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, and thereby raise their productivity.

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I. INTRODUCTION

The debate over the sources of East Asia's rapid economic growth of the last 40 years has been divided over how much weight explanations place on productivity growth, as well as over the sources of such advances.[1] In order to improve our understanding of this dramatic episode in economic development, we focus here on the role of access to international markets in stimulating increases in productivity in early-industrializing countries.[2] We explore the idea that in such societies, domestic entrepreneurs that target the more lucrative, but competitive, global markets have substantial incentives to invest in new and cost-reducing technologies, while foreign firms have incentives to support technology transfer through a variety of means -- including direct investment. The potential for improving productivity can be particularly high in such contexts, because less-developed economies typically have many unproductive firms that survive because of their insulation from competition by high transportation costs, product differentiation, and other means of market segmentation. Thus, a rapid expansion of markets, due for example to an opening or deepening of access to world trade, can lead to a substantial one-time increase in productivity by inducing the adoption of better (if not best) practices as firms strive to take advantage of the radical change in the environment.

In this paper, we use new enterprise-level data from Korea, Indonesia, Malaysia, the Philippines and Thailand to study the well-known empirical associations across firms or industries between productivity and both export orientation and foreign ownership. We highlight the striking and systematic differences across countries in the magnitude of the productivity differentials attributable to such characteristics: extremely large in less-developed economies, such as Indonesia and the Philippines, but virtually absent in more-developed South Korea. This pattern is highly

[1] Authors such as Young (1992 and 1995) argue 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] See, for example, Pack and Westphal (1998) and Dollar and Sokoloff (1990) for earlier work on the contribution of exporting to productivity growth in East Asia.

robust, and conforms well with the idea that there are major gains in productivity to be realized during the early stages of industrial development.

The finding that exporting firms are more productive still leaves open the direction of causation. Indeed, 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] This paper explores this issue of whether firms take proactive steps to compete in world markets, or whether relatively exogenous realizations of higher productivity allow favored firms to export their output. To do this, we explore two sources of evidence, taking 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. These sorts of investment decisions are what allow, we argue, these firms to attain higher productivity and to succeed in the broader export arena.

Second, 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 a 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

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

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 are far higher in the least-developed countries, such as Indonesia and the Philippines, than in nations such as Korea. Thus the evidence supports the claim that access to export markets encourages manufacturing firms to undertake investments that increase the productivity of the resources they employ, 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, 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

Concerned with improving knowledge of manufacturing development, the World Bank has helped stimulate efforts to systematically collect and examine detailed information at the establishment level. This paper draws on data from 2700 firms in Indonesia, Korea, Malaysia, the Philippines, and Thailand.[4] Conducted in face-to-face interviews, the surveys provide extensive details about the inputs consumed and outputs produced, as well as the year in which the firm was established, the year in which it first exported any of its output, as well as on the ownership and many other characteristics of the enterprise. With the assistance and advice of a World Bank team, similar instruments and sampling procedures (including industries selected for coverage) were employed to facilitate the cross-country comparisons. Enumerators personally gathered information from four to seven hundred firms in each country, and as the participating governments were

[4] 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).

particularly interested in issues related to the competitiveness of firms in manufacturing industries where there was potential for exports, they surveyed 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. To ensure adequate representation of larger firms, the sample was stratified according to size of firms. Within each size category, the establishments to be surveyed were selected randomly.

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 majority shares in only 60%.

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, Table 1 also provides a conventional indicator of economic development (GDP per capita) as well as a measure of the dispersion of manufacturing productivity to provide some perspective about how well integrated the markets of each economy are. With a per capita income exceeding $11,000, Korea obviously qualifies as the most industrialized, with the largest and most sophisticated domestic market of the five countries. Malaysia and Thailand are next, with the former having an edge over the latter in both GDP per capita and in manufacturing productivity. The Philippines and Indonesia are clearly the least developed economies of the five, with per capita incomes 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 the coefficient of variation in manufacturing productivity is much higher, in these economies than in the other three countries.

