Productivity and International Market Linkages of Indonesian Plants:

Evidence from Matched Samples

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ABSTRACT

This paper empirically investigates and compares the effects of establishing different foreign contacts on plant productivity in the case of Indonesia. Indonesia presents an interesting setting for research on productivity effects of international linkages since it is a large developing country with great economic achievement through economic liberalization in the past two decades. Methodologically, I approach this question in three steps. In the first step, I estimate a production function to obtain a measure of plant productivity using Olley-Pakes' semiparametric approach. This approach corrects for the selection and simultaneity biases in the estimates of the input coefficients required to construct a productivity measure. In the second step, I control the plant characteristics through matched sampling techniques to establish a proper comparison group for each channel of foreign contact. By balancing the relevant pretreatment plant characteristics of the control and treated groups, this approach resolves the constraint of standard linear regression that assumes the same linear relationship between each control variable and the outcome variable for all observations. In the third step, I apply nonparametric difference-in-differences (DD) model and panel data regressions on the matched samples. Using plant-level panel data on Indonesia manufacturers (1993-2001), I find that there is evidence of within plant productivity improvements though foreign ownership only. Exporting or importing does not improve productivity at plant levels, lending support to the self-selection hypothesis.

1. Introduction & Motivation

In the past two decades, many developing countries liberalized their trade and investment regimes, aspiring to acquire advanced technologies and improve productivities at home through more foreign contacts. Foreign contacts could be established through various channels, such as exporting, importing, and foreign ownership (FDI). This raises the policy issues as to whether foreign contact is an effective way to boost productivities, and if so, which channel is more effective. Most of existing studies focus on the effects of one channel, possibly picking up unidentified effects from other channels and produce misleading results. That is what motivates this research. This study aims to shed more light on policy-making and eliminate possible biases from previous studies by taking account of productivity effects from different channels and their interactions.

Previous studies estimate productivity effects of an international linkage by including a dummy variable indicating the linkage (such as exporting) in regressions explaining productivities. The estimated coefficient is taken as the productivity effects of this particular channel. This estimation strategy assumes there is no change in other channels of foreign contacts over time. More importantly, it also implicitly assumes homogeneity across the distributions of explanatory variables between plants with foreign contacts and plants without, and assumes rather than establishes causality. The resulting estimates may confound productivity differences arising from foreign contacts with those from other factors. In this research I tackle this issue by applying propensity score matching to construct control plants that best represent the treated plants (with an international linkage) had they not established the international linkage. The causal inference could be conducted by obtaining differences in productivity between plants with international linkages and the matched plants without international linkages. The long-time span of the dataset provides me with rich information about plants before they establish international linkages, which greatly facilitates the matching and comparisons.

The theoretic literature offers conflicting predictions about how productivity evolves following the establishment of an international linkage. On one hand, trade could act as a conduit for technology diffusion and hence a channel for productivity improvements. Studies on importing and productivity include Amiti & Konings (2007) and Kasahara & Rodrigue (2008), and studies on exporting productivity include Clerides et al (1998), Bernerd & Jensen (1999), Aw et al (2000), Van Biesebroeck (2005) and Blalock and Gertler (2004). Similar knowledge transfers may occur when foreign firms acquire domestic firms. Lipsey and Sjoholm (2005) provide an excellent survey on this. However, how well these different channels of technology diffusion perform, especially in a developing country, is still questionable. Eaton and Kortum (1996) models how innovation benefits spread from one country to another either through diffusion of technology or through exchange of goods. They find that the impact of knowledge diffusion on productivity depends crucially on the proximity of a country to the technology source and the flexibility of the domestic labor force. Lipsey and Sjoholm (2005) also discuss the impact of host countries' technology gap and human resources on productivity spillovers in case of foreign direct investment.

