Foreign Networks and Exports: Results from Indonesian Panel Data [*]

Fredrik Sjöholm[♣]

The Research Institute of Industrial Economics, Stockholm, and Örebro University

Sadayuki Takii

The International Centre for the Study of East Asian Development, Kitakyushu

Abstract

Most firms and plants in developing countries produce only for the domestic market and few are able to export. One plausible hypothesis is that foreign networks decrease export costs and that plants with large amounts of such networks will be relatively likely to start exporting. We focus on two types of foreign networks: foreign ownership and imports of intermediate products. Our results suggest that plants in Indonesian manufacturing with any foreign ownership are substantially more likely to start exporting than wholly domestically-owned plants. The results remain robust to alternative model specifications and after controlling for other plant characteristics. There is no effect on exports of imports of intermediate products.

JEL classification: F10; F23; L10
Keywords: Exports; Sunk Costs; Foreign Ownership; Imports

[*] This paper was prepared as part of an ICSEAD project on "Foreign Multinational Corporations and Host-Country Labor Markets in Asia", and the authors wish to thank participants at an ICSEAD seminar in Japan. Fredrik Sjöholm gratefully acknowledges financial support from Marianne and Marcus Wallenberg's Foundation.

[♣] Corresponding author: The Research Institute of Industrial Economics, P.O. Box 55665, SE-102 15 Stockholm, Sweden. Phone + 46 8 665 45 39. Fax + 46 8 665 45 99. Email: Fredrik.sjoholm@ifn.se

I. Introduction

The heterogeneity of firms has been a core aspect in recent empirical literature on international trade (Helpman, 2006; Bernard et al., 2007). Firms within sectors and countries differ substantially in various characteristics such as size, capital intensities, and productivity levels. The heterogeneity includes firms' participation in international trade; most firms typically produce for the domestic market and there are often few entries into exports. The obvious question is, what are the determinants of firms' participation in exports?

Micro-econometric studies on panel data find size, productivity, and skills of the labor force to be important determinants.[1] It is likely, however, that more than large size and high productivity are required in order to export, considering the large difficulties involved. For instance, being able to export requires knowledge about foreign consumer preferences, distribution system, legal framework and a host of other aspects of the foreign market. Such information is costly to collect and is normally referred to as sunk entry costs: expenses incurred from entering a foreign market must be written off whether the firm decides to export or not.[2] On the other hand, once the firm has invested in collecting the information, it can utilize this information without any large additional costs. The export entry costs can be expected to vary between firms and Roberts and Tybout (1997, p. 561) suggest that foreign networks will decrease a firm's cost for collecting information on new markets, but the issue has not been fully empirically examined. There are different channels where foreign networks can develop. This paper contributes to the literature by examining two possible channels: foreign ownership and imports of goods from abroad.

[1] See, e.g. Bernard and Jensen (1999, 2004), Bernard and Wagner (2001), Clerides et al. (1998), and Roberts and Tybout (1997).

[2] See e.g. Baldwin (1988, 1989), Baldwin and Krugman (1989), Dixit (1989a, 1989b), and Krugman (1989).

Cross-section studies typically find exporting firms to have more foreign contacts as compared to non-exporting firms. In particular, a relatively large proportion of exporters tends to have foreign ownership.[3] Such findings suggest a link between foreign networks and the ability to become an exporter but the causality is unclear. It is, for instance, possible that foreign owners tend to acquire exporters rather than non-exporters, and that imports follow from exports rather than being their cause. Controlling for these possibilities requires a panel data set where the plants can be followed over time.

This paper studies the export decision within the Indonesian manufacturing sector on a panel of plants between 1990 and 2000. We contribute to the empirical literature on sunk costs and exports by examining the role of foreign networks on panel-data which enables us to control for endogeneity and causality problems. We use a number of different empirical models to examine the issue at hand and avoid drawing strong conclusions on weak results. Our results show that plants with foreign ownership are relatively likely to start exporting even after controlling for various plant characteristics. There is no evidence of an effect of imports of intermediate goods on the choice to export.

II. Exports in the Indonesian Manufacturing Sector

We analyze the determinants for exports on Indonesian manufacturing data supplied by the Indonesian Statistical Office. The data includes all manufacturing plants with more than 20 employees in any of the years 1975-2000. We will use data between 1990 and 2000 when export figures are included. Plant identification codes enable us to construct a panel and follow the plants over time. After cleaning the data, our dataset contains 197,195 observations for 26,987 plants during 1990-2000.

[3] See e.g. Ramstetter (1999) and Sjöholm (2003) for the case of Indonesia.

The structure of the Indonesian manufacturing sector is seen in Table 1. The number of plants increased by about 34 percent from 16,536 in 1990 to 22,174 in 2000. The relative size of different sectors has changed over time, where the share of Food Products has declined and the shares of Textiles and Fabricated Metal Products have increased. Textiles is the largest employer in the year 2000, accounting for almost one third of the manufacturing labor force, and Fabricated Metals is the largest sector in terms of value added with a share of about 27 percent. Moreover, these two sectors together account for almost 47 percent of total manufacturing exports. Other sectors with large exports include Food, Wood and Furniture, and Chemicals. The share of manufacturing output that is exported has increased from about 17 percent in 1990 to about 26 percent in 2000. Every industry within manufacturing has become more export-oriented. Despite this increase in exports, an overwhelming share of output supplies the domestic market and only in Wood and Furniture are more than 50 percent of output exported. The importance of production for the domestic market as compared to exports is even more striking from the share of plants that export; this share has increased over time, but is still only about 17 percent. Even in the most export-intensive industry, Wood and Furniture, less than 38 percent of the plants are engaged in exports.