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.[5] 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

Our measures of total factor productivity (TFP) were derived from a Cobb-Douglas production framework estimated for each country separately. Table 2 reports the sets of output elasticities obtained from four different specifications of production functions, with each normalized to sum to one, that were the basis for computing sets of establishment-level estimates of TFP.[6] In some specifications, we used gross output (calculated as total sales plus the change in inventories) as the dependent variable, with the independent variables consisting of total assets, total employment, material inputs and energy, with dummy variables for sectors and years, but in others, 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.[7]

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

[6] Overall, our 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 Levinsohn-Petrin estimator. This qualitative result held across virtually all specifications we estimated, but not for the Philippines when we use the measure of TFP obtained from the Levinsohn-Petrin estimator, and also control for other establishment characteristics. 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. These output elasticities were estimated from production functions that included dummy variables for industries, and though they vary across countries, are generally within the ranges estimated by other investigators. We did not employ industry-specific output elasticities, because the inclusion of interaction terms 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.

[7] In all cases, output, inputs and total assets were converted to 1995 constant US dollars. 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

Concerned about possible simultaneity bias, we also followed a procedure suggested by Olley and Pakes (1996) and modified by 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 knowledge of a firm's productivity.[8] We carried out extensive sensitivity analysis in estimating these production functions, experimenting with different measures of the inputs (such as measures of the labor input that weighted classes of workers by wage rates, or distinguished among workers by occupational categories) and outputs as well as with the precise subset of observations over which the functions were estimated. The basic patterns in the data are so strong that the qualitative results presented below are highly robust to the use of different procedures, production function specifications, yearly observations, and methods of identifying and excluding outliers.[9] Reported in subsequent tables are the results based on the Levinsohn-Petrin productivity estimates.

In order to explore the systematic patterns in manufacturing productivity, we estimated a variety of multivariate regressions across the firms within each country, with 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. What is immediately striking about the results of these

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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.

[8] 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).

[9] 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. 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. 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.

regressions is how similar they are across the five countries, as well as how sensible the empirical regularities are.

First is the involvement of foreigners. 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 (table 3). Indeed, we find that, 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.[10] Moreover, that the estimated TFP differentials are largest in the least developed countries of Indonesia and the Philippines, where the estimates are around 40 percent (as compared to 15 to 20 percent in Korea and Thailand), is generally consistent with this idea.[11] In addition, there is a discontinuity in the estimated relationship between foreign ownership and productivity, with firms with foreign ownership shares of over 50 percent standing out as especially productive. This discontinuity in the estimated relationship between foreign ownership and productivity conforms well with the intuition that foreigners with a controlling share in the firm would be more inclined, and capable, of investing in transfer of technology, and thus bolsters the interpretation that the principal line of causation goes from foreign ownership to productivity.

One of the most controversial questions about productivity in developing countries concerns its relation to export market. There is a longstanding view in economics that firms serving more extensive markets are more productive. Several mechanisms have been proposed, including

[10] 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.

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

economies of scale as well as greater competitive pressures, higher returns to investment in invention and links that make it easier to learn about advanced technologies employed elsewhere.[12]

Although intuitively appealing, it has been difficult to substantiate the view that firms will come to realize higher productivity if they focus more on exports. 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 explore 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. In these panels, CLT found a 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 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. They conclude that pattern follows from higher productivity to exports, not from involvement in the world or export to higher productivity.[13]

Although Clerides, Lach and Tybout 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,

[12] 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).

[13] 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).

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.[14]

The East Asia enterprise surveys contain the year when firms were established and 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.[15] Indeed, such 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

[14] 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. Yet another issue is how representative of exporters are the firms that make the transition from non-exporters to exporters. Although such transitioning is common in highly industrialized countries, such as the United States, it appears much less so in the less-developed economies surveyed here.

[15] 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.

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 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.[16] 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 began to export at some point before the survey was conducted; 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.