Many empirical papers reviewed in the next section have investigated the relationship between engaging international activities and productivity at micro level, but the questions remain far from settled. Tybout (2003) gives a comprehensive survey of this issue. This paper makes several contributions to the literature. First, it goes beyond one-channel studies by explicitly considering all three channels of foreign contacts. Most of the work focuses on one single channel except a series of papers by Yasar and Paul (2007, 2008). Emphasis on one channel could produce misleading conclusion as different ways of foreign contacts are more likely to bundle together (Kraay et al, 2002). Furthermore, the account of multiple channels makes it possible to study the interaction of different channels. Take foreign ownership as an example. Plants that have no foreign contacts initially and are acquired by foreigners later could be compared to plants that do not have foreign contacts within the sample period. Plants that are exporters from the beginning and become foreign-owned exporters later could be compared to plants that are always exporters. Similar comparisons could be done for importing and foreign ownership, and for other channels of foreign contacts. This would lead to a more comprehensive conclusion as to whether one particular channel of foreign contacts could improve productivities. The second contribution of the paper is the procedure for appropriately controlling the observed plant characteristics through matched sampling. The empirical research has consistently shown that plants with and without foreign contacts differ substantially from each other in many characteristics (table 3). An additive regression equation applied to the entire sample essentially controls covariates by forcing the same linear relationship on plants with and without foreign contacts. The matching methods have been shown to reduce these confounding variable biases (Rosenbaum & Rubin 1984;

Heckman et al. 1997) by balancing the relevant pre-foreign-contact plant characteristics for plants with some foreign contacts and those without. The last contribution is the combination of propensity score matching with model-based regression adjustments. Although an extensive list of plant characteristics have been matched, biases may still exist due to many observed covariates or incomplete controls. Rubin & Thomas (2000) illustrates that combining propensity score matching with regression adjustment effectively reduces the biases. To my best knowledge, this approach has not been applied to the literature on productivity and foreign contacts.

In order to obtain a measure of plant-level productivity I estimate a production function using Olley-Pakes' semiparametric approach. This approach models the plant efficiency as an unobserved plant specific effect and corrects for the selection and simultaneity biases in the estimates of the input coefficients required to construct a productivity measure. I modify the standard Olley-Pakes approach to take into account more state variables in addition to capital, such as three channels of foreign contacts. Therefore, the plant-level productivities yielded are functions of foreign contacts and could be used for further analysis.

The main findings of this study are that foreign ownership improves productivities when plants initially do not have any foreign contacts, and the increase in plant efficiency starts from the year of foreign acquisition and continues within three year of the acquisition. However, for exporters and importers, the foreign acquisition does not improve productivities at least within three years of the ownership change. Additionally, exporting, or importing, does not boost productivities by itself.

The rest of the paper is organized as follows. Section 2 provides an overview of the empirical issues, and reviews previous work in this area. Section 3 introduces the empirical estimation strategy. Section 4 looks at data and summary statistics. Section 5 discusses the estimation results. Section 6 concludes.

2. Previous Studies and Empirical Issues

Most of studies focus on one channel of foreign contacts and there is no general agreement as to whether the establishment of foreign contacts could improve productivities for any of the three channels. There are two primary hypotheses about how plant productivity is related to international linkages. The first suggests that more productive firms self-select into, say, export markets, because their characteristics make them better able to deal with the costs and complexities of international markets. The second is that the establishment of foreign contacts could enhance productivities through learning effects as domestic plants could gain exposure to state-of-the-art technology and managerial skills from their international counterparts.

Most empirical studies of export-productivity relationships support the self-selection hypothesis (Bernard and Jensen 1995 and 1997, Clerides et al., 1998, Aw et al., 2000, Delgado et al., 2002). Other studies find learning-by-exporting (Van Biesebroeck, 2005, Blalock and Gertler 2004, Bigsten et al 2004). The empirical studies of foreign ownership and productivity relationship mostly focus on productivity spillover (Blalock and Gertler 2008, Blomstrom and Sjoholm 1999, Aitken and Harrison 1999), except for Arnold and Javorcik (2005), in which they find that foreign acquisition could improve productivities. Comparatively speaking, there are fewer studies on the relationship between importing and productivities. Kasahara and Rodrigue (2008) find evidence that becoming an importer of foreign intermediates improves productivity in case of Chile. A related study by Amiti and Konings (2007) finds that input tariff reduction leads to improved productivities for importing plants in case of Indonesia, though this does not necessarily imply that importing by itself would improve productivities.