Table 2 compares characteristics of exporters and non-exporters. Labor productivity (log) size measured by the number of workers (log), and the ratio of non-production workers were each regressed on a dummy variable equal to one if the plant is exporting. Hence, there is a simple estimation on the difference in plant characteristics between exporters and non-exporters. Table 2 shows that exporters have a 78% higher labor productivity than non-exporters in 1990 and 64% in 2000. Exporters relatively high labor productivity is found in every sector in both years, although some of the differences are not statistically significant. Moreover, exporters are considerably larger in terms of employment than non-exporters, in fact more than 120% larger on average. Once more, exporters are relatively large in all sectors in both years. Finally, exporters seem to include a higher share of white-collar workers, but the difference is relatively small and not consistent over sectors.

Our main hypothesis is that foreign contacts increase the likelihood of exports. The figures on imports and foreign ownership in table 3 confirm that foreign plants are more common among exporters than among non-exporters and that exporters have a higher share of imports of intermediate goods. The share of foreign plants among exporters was 13 percent in 1990 and 27 percent in 2000. The share among non-exporters was 3 and 7 percent, respectively, and foreign plants are more common among exporters than among non-exporters in all sectors. The same pattern is seen for imports where the share of imports among exporters increased from 19 to 24 percent between 1990 and 2000, and the share among non-exporters has remained stable at 9 percent.

As previously said, the causality between plant characteristics and exports in tables 2 and 3 is not clear. We will try to control for this by looking at plants' entry to, and exit from, exports. Table 4 shows the pattern of entry and exit. The share of non-exporters that start to export in the following year has remained rather stable at around five percent over the years. However, there are differences between sectors where, for instance, plants in Wood and Furniture and Other Manufacturing are relatively likely to become exporters, and plants in Food products and Paper and Pulp are relatively unlikely to become exporters. The exit rate from exports is very large; about one third of the exporters in 1990 exit from exports in the following year. The exit rate declines over time to about 20 percent in 1999. Part of these high figures seems to be caused by plants that exit from and re-enter into exports. For instance, the exit rate declines to about 20 percent in 1990 if only those plants that do not export in any of the next three years are included (not shown). Hence, about one third of the plants that exited exports in 1991 re-entered exports in the two following years. The implication is that it seems important to control for previous exports in our econometric analysis.[4]

III. A Model of Export-Market Participation with Sunk Entry Costs

A profit-maximizing firm will export if the current value of expected total profit when it chooses to export is greater than the corresponding profit when it chooses not to export. Roberts and Tybout (1997) stress that firms face sunk entry costs when they enter foreign markets, and provide supporting evidence from Colombian firm-level data. The basic theoretical model assumes that sunk (re-)entry costs (F^k) depend on the length of absence from foreign markets (k) and that the function F^k is a non-decreasing function of k with $F^0=0$. Profits from export (R) at time t can be expressed as follows:

$$R_t = Y_t[\pi_t - F^k] - (1-Y_t)Y_{t-1}X \ , \quad k \geq 0, \tag{1}$$

Where Y_t is an indicator variable that equals to one if the plant is exporting in period t, and π_t represents the increase in expected profits from exports in period t, and X is the cost for exiting from the foreign markets. The condition for a firm to export during period t can be derived using Bellman's equation (see Roberts and Tybout 1997, pp. 547-548). Firms choose to export if

$$\pi_t + \delta[E_t(V_{t+1}(\Omega_{t+1}) \mid Y_t = 1) - E_t(V_{t+1}(\Omega_{t+1}) \mid Y_t = 0)] \geq F^k + Y_{t-1}X \ , \tag{2}$$

where $E(V_t(\Omega_t))$ is the expected present value of maximized payoff conditioned on the information set, Ω_t, and δ is the one-period discount rate.

The empirical model used in the next section is largely based on the basic model above. It should be noted that in our model, sunk entry costs are assumed to be positive even when a

---

[4] In addition, there is a group of plants that only export a minor share of their output. The exit rate declined to slightly less than 30 percent in 1990 if exporters are defined as plants that export more than ten percent of their output.

firm exported in the previous year ($F^0 \geq 0$). This reflects the fact that foreign market conditions are constantly changing and thus incur fixed costs for firms to gather new information and upgrade products in order to continue to export. Under this assumption, the right-hand side of Equation 2 can be rewritten using past series of Y on which k is dependent.

$$F^k + Y_{t-1}X = F^\infty + (F^0 - F^\infty + X)Y_{t-1} + \sum_{j=1}^{J}(F^j - F^\infty)\tilde{Y}_{t-j-1}, \qquad (3)$$

where F^∞ is a sunk cost for a plant that has never previously exported, $\tilde{Y}_{i,t-j} \equiv Y_{i,t-j}\prod_{l=1}^{j-1}(1-Y_{i,t-l})$ is an indicator variable equal to one if a firm exported in period t-j but has not exported since, and J is the age of the firm minus one.

Hence, a firm's decision to enter foreign markets partially depends on F^k. If the series of sunk entry costs, F^k (k=0, 1,…,∞), differ between firms with and without foreign contacts, the decisions to enter foreign markets are also different. For example, sunk entry costs can be expected to be smaller for foreign than for local firms because the parent MNC may provide information on foreign markets. Figure 1 shows F^k for firms with foreign contacts and for firms without foreign contacts. More precisely, the dashed curve f shows sunk costs for firms with foreign contacts and curves d1 and d2 show the corresponding costs for firms without foreign contacts. F^∞ on curve f is z units lower than F^∞ on curves d1 and d2 while the shape of curve d1 is same as that of curve f. Hence, in the case where the sunk costs for firms without foreign contacts are expressed as curve d1, the difference in Equation 3 for firms with and without foreign contacts only appears in the first term of the right-hand side, F^∞, because F^k-F^∞ (k=1, 2,…) is equal for both groups of firms. On the other hand, the slope of curve f is lower than that of curve d2, indicating that the longer the period of absence from foreign markets, the relatively higher are the sunk costs for firms without foreign contacts as compared to firms with foreign contacts. This reflects the fact that firms with foreign contacts can make up the depreciation of past experience with information gathered through other foreign contacts.