[16] 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.

Table 3 presents the results of the regressions of TFP including interaction terms between export orientation during the first year and whether the firm is domestically owned. 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 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.[17]

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 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.

[17] 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.

Before accepting this interpretation, there are two issues that need to be considered: how to deal with the co-existence of such different productivity levels, and the possibility of unobserved entrepreneurial talent driving the productivity differences. We address the evident co-existence of firms in the same industry with such different levels of productivity in two ways. It is true that 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. Certainly conditions such as poor infrastructure and high transportation costs, act as obstacles to integrated product markets in less-developed economies and contribute to 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, 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.[18]

This explanation has implications for the validity of our estimation procedures that we can test for. If the quality or specifications of products are a powerful factor in accounting for segmented product markets in less-developed economies, is it sensible 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 for two reasons. First, the differences in the character or nature of the inputs being utilized in the respective production processes are either captured in market prices – or if they are not, that the inputs are similar in nature. The composition of the labor force is the obvious subject of concern here. But (as shown in Table 2c), although

[18] 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).

foreign-owned firms employ a markedly more educated workforce, domestic firms established as exporters have a labor force much 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.[19]

Even accepting that the inputs being used by the firms that export are quite similar, or appropriately evaluated by market prices, it still may be that the technologies employed by the two classes of firms are so different that using a single set of output elasticity estimates for capital and labor is inappropriate. 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 could be a concern 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 measures computed with much higher elasticities for the capital input than is feasible (up to 0.8 in a production function with value added as the measure of output and only two inputs). 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 reported above hold.

[19] 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.

The clear implication is that the domestically-owned firms established originally as exporters produce so much output relative to inputs, as compared to their counterparts 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. Indeed, we find evidence that exporting firms were distinctly different in their mode of operations. As is evident from the regressions presented in Table 4, domestic firms that export are substantially different in their capital intensity 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 4 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, the same classes of firms are generally 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.

In Table 5, 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). This interpretation is consistent with the regressions reported in Tables 6, 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.[20] 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.

The analysis so far suggests that an increasing orientation towards exports leads to higher productivity of the resources employed in manufacturing. However, we now turn to the second broad issue, the question of whether the observed patterns could be explained by the supply of entrepreneurial talent. For example, skeptics might argue 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.

[20] In Hallward-Driemeier, Iarossi, and Sokoloff (2003), we find no consistent relationship between TFP and variables reflecting 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 is impressive.

We investigate the significance of the relative scarcity of entrepreneurial 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 7 we report TFP regressions 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 with joint ventures, were significantly more productive than their counterparts in all countries except for Korea.[21] This pattern is quite consistent with the notion that the scarcity of entrepreneurial talent is greater in less-developed economies. However, 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.

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

[21] 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.

exogenous variables moving averages of the growth rate of the world economy, the growth rate of world trade in that sector, the growth of the country's total exports and the real exchange rate for the respective country around the year the firm was established.[22] 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 8, 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 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.[23] These results tend to undercut the idea that our basic qualitative result can be explained

[22] 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.

[23] 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).

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.[24]

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 -- 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.

[24] 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.

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. The implication for policy is that it is the least developed economies that have the most to gain from measures that would broaden the markets they face. The empirical association between productivity and a proxy for involvement in broader markets such as the export of output cannot confirm the direction of causation. 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. 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. 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[25]. 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. 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. Levinsohn-Petrin argue that intermediate input demand is a function of the anticipated productivity shock and provided a monotonicity assumption holds, they can invert the functionThey 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[26].

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

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[25] 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.

[26] 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 Levinsohn-Petrin 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.

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

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}.

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

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

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

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.