Most of literatures on international market linkages and productivity involve two steps. First, productivity is estimated using index numbers or is estimated econometrically using production functions. Subsequently, productivity estimates are regressed on a set of dummy variables characterizing the dynamics of a plant's foreign contacts. The first approach has been adopted in the studies of exporting and productivity such as Bernard and Jensen (1999) and Aw, Chung, and Roberts (2000). The index number productivity measure has the advantage that no estimation is required, but as Van Biesebroeck (2003, 2004) illustrated, the index number measure is less robust to measurement error than econometric productivity estimates, which could be a concern for data from a developing country with a high level of corruption like Indonesia. More importantly, I am interested in investigating and comparing how plant efficiency evolves over time in response to the establishment of different channels of foreign contacts. The relatively stable foreign ownership prevents me from tackling this issue by exploiting the dynamics of foreign contacts as Bernard & Jensen (1999) did on exporting.

Alternatively a number of studies obtain the productivity measure by estimating a production function and the productivity effects of an international linkage is estimated by including a dummy variable indicating the linkage (such as exporting) in the estimation of production functions (Blalock and Gertler 2004, Van Biesebroeck 2005, Yasar and Paul 2007). The estimated coefficient on the linkage dummy variable is taken as the productivity effects of this particular channel. Although this approach improves the productivity measures, it cannot be employed in the research of comparing productivity effects of different foreign contacts. Most of the literatures focus on one or two channels and could result in omitted variable bias. Even when all three channels are considered as in Yasar and Paul (2007), conclusions based on the coefficients on individual channels have a few limitations. It only gives the productivity effects of one particular channel, say foreign ownership, given the state of the other two channels (exporting and importing), but it cannot reveal how different channels are interacted. Kraay et al (2002) shows that different channels of foreign contacts are more likely to bundle together, and thus there could be some interactions among different channels. Furthermore, this approach does not control other plant characteristics. A number of studies have documented that exporters or foreign-owned plants are different from their domestic counterparts (Bernard and Jensen 1999, Yasar and Paul 2007). Without controlling plant-specific characteristics, the results could pick up effects from other unidentified factors.

3. Estimation Strategy

3.1 Productivity

To determine the effects of foreign contacts and international linkages, I consider a plant with Cobb-Douglas production function:

$$\begin{aligned} y_{it} &= \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + e_{it} \\ e_{it} &= \omega_{it} + \mu_{it} \end{aligned} \tag{1}$$

where y_{it}, l_{it}, m_{it}, k_{it} are gross output, labor, materials, and capital used by plant i at time t. All the variables are in logarithms so that the coefficients on inputs are interpreted as elasticities. Plant specific term e_{it} is a function of a plant-specific efficiency ω_{it} known by the plant but not by the econometrician, and an unexpected productivity shock μ_{it}. In this framework, any plant-level productivity measure relies on the difference between a plant's actual output and the predicted output. Thus it is crucial to obtain consistent estimates of the coefficients on input variables in the production function. However, as the unobservable productivity shock, ω_{it}, is known to the plants, it could affect the plants' choice of input levels, resulting in simultaneity biases. OLS estimates yield inconsistent estimates in this situation. And the input variables are likely to be correlated positively with the error term. This results in an upward bias of the coefficients on the input variables, like labor and material, under OLS.

The semi-parametric estimator from Olley and Pakes (1996) overcomes the simultaneity biases in the estimation of production function and it also controls for endogenous exit from the sample, which is assumed to occur when productivity falls below a threshold. In particular, Olley and Pakes (1996) argue that plants with more capital, such as plants with foreign contacts, are likely to weather greater reductions in productivity, making the exit threshold a decreasing function of capital. The underlying approach uses investment as a proxy for these unobservable productivity shocks. The investment function, $i_t = I_t(k_t, \omega_t)$, is assumed to be monotonically increasing in productivity (ω_t) for any given level of capital. Inverting the investment function gives an expression for productivity as a function of capital and investment:

$$\omega_{it} = I_t^{-1}(i_t, k_t) = \theta_t(i_t, k_t) \tag{2}$$

Substituting productivity function (eq. 2) into production function (eq. 1) allows estimation of the input coefficients using nonparametric techniques. In the first step, the coefficients on labor and materials are recovered using nonparametric techniques, controlling for the dependency on investment and capital. In the second step, the plant's probability of staying in the market is obtained using a probit regression. In the third step, coefficient on the state variables, capital, is recovered through semiparametric nonlinear least squares estimator.