IV. Econometric Model and Variables

Defining the left-hand side of Equation 2 as a latent variable π^*, which is assumed to be affected by various firm- and industry-level factors ($\mathbf{z}_{it}$), a non-structural dynamic binary choice model can be obtained from Equations 2 and 3.

$$Y_{it} = \begin{cases} 1 & \text{if} \quad \gamma^{\infty} + \gamma^{0} Y_{i,t-1} + \sum_{j=1}^{J} \gamma^{j} \tilde{Y}_{i,t-j-1} + \boldsymbol{\beta}' \mathbf{z}_{it} + \varepsilon_{it} \geq 0, \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

Hence, our continues variable on export is transformed to a binary variable. The reason is that the main costs are expected when the firm chooses to start export. Once the firm has invested in collecting information on foreign markets, it can increase the amount of export without much further costs. The error term ε_{it} is decomposed into a time-invariant plant-specific effect, η_i, and a pure error term, μ_{it}. The former includes observable effects such as location, and unobservable effects such as firm-specific assets including managerial skill. The series of fixed costs and X_{it} are assumed to differ between firms with and without foreign contacts, but to be the same within each group. Parameters γ^{∞}, γ^{0}, and γ^{j} (j=1, 2, …) correspond to F^{∞}, F^{0}-F^{∞}+X, and F^{j}-F^{∞} (j=1, 2, …) in previous equations. The difference in the size of the parameters for firms with and without foreign contacts is accounted for by dummy variables on foreign ownership and imports of intermediate goods.

Two types of variables are included in vector, $\mathbf{z}_{it}$. First, there are time-specific factors that have a common effect on all plants' export-decision, such as exchange rates and trade policy conditions. Including time-specific dummy variables will capture such factors. The second type is time-variant plant-specific variables. We include variables that are likely to affect exports: value added per worker, the use of power divided by the number of workers, the share of white-collar workers in total employees, and plant size measured by the number of workers. The first two variables aim at measuring labor productivity and capital intensity and are included since they might affect product quality or plant profitability, and thereby the probability of exporting. Our proxy variable on capital intensity is of course imperfect and can presumably also capture the degree of capacity utilization in a plant, but the lack of good capital stock variables leave us with no better alternative. We include the share of white-collar workers to capture the skill level of the plant workers, which might have an impact on product quality and exports. Size may affect exports through, for instance, scale economies. Another plausible mechanism between size and exports is that large plants have been successful in the domestic market, which could increase the possibility of also succeeding internationally. We also examine the effect of public ownership since such firms may have other objectives than private plants.

V. Econometric Methods

The estimation of a dynamic binary choice model for panel data is econometrically complicated by various possible biases. One such bias is that some of the independent variables are likely to be highly correlated with the plant-specific effect, η_i. For instance, managerial skill and plant-specific assets, which are included in the plant-specific effect, are presumably correlated with firm size and productivity. The commonly used method of treating the individual effects η_i as random will therefore cause biased estimates of the parameters.[5] Treating the individual effect as fixed may also cause inconsistent estimates in a non-linear model with panel data and a relatively short time period.[6] Therefore, we choose to estimate equation 2 as a linear probability model. This method follows Bernard and Jensen (1999, 2001) and Bernard and Wagner (2001) who examine sunk costs and exports by estimating a dynamic linear probability model with the assumption of a first-order autoregressive process, which implies that $\tilde{Y}_{i,t-j}$ in equation 2 is omitted. It is known that the

---

[5] See e.g. Bernard and Jensen (2001, pp.11-12).

[6] Hsiao (1986, p.159).

coefficient on $Y_{i,t-1}$ is upward-biased when the model is estimated with ordinary least square (OLS) ignoring plant-specific effects.[7] In addition, the slope coefficients are biased in the fixed-effect model because the lagged dependent variable is correlated with the error term.[8] When γ^{∞} is positive, the bias of the coefficient is always negative.[9]

There are other different approaches that can be used. The first, and most common, approach is to use an instrumental variable model (IV).[10] In such a model, a consistent estimate of γ^{∞} is obtained by applying instrumental-variable methods after differencing out plant-specific effects. The IV estimator is consistent but not necessarily efficient because it only uses some of the available moment conditions.[11] Furthermore, the error term is auto-correlated in the differenced equation unless it follows a unit root process. We will follow the approach by Arellano and Bond (1991), Arellano and Bover (1995), and Ahn and Schmidt (1995) who have suggested a general method of moments approach (GMM) for linear dynamic panel models. After differentiating to delete individual effects η_i, lagged dependent variable ΔY_{t-1} is correlated with $\Delta\varepsilon_t$. Arellano and Bond (1991), Arellano and Bover (1995), and Ahn and Schmidt (1995) suggest using Y_{t-2} and further lags as instrumental variables. Similarly, lags of z can be used as instrumental variables for Δz.

Considering the different potential problems in the models discussed above, we add a dynamic probit model to further examine the robustness of our results. The estimation of dynamic non-linear panel data models raises another estimation problem: we have to integrate unobserved individual effects (plant-specific effect, η_i) out of the likelihood function with

---

[7] See e.g. Hsiao (1986, pp.76-78).

[8] The fixed-effect model is in the literature also referred to as dummy variable least square.

[9] See, e.g. Hsiao (1986, pp.73-76).

[10] See e.g. Bernard and Jensen (1999, 2001), Bernard and Wagner (2001), and Holz-Eakin *et al*.(1988).

