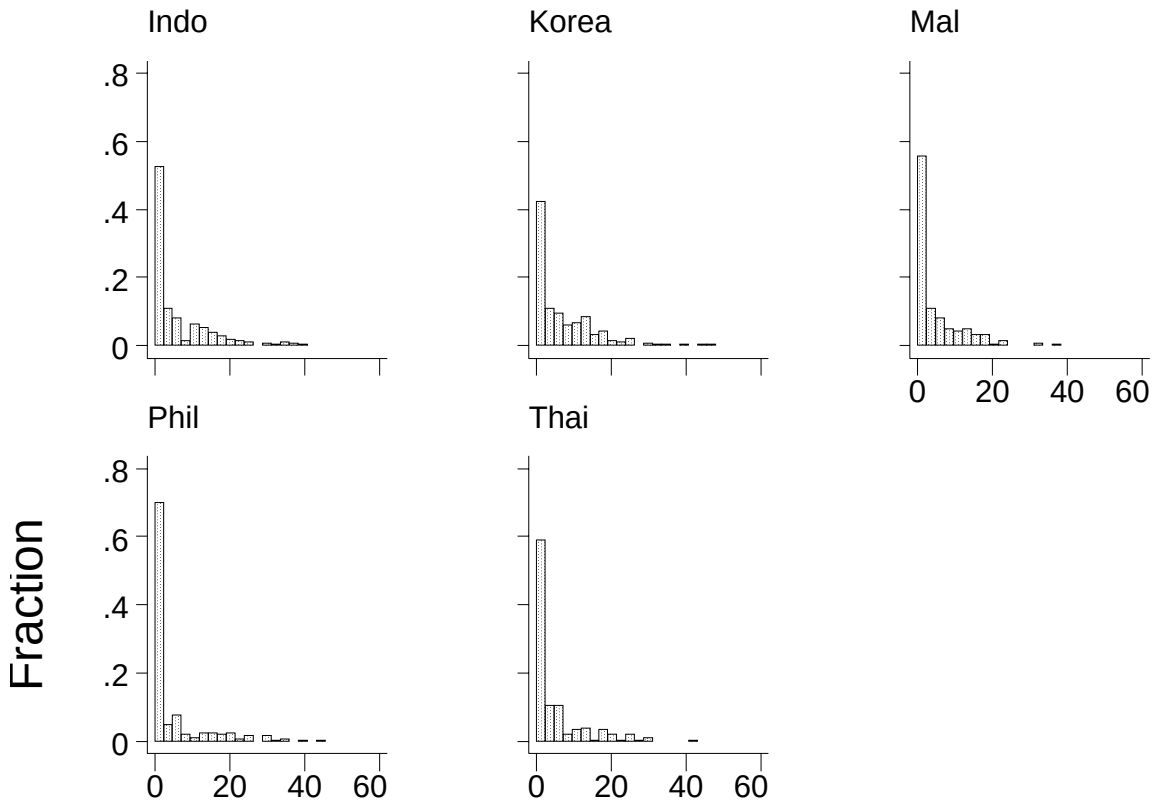
Figure 1: Coefficient of Variation of Total Factor Productivity



Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

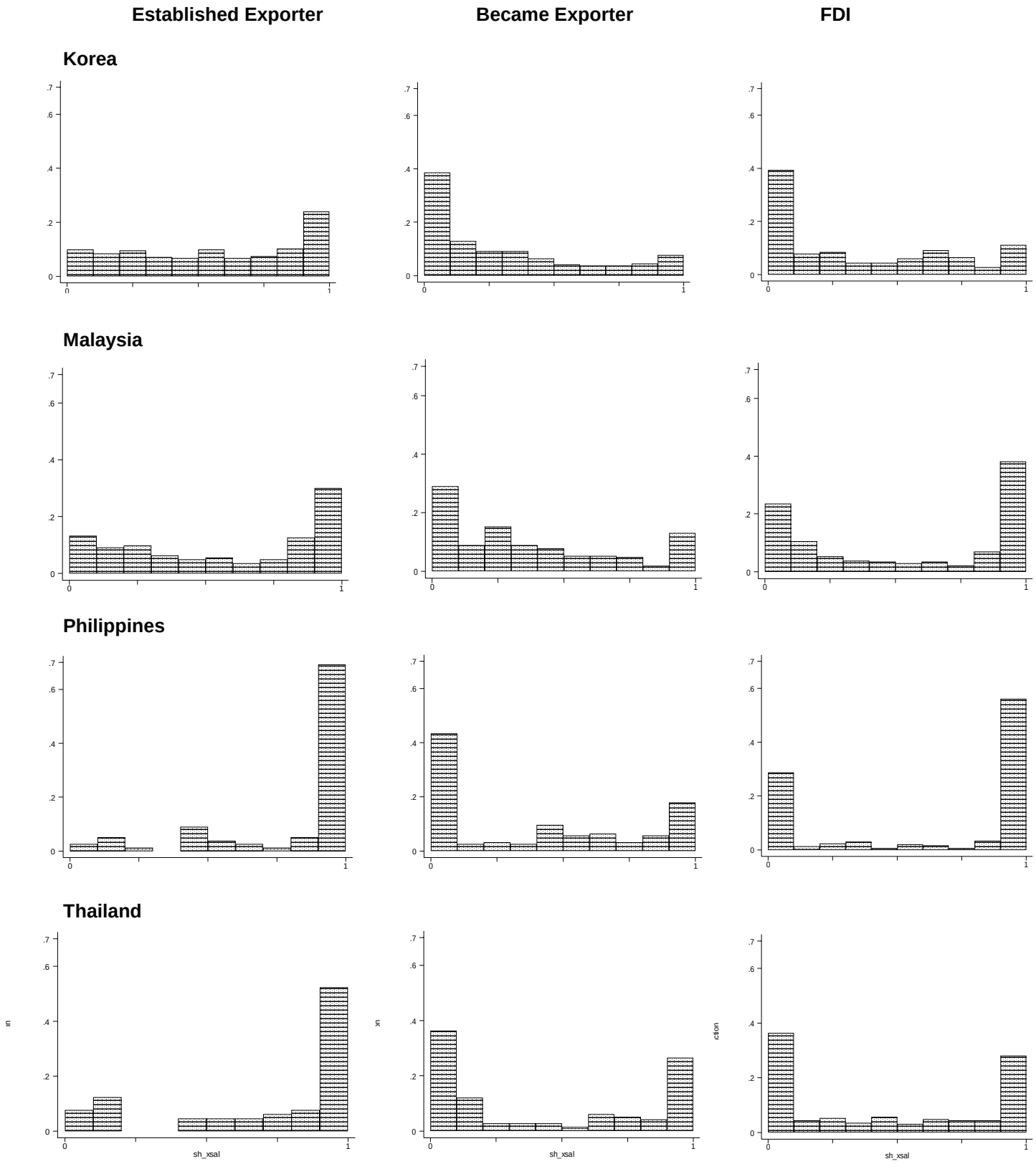
Figure 2

Time between Establishment and First Export



Source: World Bank, Asian Corporate Crisis & Recovery Firm-Level Survey 1999

Figure 3
Share of Export Over Total Sales



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