For current application, I modify the Olley-Pakes approach to take into account more state variables in addition to capital, such as three channels of foreign contacts. Plants with foreign contacts might choose a different investment level and have a different exit rule, even controlling for capital stock and productivity, because they face different factor markets and different market prospects. Hence, the investment function becomes $i_t = I_t(k_t, \omega_t, EXP_t, IMP_t, FDI_t)$ and the inversed productivity function becomes $\omega_{it} = I_t^{-1}(i_t, k_t, EXP_t, IMP_t, FDI_t) = \theta_t(i_t, k_t, EXP_t, IMP_t, FDI_t)$. Plug it into the production function (eq. 1) gives a partial linear model:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \theta_{it}\left(i_{it}, k_{it}, EXP_{it}, IMP_{it}, FDI_{it}\right) + \mu_{it}$$

The estimation algorithm is the same as before. I use a series estimator with a fourth-order polynomial in investment, capital, and three channels of foreign contacts to obtain the consistent estimates of input coefficients on labor and capital in the first step. The subsequent steps are conducted similarly with the addition of channels of foreign contacts.

Using the estimates of the input coefficients from the Olley-Pakes methodology, the log of productivities of plant i at time t, denoted by pr_{it}, as

$$pr_{it} = y_{it} - \hat{\beta}_0 - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it} - \hat{\beta}_k k_{it} \qquad (3)$$

It is important to take account of all the channels in estimating productivities since each of them could have its own way to affect input choices and the omission could result in biased estimates of input coefficients. Now the estimated plant-level productivities are a function of foreign contacts and further analysis could be carried out with consideration of their interactions. I estimate productivities at the plant level for each group of plants that operate in the same sector, defined at the three-digit level of ISIC. All our variables are deflated using four-digit price deflators (see the appendix for details on deflators). In order to verify that the results are not driven by the methodology of estimating productivities, I also use labor productivity, proxied by value added per employee, as a robustness check.

The estimated input coefficients are reported in table 1. The OLS estimates are included for comparison. Since OLS does not adjust the positive correlation between input choice and the productivity shocks known to the plants, the labor and material coefficients are overestimated with OLS. However, it is ambiguous as to the OLS estimates of the capital coefficients. If more productive plants are more likely to invest more in capital, then OLS gives a higher estimate of capital coefficient. But firms with larger capital stocks can continue in operation at lower ω_t realizations. The endogenous exit implies that, productivity shock, ω_t, conditional on the surviving plants is a decreasing function of capital, yielding a downward bias on the coefficient on capital (Olley and Pakes 1996). The results in table 1 confirm these theoretical predictions.

Table 2 compares the productivities of the plants with different dynamics of international linkages. In either measure of productivities, plants with any foreign contact have higher productivities compared to those with no foreign contacts at all. And plants with multiple channels of foreign contacts mostly have higher productivities compared to those with only one channels. This reveals the potential problem when estimating the productivity effects of one channel only (e.g. foreign ownership) since effects from other unidentified channels (e.g. exporting or importing or both) could accentuate the effects from the particular channel of interest (e.g. foreign ownership). Some studies resolve this issue by excluding plants with other channels of foreign contacts from the sample as a robustness check to make sure the estimated productivity effects come from the channel of interest (Amiti and Konings 2007, Arnold and Javorick 2005, Blalock and Gertler 2004). But the effects from one channel (e.g. foreign ownership) interact with those from other channels (e.g. exporting or importing) could also reveal interesting information to study.

3.2 Matched Sampling

Matched sampling is a method for selecting units from a large pool of potential controls of a reduced control group that has similar distributions of observed covariates to a treated group (Rosenbaum & Rubin 1985). In this research, the treatment is the establishment of some foreign contact and the control group includes the plants without that foreign contact. Regression analysis has been widely used to study the relationship between foreign contacts and productivities at industry or plant levels. However, the standard linear regression assumes the same linear relationship on all the explanatory variables for all observations. The empirical research has consistently shown that plants with and without foreign contacts differ substantially from each other in many characteristics. Thus the linear regression on the unmatched sample could result in an extended extrapolation across plants. The matching methods have been shown to reduce these confounding variable biases (Rosenbaum & Rubin 1984; Heckman et al. 1997) by balancing the relevant pre-foreign-contact plant characteristics for plants with and without foreign contacts.