[11] See Ahn and Schmidt (1995), and Baltagi (1995, p.126). In addition, IV estimators do not take into account the differenced structure of the residuals in differenced equations (Baltagi, 1995).

appropriate treatment of initial observations. Wooldridge (2005) provides a simple approach to handle the problem although independent variables except for lagged dependent variables are assumed to be strictly exogenous. Our probit model with a one-year lagged dependent variable can be written as follows:

$$P(Y_{it} = 1 \mid Y_{i,t-1}, \ldots, Y_{i0}, \mathbf{z}_{it}, \eta_i) = \Phi(\gamma^{\infty} Y_{i,t-1} + \boldsymbol{\beta}' \mathbf{z}_{it} + \eta_i),$$

where $\Phi(\cdot)$ is a standard normal cumulative distribution function. Wooldridge's approach specifies the individual effects,

$$\eta_i = \alpha_0 + \alpha_1 Y_{i0} + \boldsymbol{\alpha}' \mathbf{z}_i + a_i$$

where $a_i \mid Y_{i0}, \mathbf{z}_i \sim N(0, \sigma_a^2)$, $\mathbf{z}_i = (\mathbf{z}_{i1}, \ldots, \mathbf{z}_{it})$. The above response probability can be rewritten as

$$\Phi(\gamma^{\infty} Y_{i,t-1} + \boldsymbol{\beta}' \mathbf{z}_{it} + \alpha_0 + \alpha_1 Y_{i0} + \boldsymbol{\alpha}' \mathbf{z}_i + a_i), \qquad (5)$$

and the model can be estimated using standard econometric software.

VI. Econometric Results

Table 5 shows the results for the OLS and the fixed-effect models. All estimations in the table confirm our hypothesis that foreign ownership is important for exports. Foreign-owned firms are between 6.2 and 8.4 percent more likely than domestic plants to start exporting (columns 2 and 3). The fixed-effect model examines changes within plants over time and the coefficient for foreign ownership in this model estimates the likelihood of exports in plants that change ownership. It is seen that such firms are between 8.4 and 9.4 percent (columns 5 and 6) more likely to become an exporter when they are foreign owned as compared to when they were domestically owned. We also used OLS to examine if the effect of foreign ownership differed between greenfield investments and foreign takeovers of domestic plants (not shown). The hypothesis of equal coefficients for the two types of foreign plants could not be rejected and we conclude that the form of foreign entry has little impact on the likelihood of becoming an exporter.

The result for imports is more uncertain with a positive and statistically significant coefficient in two estimations out of four. Moreover, the size of the import coefficient is very small, which suggests that imports are of little importance in explaining exports.

Sunk costs seem to be important for exports: the one-year lagged export variable is positive and statistically significant in all estimations. However, the two-year lag is positive in the OLS estimation but negative in the fixed-effect model. The coefficient and the significance levels differ between the models also for a few other variables. All estimations find capital intensities (as captured by energy consumption) and size to positively affect exports, whereas the result for white-collar workers and labor productivity is more uncertain. Public ownership is never statistically significant. The OLS examines differences between plants and the fixed-effect model estimates the intertemporal relationship between the export decision and possible determinants within a plant. Hence, the results imply, for instance, that plants with high productivity levels tend to export but that productivity changes within a plant have no effect on exports.

The studied time period has been extremely turbulent in Indonesia. Few countries were as affected by the Asian crisis and Indonesia's GDP declined by almost 15 percent in 1998. In addition, the crisis sparked strong protests that brought an end to the Suharto era and the installation of democracy. It is possible that such big economic and political changes will affect the results of our study. We have therefore in columns 4 and 7 estimated the OLS and FE models on the relatively stable period 1992-1996. The results remain surprisingly similar to the previous ones and we conclude that the extraordinary Indonesian development in the late 1990's has not seriously impacted our results on export.

As previously said, we can compare our OLS and fixed effect results with previous studies. Our findings seem to be broadly consistent with the results in Bernard and Jensen

(1999, 2001) and Bernard and Wagner (2001); sunk costs are important in explaining exports, as is size. Previous studies have also found that high productivity levels have a positive effect on the decision to export but that the effect of productivity growth (fixed-effect model) is more uncertain. The size of the sunk cost effect seems to be higher in other studies, often close to 1.0, suggesting entry and exit from exports to be more pronounced in Indonesia. Finally, measures on foreign networks have not been included in previous studies, which prevents a comparison of these effects.

Table 6 shows the estimation results of the GMM model.[12] This model is similar to the fixed-effect model in the respect that it examines changes within plants. Estimation 1 does not include other plant characteristics than ownership and previous exports. It is seen that foreign plants are about 19 percent more likely to start exporting than domestically-owned plants. The rest of the estimations includes various plant characteristics that are likely to affect exports. The results are very robust to the inclusion of additional variables and there is actually a slight increase in the effect of foreign ownership. Estimations 2-5 suggest that the probability of exporting is 19-21 percent higher when a plant is foreign-owned as compared to when the same plant is domestically-owned. The effect is substantially higher than in the OLS or the fixed-effect models.

The coefficient for imports is not statistically significant. Moreover, the results suggest that publicly owned plants have a lower probability of starting to export than other plants. However, public ownership is statistically insignificant when we control for industry-specific effects. Hence, the low export probability of public plants is partly caused by their location in domestically oriented industries. The results for the other variables are similar to the estimations in table 5. There is clear evidence of export rigidities; firms that have started to

[12] These equations were estimated using Arellano and Bond's (1998) DPD program downloaded from http://www.cemfi.es/~arellano/#dpd.

export continue to export as seen from the statistically significant coefficient on $Y_{i,t-1}$ and the coefficients are, as would be expected, between the upper bound of OLS and the lower bound of the fixed-effect model. Accordingly, the coefficient of $\tilde{Y}_{i,t-2}$ is also positive and statistically significant. Moreover, plants are relatively likely to start exporting as they grow in size, capital intensity, or labor productivity, but the change in the white-collar ratio has no effect on the probability of exporting.