For the next stage, we assume that productivity is serially correlated, following a Markov process $\omega_{it} = E[\omega_{it}/\omega_{it-1} + \psi_{it}]$The identification assumption is that capital is slow to adjust, so that it may adjust to the expected part of productivity conditional on lagged productivity, but not to the unexpected part of the shock. This gives a first moment condition for capital: $E[\psi_{it} + \eta_{it} / k_{it}] = 0$. As electricity can be adjusted quickly, the assumption here is that lagged electricity will be uncorrelated with the next period's productivity shock. $E[\psi_{it} + \eta_{it} / e_{it-1}] = 0$. The GMM function is then constructed :

(4) $$Min_{\beta_e \beta_k}\left[(\sum_i \sum_t [(\psi_{it} + \eta_{it}) \times k_{it}])^2 + (\sum_i \sum_t [(\psi_{it} + \eta_{it}) \times e_{it-1}])^2 \right]$$

where $\psi_{it} + \eta_{it}$ is obtained from rearranging (1) and substituting in the Markov process for ϖ_{itt}.

(5) $$\psi_{it} + \eta_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \beta_e e_{it} - \beta_k k_{it} - \hat{E}[\omega_{it} / \varpi_{it-1}]$$

where the conditional expected value function is approximated by a locally weighted least squares regression of ϖ_{it} given by: $(\omega_{it} + \hat{\eta}_{it}) = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \beta_e e_{it} - \beta_k k_{it}$ on an estimate of ϖ_{it-1}, given by: $\hat{\omega}_{it-1} = \hat{h}(e_{it-1}, k_{it-1},) - \beta_e e_{it-1} - \beta_k k_{it-1}$. Using an iterative procedure, the resulting coefficients on electricity and capital are unbiased.

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.

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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
Total number of firms	587	694	607	424	406	2,718

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

Indicators of Level of Development

	Indonesia	Korea	Malaysia	Philippines	Thailand
Macro					
GDP per capita	$1,105	$11,467	$4,625	$1,122	$3,017
Gross Domestic Investment,% GDP	31.8	34.2	42.8	24.8	33.3
Manufacturing Value Added, % GDP	25.6	28.9	27.8	22.8	28.2
Micro					
Median Value Added/worker ($'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 2

2a. 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
Levinsohn-Petrin Estimation					
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

2b. Scale Effects

	Indonesia	Korea	Malaysia	Philippines	Thailand
Levinsohn-Petrin Est.	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.

2.c Composition of Workforce: Share of Workers with Tertiary Education

	Indonesia	Korea	Malaysia	Philippines	Thailand
Foreign owned	NA	42.8	10.1	23.8	6.3
Domestic – established as exporter	NA	30.0	7.0	26.2	4.4
Domestic – not established as exporter	NA	31.6	9.6	28.9	4.5

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

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

Table 3
Pooled Cross-Section Variation in Total Factor Productivity Across Firms, by Countries:
Regressions using TFP Measures using Levinsohn-Petrin Estimation

	(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 4

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 5
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 Providing Formal Training							
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
Share of Firms Using Foreign Technology							
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 6
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 7

The Significance of the Experience of the Founder:
Regressions using TFP Measures Using Levinsohn-Petrin Technique