Matching based on one specific variable would only balance one characteristic between plants with and without foreign contacts, but this does not help to eliminate biases due to disparities in other variables. The challenge is to find a composite score that encompasses all the plant characteristics that are deemed to be important both for the probability of establishing foreign contacts and for improving productivities at plant levels. Rosenbaum and Rubin (1983) propose the use of propensity scores to resolve the dimensionality problem of matching all the plants' characteristics. More specifically, propensity score collapses a vector of plant characteristics into a composite score representing the plant's probability of establishing foreign contacts based on observables. Then the composite score obtained could be used to match the treated and control plants using a number of matching methods including nearest neighbor or kernel matching.

In this research I construct the matched sample through finding the matched pair using logit model. For example, the effects of exporting are analyzed from three distinctive pairs: plants without foreign contacts vs. new exporting plants, always foreign plants vs. new foreign and exporting plants, always importing plants vs. new importing and exporting plants. The effects of other channels are conducted in a similar pattern.

As discussed in the next part, I study the productivity effects on the matched sample in two approaches with different emphases. In the first approach[1], I focus on the matched pairs that are between plants with one specific channel such as foreign ownership or exporting or importing and plants without any foreign contact at all. This is similar to other studies focusing on one channel of foreign contact, but this removes the potential biases from previous studies omitting the potential effects arising from other channels. In the second approach, I use the whole matched sample to include plants with multiple channels of foreign contacts. This improves the previous studies by exploiting the variations of productivity effects from the interactions of different channels.

[1] In the first approach, I attempted to construct a different matched sample using multinomial logit model. Each plant without any foreign contact could remain so, or become foreign-owned, or exporters, or importers. However, the fitted probabilities obtained are skewed to zero for non-base treatment, probably an indication of the failure of the strong assumption of independence of irrelevant alternatives required for multinomial logit model. As long as the plant characteristics are balanced after matching, it does not matter which method is adopted to obtain the propensities.

Nearest neighbor matching are employed. Nearest neighbor matching has the advantage of finding each treated units a match from control group, though I did impose the constraint that the treated units and the matched control units should be in the same year and same industry, which could result in some treated units unable to find matched control units. In either matched samples, the important diagnostic check for the effectiveness of the matching is the covariate balance within matched pairs (Rosenbaum & Rubin 1984). I apply the standardized differences (SDiff) and t-test to check the similarity of covariates distributions within the matched samples. In the standardized differences test, for each covariate, I take the average difference between the treated units and the matched control units and normalize it by the pooled standard deviation of the covariate in the treated and control samples. Based on Rosenbaum and Rubin (1985), the following measure is calculated:

$$SDiff\left(X_k\right)=100\frac{\frac{1}{n_t}\sum_{i\in t}X_{ki}-\frac{1}{n_c}\sum_{j\in c}X_{kj}}{\sqrt{\frac{Var_{i\in t}\left(X_{ki}\right)+Var_{j\in c}\left(X_{kj}\right)}{2}}}$$

where n_t is the number of plants with some foreign contact and n_c is the number of matched control plants. The drawback of this test is that, as noted in Smith and Todd (2005), there is no clear criterion for determining if a value of the standardized difference is too large. Rosenbaum and Rubin (1985) suggest that a value of 20 is large. The results of the test are presented in the results section.

3.3 Difference-in-differences (DD) and Regression Models

As explained above, two approaches have been applied to the matched samples with emphasis on individual channel of foreign contact and interactions of different channels respectively. In the first approach, only individual channels are considered and could be compared directly as to their effects on productivities. I apply nonparametric difference-in-differences (DD) model to the matched sample to obtain the productivity effects of one particular channel. Through matching, treatment and control groups are not statistically different in terms of observable characteristics, though there could be potential biases from the disparities between treatment and control group due to unobserved variables. The DD estimator alleviates the issue by eliminating unobservable time-invariant differences. In the second approach, various pairs of multiple channels of foreign contacts are constructed through matching. Although this research attempts to match on and control for a range of variables that could correlate with a plant's productivities, biases could still exist due to incomplete controls. This problem is addressed by using a panel data regression method (Rubin and Thomas, 2000). The formal regression models are estimated for each channel on the matched pairs.