To examine the robustness of our results, we continue with the GMM estimations shown in columns 3 and 4. First, we include a dummy variable for majority-foreign ownership. The variable is not statistically significant and the results suggest that foreign ownership is an important determinant for exports but that it does not seem to be important that the plant has a majority of foreign ownership. Second, we include a variable on the import intensity constructed as imports of intermediate goods as a share of total intermediate goods. The import intensity variable is positive and statistically significant. Hence, an increase in imported inputs increases the probability of exporting. However, the size of the coefficient is very small, implying that a one percentage point increase in imported inputs increases the probability of exporting by only about 0.05 percent.[13]

Arrelano and Bond (1991) suggest two specification tests that are applicable with GMM estimations. These tests are captured by variables m1 and m2. The first variable, m1, is a test for first-order serial correlation in the differenced residuals. The statistically significant coefficients suggest that such correlation exists and that a GMM model, rather than OLS and IV estimations, is appropriate. The second test, m2, is on the second-order correlation of the differenced residuals. The statistically insignificant coefficient for m2 suggests that there is no such correlation and that the GMM models are well specified.

---

[13] We also estimated the models in table 6 with data for 1993-1997 to examine if the turmoil at the time of the Asian crisis affects the results. The results largely remained unchanged.

We end our econometric analysis with estimations from a dynamic probit model. The results shown in Table 7 are very similar to the previous ones: there is large persistence in export; foreign firms are likely to export; and so are large, capital intensive plants with high labor productivity. The main difference with the other models is a positive effect of import but there is no significant effect of the import ratio.

Summarizing the results for the different models and specifications, it seems that foreign ownership is important for exports, as are size, capital intensity and labor productivity. The result for imports, and for a few other variables, is mixed and differs between models.

VII. Concluding Remarks

Inflows of foreign direct investment (FDI) are widely recognized as one potentially important factor for developing countries' industrialization and growth. FDI may benefit the host country by inflows of capital, new technology, and improved management. In addition, foreign-owned firms often have comparatively good access to foreign markets. Our study confirms the relatively high export orientation of foreign-owned plants. In addition, our results suggest that inflows of FDI may create a higher degree of flexibility in the economy; even foreign-owned plants that began their operation in Indonesia by only producing for the domestic market are more likely to start exporting than domestically-owned plants . Foreign-owned plants are about 6-19 percent more likely to start exporting than purely domestically-owned plants. Foreign and domestic plants also differ in many other characteristics that are likely to affect export behavior, such as size, capital intensity, and labor productivity. However, the effect of foreign ownership on exports remains robust to the inclusion of such plant characteristics.

Our second variable on foreign networks, imports of intermediate products, does not seem to affect the likelihood of exports. The coefficient for imports is statistically significant in some model specifications, but the coefficient is very small and of no practical significance.

V. References

Ahn, Seung C. and Peter Schmidt (1995). “Efficient Estimation of Models for Dynamic Panel Data”, *Journal of Econometrics*, Vol. 68 (1), pp.5-27.

Arellano, Manuel, and Stephen Bond (1991). “Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations”, *Review of Economic Studies*, Vol. 58 (2), pp. 277-297.

Arellano, Manuel, and Stephen Bond (1998). “Dynamic Panel Data Estimation Using DPD98 for GAUSS: A Guide for Users”, downloaded from http://www.cemfi.es/~arellano/#dpd.

Arellano, Manuel, and Olympia Bover (1995) “Another Look at the Instrumental Variable Estimation of Error-Components Models”, *Journal of Econometrics*, Vol. 68 (1), pp.29-51.

Baldwin R. Edward (1988) “Hysteresis in Import prices: the Beachhead Effect”, *American Economic Review,* Vol. 78 (4), pp. 773-85.

Baldwin R. Edward (1989) “Sunk-Cost Hysteresis”, *NBER Working Paper Series* No. 2911.

Baldwin R. Edward, Krugman P (1989) “Persistent Trade Effects of Large Exchange Rate Shocks”, *Quarterly Journal of Economics,* Vol. 104 (4), pp. 635-54.

Baltagi, Badi H. (1995) *Econometric Analysis of Panel Data*, Chichester: John Wiley & Sons.

Bernard, Andrew B. and J. Bradford Jensen (1999). “Exceptional Exporter Performance: Cause, Effect, or Both?”, *Journal of International Economics,* Vol. 47 (1), pp. 1-25.

Bernard, Andrew B., and J. Bradford Jensen (2004). “Why Some Firms Export”, The Review of Economics and Statistics, Vol. 86 (2), pp. 561-569.

Bernard, Andrew B., and Joachim Wagner (2001). “Export Entry and Exit by German Firms”, *Weltwirtschaftliches Archiv,* Vol.137 (1), pp. 105-123.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott (2007), “Firms in International Trade”, *Journal of Economic Perspectives*, forthcoming.

Clerides, Sofrans K., Saul Lach, and James R. Tybout (1998). "Is Learning by Exporting Important?: Micro-Dynamic Evidence from Colombia, Mexico, and Morocco", *Quarterly Journal of Economics,* Vol. 113 (3), pp. 903-947.

Dixit, Avinash (1989a) "Entry and Exit Decisions under Uncertainty", *Journal of Political Economy* Vol. 97 (3), pp. 620-38.

Dixit, Avinash (1989b) "Hysteresis, Import Penetration, and Exchange Rate Pass-Through", *Quarterly Journal of Economics*, Vol. 105 (2), pp. 205-28.

Helpman, Elhanan (2006), "Trade, FDI, and the Organization of Firms", *Journal of Economic Literature*, Vol. 44 (3), pp. 589-630.