	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

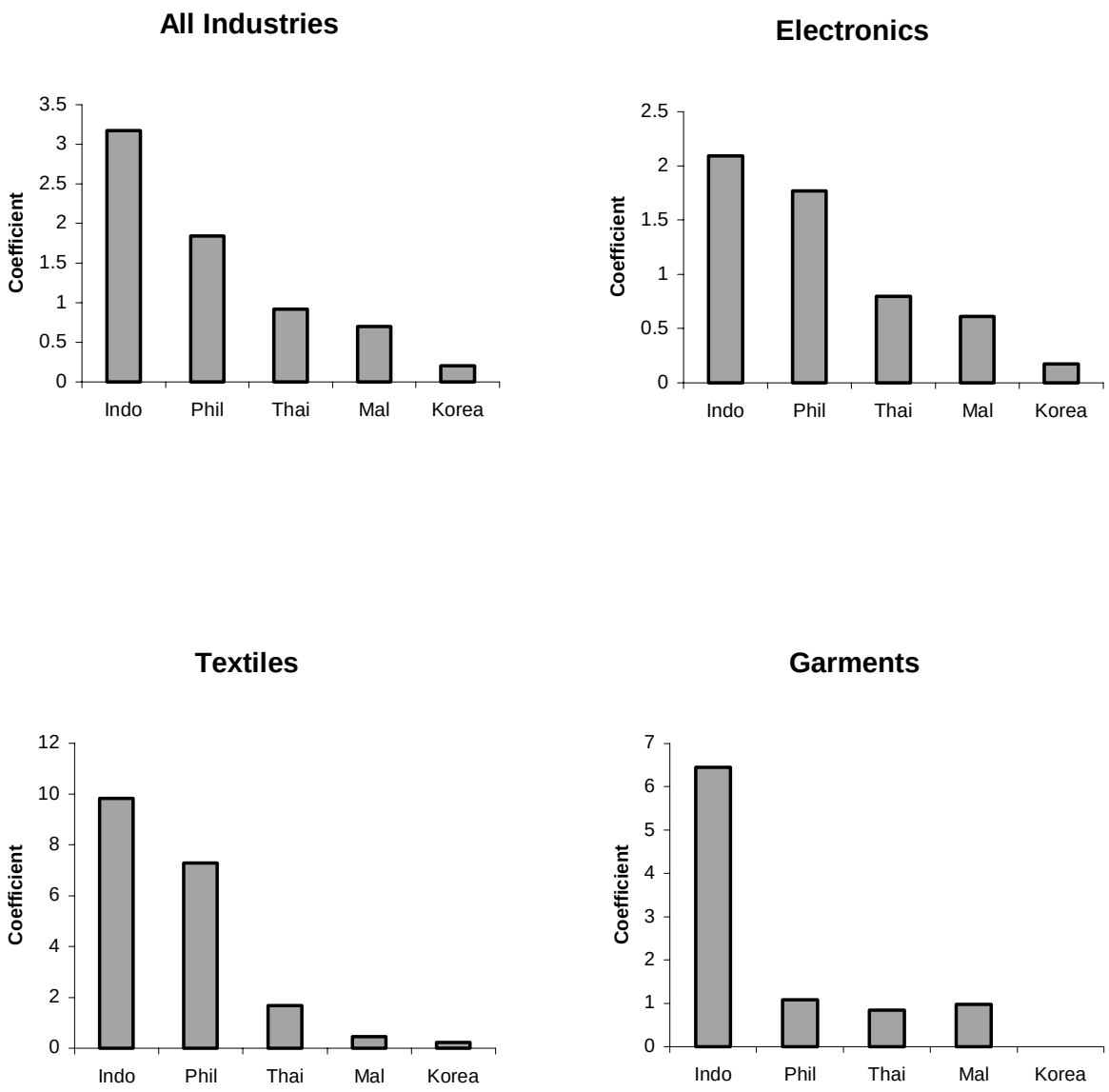
Notes: Dummy variables for the sectors, years, and age of firm were included, but are not reported. Robust t-statistics are reported within parentheses: *significant at 5%; and **significant at 1%. See the notes to Table 4. The dummy variables pertaining to the experience of the founder of the firm pertain 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 8
Instrumental Variable Approach With Macroeconomic Variables Employed in First Stage:
TFP Measures Based on Levinsohn-Petrin Estimation