In particular, the DD estimator is obtained in the following way:

$$DD = E\left(pr_{1,t^{'}+n} - pr_{1,t^{'}} \middle| X\right) - E\left(pr_{0,t^{'}+n} - pr_{0,t^{'}} \middle| X\right)$$

Suppose $pr_{1,t^{'}+n}$ represents the productivity of treated group n years after receiving treatment, and $pr_{0,t^{'}}$ represents the productivity of control group at $t^{'}$ a time period before treatment. This framework relies on the assumption that conditional on observables X, the potential unobserved bias stays the same over different time periods before and after the treatment. This way differencing the differences between the treated and control units eliminates the bias. Applying this estimator on matched sample is effective in reducing the bias (Heckman et al. 1997). As to the number of years after treatment, productivity effects could start in the year of treatment especially in the case of foreign ownership (Arnold and Jovorcik 2005), though literatures on productivity and exporting mostly demonstrate that exporting itself does not boost productivities. In this research, I start with the year of treatment and focus on productivity effects within three years of treatment since exporting and importing are more dynamic and there are fewer plants that export, or import, for a long time period. Longer-span analysis would be handicapped by insufficient plants available.

Compared to the previous single-channel studies, which mostly use the dummy variable in the estimation of production function as the productivity effects of the channel, the DD estimators have several advantages. First, this methodology is nonparametric and imposes no functional form constraint. Second, it allows me to trace the performance trajectory following the establishments of foreign contacts rather than just estimating the average effects after treatment. Lastly, it allows me to conduct the analysis conditioned on any function of x, and hence I could estimate the productivity effects at different levels of x.

For the second matched sample, the formal regression models are estimated for different channels respectively:

$$pr_{i,j,t'+n} = \beta_0 + \beta_1 \times EXP_{i,j} + \beta_2 \times pr_{i,j,t'} + \beta_3 \times COVARIATES_{i,j} + \beta_4 \times YR_t + \varepsilon_{i,j,t'+n}$$

$$pr_{i,j,t'+n} = \beta_0 + \beta_1 \times FDI_{i,j} + \beta_2 \times pr_{i,j,t'} + \beta_3 \times COVARIATES_{i,j} + \beta_4 \times YR_t + \varepsilon_{i,j,t'+n}$$

$$pr_{i,j,t'+n} = \beta_0 + \beta_1 \times IMP_{i,j} + \beta_2 \times pr_{i,j,t'} + \beta_3 \times COVARIATES_{i,j} + \beta_4 \times YR_t + \varepsilon_{i,j,t'+n}$$

$EXP_{i,j}$ refers to exporters when compared to plants with always no foreign contacts, foreign-owned and exporters when compared to always foreign owned plants, and importers and exporters when compared to always importers. $FDI_{i,j}$ refers to foreign-owned plants when compared to plants with always no foreign contacts, foreign-owned and exporters when compared to always exporters, and importers and foreign-owned when compared to always importers. $IMP_{i,j}$ refers to importers when compared to plants with always no foreign contacts, foreign-owned and importers when compared to always foreign-owned plants, and importers and exporters when compared to always exporters. $pr_{i,j,t'+n}$ is the productivity of each plant j of pair i in the reduced sample in year $t'+n$ (n years after treatment). β_0 is the pair-specific effects[2]. $COVARIATES$ refers to a vector of control variables. The approach improves previous studies by exploiting the interacting effects of different channels.

4. Data and Preliminary Results

Indonesia provides an interesting setting for research on productivity effects of international linkages. It is a large developing country with great economic achievement through economic liberalization in the past two decades and it provides rich micro datasets over a long time span. The World Bank classified it as one of the seven East Asian 'miracle economies' (Basri and Hill 2008).

[2] Pairwise fixed effects have also been experimented similar to Qian (2007) as follows.

$$pr_{i,j,t'+n} = \beta_{0,i} + \beta_1 \times EXP_{i,j} + \beta_2 \times pr_{i,j,t'} + \beta_3 \times COVARIATES_{i,j} + \beta_4 \times YR_t + \varepsilon_{i,j,t'+n}$$

This allows for heterogeneity across pairs, but as dummy variable regression, the coefficients on pair dummy variables are not consistent since more degrees of freedom are lost when more pairs are added. And in a few dynamic studies, there are no enough observations to include the pair fixed effects.

The main data source is from the Manufacturing Survey of Large and Medium-sized Firms (Survei Industri, SI) from 1993 to 2001. The data are from an annual survey of manufacturing establishments with more than 20 employees. This survey provides a large number of variables including ownership, exports, imports, outputs, inputs, etc. Additionally, industry wholesale price indices (WPI) are used to deflate plant-level output. These are published in the Monthly Statistical Bulletin of Economic Indicators (see the appendix for details on deflators).