Holtz-Eakin, Douglas, Whitney Newey, and Harvey S. Rosen (1988) "Estimating Vector Autoregressions with Panel Data", *Econometrica*, Vol. 56 (6), pp. 1371-1395.

Hsiao, Cheng (1986) *Analysis of Panel Data*, Cambridge: Cambridge University Press.

Krugman, Paul (1989) *Exchange rate instability.* MIT Press, Cambridge.

Ramstetter Eric D. (1999) "Trade Propensities and Foreign Ownership Shares in Indonesian Manufacturing", *Bulletin of Indonesian Economic Studies*, Vol. 35 (2), pp. 43-66.

Roberts, Mark J., and James R. Tybout (1997) "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs", *American Economic Review*, Vol. 87 (4), pp. 545-564.

Sjöholm, Fredrik (2003), "Which Indonesian Firms Export? The Importance of Foreign Networks", *Papers in Regional Science*, Vol. 82 (3), pp. 333-350.

Wooldridge, Jeffrey M. (2005) "Simple Solutions to the Initial Conditions Problem in Dynamic, Nonlinear Panel Data Models with Unobserved Heterogeneity", *Journal of Applied Econometrics,* Vol. 20 (1), pp. 39-54.

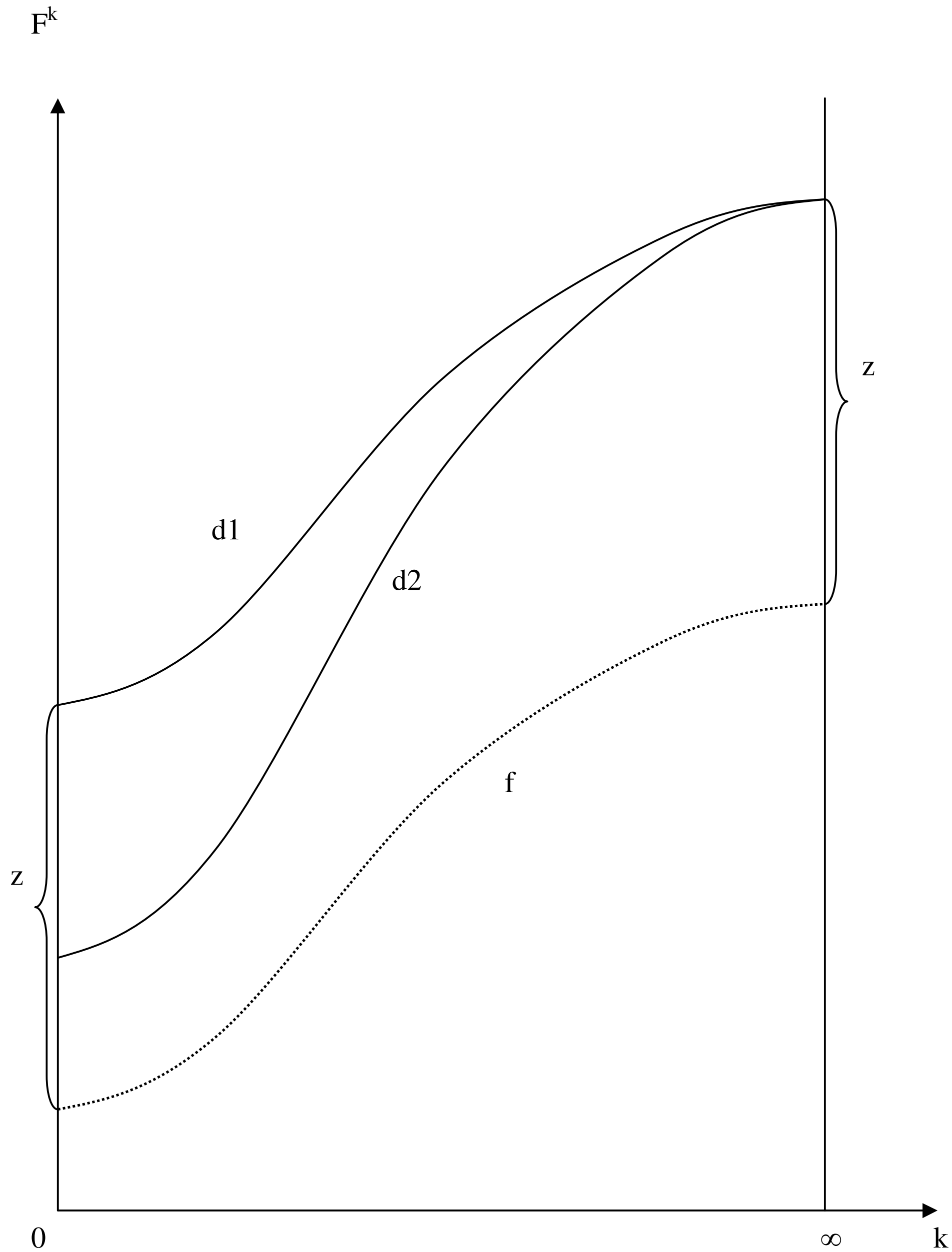

Figure 1. Series of Sunk Entry Costs

Table 1. Descriptive statistics of the Indonesian manufacturing sector in 1990 and 2000 (%).