	(1) TFP Indonesia	(2) TFP Korea	(3) TFP Malaysia	(4) TFP Philippines	(5) TFP Thailand
Domestic, Established as Exporter[1]	1.083	-0.432	0.302	0.551	0.471
	(1.70)+	(1.12)	(0.39)	(1.76)+	(2.29)*
Minority Foreign Ownership[3]		-0.051	-0.225	0.138	0.181
		(0.44)	(0.89)	(1.61)	(2.29)*
Majority Foreign Ownership[4]	0.543	0.051	-0.187	0.343	0.378
	(4.57)**	(0.52)	(0.69)	(3.50)**	(3.96)**
Medium (50-149)	0.036	0.013	0.483	0.098	0.016
	(0.67)	(0.30)	(2.35)*	(1.89)+	(0.30)
Large (150 plus)	0.165	0.104	0.297	0.045	-0.101
	(1.48)	(1.17)	(1.46)	(0.72)	(0.98)
Dummy for Firm Established 10 or More Years Ago	-0.012	-0.024	0.157	0.036	0.028
	(0.24)	(0.37)	(1.30)	(0.81)	(0.42)
Capital city	0.119	0.088	0.307	0.089	-0.061
	(1.52)	(1.96)+	(2.41)*	(2.12)*	(0.75)
Observations	633	1401	673	672	721
Adj. R-squared (1st stage)	0.22	0.38	0.34	0.51	0.31

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

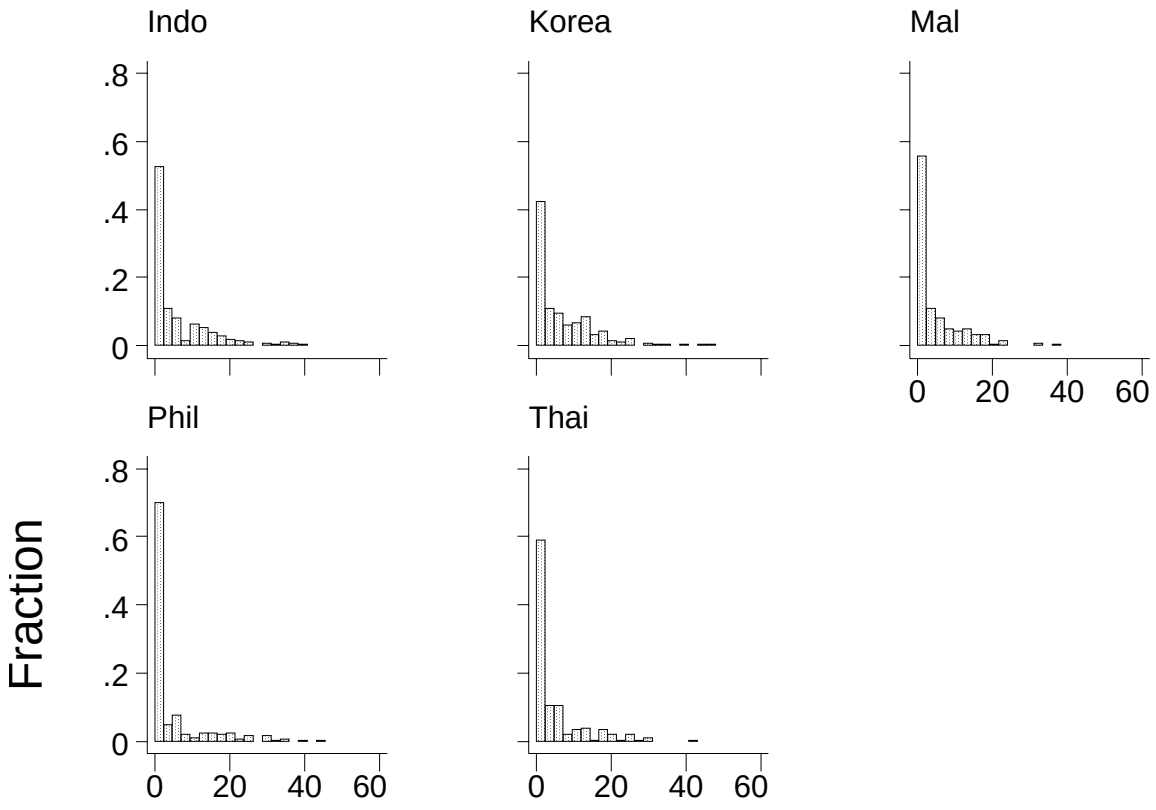
Figure 1: Coefficient of Variation of Total Factor Productivity



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