ISIC	Sector	Number of plants		Share of Value Added		Share of Employment		Share of Exports		Share of exports in total output		Share of plants that export	
		1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
	Total	16536	22174	100.0	100.0	100.0	100.0	100.0	100.0	16.9	26.4	11.7	16.5
31	Food	4 616	5 482	27.5	21.2	23.1	19.3	11.9	12.6	8.5	6.4	6.4	9.6
32	Textile	3 958	4 876	14.6	16.1	27.5	32.7	22.6	24.0	24.0	37.1	13.5	17.1
33	Wood, Furniture	1 946	3 147	11.0	6.6	15.3	13.1	31.5	15.1	47.4	59.8	29.3	37.7
34	Paper, printing	702	967	4.6	6.3	3.3	3.8	2.2	4.6	7.7	15.7	2.8	5.2
35	Chemicals	2 059	2 622	14.3	14.8	14.4	11.5	17.2	14.5	17.2	24.7	14.2	16.0
36	Non-metallic minerals	1 323	1 907	3.8	3.5	4.3	3.9	1.9	2.6	9.1	23.0	4.4	6.2
37	Basic metal industries	95	239	9.0	3.4	1.2	1.2	6.8	3.1	14.4	18.4	18.9	16.3
38	Fabricated metal products	1 595	2 434	14.8	27.3	9.8	12.4	5.4	22.6	5.9	24.1	7.0	13.7
39	Other manufacturing	242	500	0.4	0 .8	1.1	2.0	0 .4	1.0	15.9	34.3	14.9	30.8

Table 2. Plant characteristics of exporters and non-exporters in 1990 and 2000.

ISIC	Sector	Labor productivity (value added per worker, 1000 rupiahs)				Size (number of workers)				Share of white-collar workers (%)			
		Exporters		Non-exporters		Exporters		Non-exporters		Exporters		Non-exporters	
		1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
	Total	4 037	18 779	2 154	8 273	197	297	45	47	16	16	14	14
31	Food	2 672	13 561	1 000	4 643	117	170	33	35	18	18	13	12
32	Textile	2 511	12 575	1 386	5 990	258	475	42	47	11	12	9	10
33	Wood, Furniture	3 771	9 814	2 278	6 841	174	146	42	32	14	12	15	12
34	Paper, Printing	9 245	12 860	2 316	10 871	279	258	46	54	26	18	19	19
35	Chemicals	5 347	34 268	4 628	15 813	196	237	54	54	21	24	20	23
36	Non-metallic mineral	2 938	22 640	1 438	6 473	225	263	56	64	15	17	13	12
37	Basic metal industries	27 996	66 959	9 601	22 646	270	312	132	78	27	20	28	23
38	Fabricated metal products	5 988	36 403	2 635	13 284	202	294	58	68	18	19	18	19
39	Other manufacturing	2 142	6 897	1 236	6 084	195	121	32	35	12	12	9	10

Table 3. Imports and ownership of exporters and non-exporters in 1990 and 2000.

ISIC	Sector	Share of foreign plants (%)				Share of imported intermediate goods			
		Exporters		Non-exporters		Exporters		Non-exporters	
		1990	2000	1990	2000	1990	2000	1990	2000
	Total	13	27	3	7	19	24	9	9
31	Food	5	16	1	2	2	6	2	2
32	Textile	11	24	1	4	22	27	9	9
33	Wood, Furniture	6	9	2	2	1	2	1	1
34	Paper, Printing	19	23	2	4	46	22	9	7
35	Chemicals	18	37	8	19	31	34	20	13
36	Non-metallic mineral	7	26	2	5	24	24	10	11
37	Basic metal industries	33	45	17	18	46	51	17	24
38	Fabricated metal products	38	60	7	21	43	58	20	25
39	Other manufacturing	22	23	3	8	34	21	19	12

Table 4. Entry and exit rates for exports in 1990 and 1999.

ISIC	Sector	Entry rate to exports (share of non-exporters who start exporting the following year)		Exit rate from exports (share of exporters who stop exporting the following year)	
		1990	1999	1990	1999
	Total	4.5	5.2	33	20
31	Food	2.5	2.8	47	24
32	Textile	5.2	6.2	34	21
33	Wood, Furniture	9.4	11.6	25	15
34	Paper, Printing	2.8	2.1	50	29
35	Chemicals	6.1	5.7	33	19
36	Non-metallic mineral	2.9	2.0	47	21
37	Basic metal industries	16.9	6.6	33	31
38	Fabricated metal products	3.0	5.0	30	23
39	Other manufacturing	12.1	11.2	19	21

Table 5. Export determinants in Indonesian manufacturing. OLS and fixed-effect estimations.

	OLS	OLS	OLS	Fixed Effect	Fixed Effect	Fixed Effect
Constant	-0.167*** (24.8)	-0.119*** (17.5)	-0.156*** (18.5)	-0.009*** (2.9)	0.011*** (3.6)	0.003 (0.6)
Exports the previous year	0.525*** (125.4)	0.554*** (129.0)	0.635*** (119.2)	0.134*** (27.3)	0.084*** (14.0)	0.023*** (3.3)
Exports two years ago	--	0.238*** (39.6)	0.284*** (30.8)	--	-0.049*** (8.2)	-0.002*** (6.0)
Electric power (log)	0.002*** (6.6)	0.002*** (6.1)	0.001** (2.6)	0.002*** (3.7)	0.003*** (3.7)	0.002** (2.0)
White-collar workers (%)	-0.000*** (7.4)	-0.000*** (6.7)	-0.001*** (6.1)	0.000 (0.3)	0.000 (0.3)	-0.000 (0.9)
Size (log)	0.044*** (43.7)	0.036*** (36.1)	0.040*** (31.2)	0.0089*** (2.9)	0.009*** (2.7)	0.025*** (6.3)
Labor productivity (log)	0.005*** (6.2)	0.004*** (4.9)	0.006*** (4.7)	-0.0001 (0.5)	-0.000 (0.2)	0.007*** (4.2)
Public ownership	0.001 (0.2)	-0.001 (0.2)	-0.01 (1.5)	0.001 (0.1)	0.006 (0.7)	0.026 (0.9)
Foreign ownership	0.084*** (17.5)	0.062*** (12.8)	0.080*** (12.5)	0.094*** (6.7)	0.084*** (5.2)	0.137*** (5.5)
Imports	0.008*** (3.4)	0.004 (1.5)	0.009*** (3.2)	0.007 (1.7)	0.006 (1.3)	0.012** (2.2)
Industry dummies	Included	Included	Included	Included	Included	Included
Time dummies	Included	Included	Included	Included	Included	Included
Number of plants	20,694	20,694	19,560	20,694	20,694	19,560
Number of obs.	154,914	134,220	71,825	134,220	113,526	71,825
Period	1991-2000	1992-2000	1992-1996	1992-2000	1993-2000	1992-1996
Wald test (p-value)	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
m1 (p-value)	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
m2 (p-value)	[0.00]***	[0.00]***	[0.00]***	[0.01]***	[0.00]***	[0.00]***

Note: t-statistics within brackets are derived from robust standard errors. *- significant at the 10 percent level, **- significant at the 5 percent level, ***- significant at the 1 percent level.

Table 6. Export determinants in Indonesian manufacturing 1993-2000. GMM estimations.

	(1)	(2)	(3)	(4)	(5)
Constant	-0.0065* (1.6)	-0.0070 (3.7)	-0.0043** (2.1)	-0.0072*** (3.6)	-0.0043* (1.9)
Exports the previous year	0.2506*** (23.9)	0.2508*** (23.9)	0.2480*** (23.5)	0.2484*** (23.9)	0.2452*** (23.5)
Exports two years ago	0.0783*** (7.4)	0.0725*** (7.2)	0.0708*** (6.7)	0.0699*** (7.1)	0.0680*** (6.7)
Electric power (log)	--	0.0040*** (3.8)	0.0024*** (2.8)	0.0038*** (3.5)	0.0024*** (2.6)
White-collar workers (%)	--	0.0001 (0.43)	0.0001 (0.1)	0.0001 (0.4)	0.0001 (0.1)
Size (log)	--	0.0406*** (5.1)	0.0440*** (4.9)	0.0404*** (4.8)	0.0442*** (4.7)
Labor productivity (log)	--	0.0056*** (3.9)	0.0051*** (3.6)	0.0052*** (3.7)	0.0048*** (3.5)
Public ownership	-0.0018 (0.9)	-0.0090* (0.6)	-0.0077 (1.2)	-0.0089* (1.7)	-0.0082 (1.2)
Foreign ownership	0.1875*** (3.9)	0.2008*** (4.2)	0.1937*** (3.8)	0.2050*** (3.8)	0.1939*** (3.3)
Majority foreign ownership	--	--	--	0.0074 (0.2)	0.0168 (0.3)
Imports	0.0291* (1.1)	0.0217 (1.1)	0.0136 (0.6)	0.0072 (0.0)	0.0051 (0.1)
Import ratio	--	--	--	0.0005*** (3.6)	0.0004** (2.4)
Industry dummies	Included	--	Included	--	Included
Time dummies	Included	Included	Included	Included	Included
Number of plants	20,694	20,694	20,694	20,694	20,694
Number of observations	113,526	113,526	113,526	113,526	113,526
Wald-test (p-value)	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
m1 (p-value)	[0.00]***	[0.00]***	[0.00]***	[0.00]***	[0.00]***
m2 (p-value)	[0.69]	[0.68]	[0.67]	[0.54[	[0.53]

Note: t-statistics within brackets are derived from robust standard errors. *- significant at the 10 percent level, **- significant at the 5 percent level, ***- significant at the 1 percent level.

Table 7. Export determinants in Indonesian manufacturing 1990-2000. Dynamic probit estimations.

	(1)	(2)	(3)	(4)
Exports the previous year	0.568***	0.6194***	0.8582***	0.9326***
	(30.6)	(31.6)	(28.9)	(30.3)
Exports two years ago	--	--	0.4351***	0.4792***
			(15.8)	(16.5)
Electric power (log)	0.039***	0.0408***	0.0365***	0.0378***
	(7.9)	(7.7)	(6.3)	(6.2)
White-collar workers (%)	0.001	0.0007	0.0005	0.0005
	(1.2)	(1.2)	(0.8)	(0.7)
Size (log)	0.170***	0.1776***	0.1551***	0.1588***
	(10.6)	(10.3)	(8.0)	(7.7)
Labor productivity (log)	0.034***	0.0352***	0.0317***	0.0325***
	(4.3)	(4.2)	(3.4)	(3.3)
Public ownership	0.059	0.0638	0.1389	0.1429
	(0.6)	(0.6)	(1.2)	(1.2)
Foreign ownership	0.354***	0.3748***	0.326***	0.3394***
	(5.1)	(5.0)	(3.9)	(3.8)
Majority foreign ownership	-0.001	-0.0024	-0.0207	-0.0262
	(0.0)	(0.0)	(0.3)	(0.3)
Imports				
	0.073***	0.0785***	0.0564*	0.0599*
Import ratio	(2.6)	(2.6)	(1.7)	(1.7)
	0.001	0.0008	0.0007	0.0006
	(1.6)	(1.4)	(1.1)	(1.0)
Industry dummies	--	Included	--	Included
Time dummies	Included	Included	Included	Included
Export in 1990	1.051***	0.8823***	0.9025***	0.7229***
	(34.0)	(29.1)	(29.5)	(24.1)
$\mathbf{z}_i = (\mathbf{z}_{i1},...,\mathbf{z}_{it})$	Included	Included	Included	Included
$\rho=\sigma^2/(\sigma_\alpha^2+\sigma^2)$	0.525	0.4492	0.4345	0.3515
	(49.7)	(40.8)	(32.0)	(25.5)
Number of plants	7,439	7,439	7,439	7,439
Number of observations	74,390	74,390	66,951	66,951
Log likelihood	-18,411	-17,970	-16,538	-16,091

Note: t-statistics are within brackets. *- significant at the 10 percent level, **- significant at the 5 percent level, ***- significant at the 1 percent level.