The production function is estimated by using the information on output and three factors of production: the number of workers, materials and capital. The capital stock is measured by the replacement value of fixed assets with the year 1996 missing. I interpolated the capital stock for the year 1996 using the 1997 and 1995 values. Since the data contain no information on physical quantities of inputs used or output produced by plants, I have to deflate the nominal values using a set of wholesale price indices for manufactured commodities (see the appendix for details on deflators).

The data have been cleaned to remove large unrealistic numbers and estimate some missing values. The cleaning process is described in the appendix. In the end, I have an unbalanced panel of at least 11,000 plants per year with a total of 127,918 observations. I characterize each plant in terms of the dynamics of its international linkages, as always exporting, importing to exporting, foreign ownership to exporting, etc. As table 3 demonstrates, almost half of the plants are plants with no foreign contacts at all during the sample period, providing a vast pool for selecting control units when plants with no foreign contacts serve as the control group. In general, there are more plants available when only one channel is available. But plants with multiple channels available could provide more evidence for the analysis of productivity effects. Given the fact that there are almost 35,000 plants available over the sample period, there is sufficient information available for more disaggregated study.

Table 3 shows that exporting or importing is the main channel for foreign contacts. Compared to the plants with no foreign contacts at all, plants with any foreign contact in general hire more employees and more white-collar workers, and are more capital-intensive. However, for plants with changes in international linkages, the average descriptive statistics could give a bias picture since it is not clear whether plants possess these characteristics before or after they set up the new foreign contact. This is the issue that would be tackled in the next section. The general picture is that plants with foreign contacts are different from those without. The distinctive characteristics of the plants with foreign contacts render the standard linear regression analysis limited as it assumes the same linear relationship between each control variables and the outcome variable for all observations. Matched sampling provides an effective tool to this problem as a proper comparison group for each channel of foreign contact could be established through balancing the relevant pretreatment plant characteristics of the control and treated groups.

In the sample matching, the variables used for obtaining propensity scores include age, employment, employment squared, ratio of white-collar workers, capital intensity, energy intensity, raw materials per employee, and productivity. Except for age and ratio of white-collar workers, all the variables are in logs. The effects of age on the probabilities of establishing foreign contacts are unclear. On one hand, older plants are more likely to be known to foreigners and thus easier to establish foreign contacts, but on the other hand, older plants tend to have more bureaucracies making it harder to have foreign contacts. Most of previous empirical studies show that age has a negative effect on the probabilities of establishing of foreign contacts. Employment is used to control the size of the plants and squared employment in the model allows for the nonlinear effects of employment on the probabilities of foreign contacts. The ratio of white-collar workers captures the structure of labor force at a plant level. Other variables are used to proxy the production technology and industry characteristics of the plants. Time fixed effects are used in the estimation. This study uses t-1 information to obtain the propensity scores, though using earlier information would not change the results.

5. Results

5.1 Matched Samples

The results from fitting logit model to each pair of treated and control unit are shown in table 4. In most cases, age is negatively related to the probabilities of establishing foreign contacts, while employment and capital intensity are positively related. A number of control variables are significant in most equations, indicating that the plants with foreign contacts are systematically different from their corresponding control units. Productivity at one period before establishing foreign contact has been used to control the selection bias. It does not always appear to be significant probably due to high correlation with other variables.

Next I carry out nearest neighbor matching with replacements to match the treated and control units based on the propensity scores obtained above. I explicitly control the matched control units coming from the same year and same industry as the treated units. To assess how balanced this matched sample is, I conducted two balancing tests for all the control variables in the logit model. Table 5 to table 7 provides the balancing results for each single channel of foreign contact when compared to plants that do not have any foreign contact during the sample period. More balancing results on each pair could be found in the Appendix table A1 to table A6. Comparing the SDiff and t-statistics of the covariates in the matched and unmatched samples, it can be clearly seen that the covariates are much for balanced after matching.

5.2 DD on Matched Samples

Comparing plants of one channel of foreign contact with those of no any foreign contacts within the matched sample, I applied the nonparametric difference-in-differences model as in Heckman et al (1997). Table 8 shows the results. In Olley-Pakes estimates, foreign ownership appears to have positive effects on productivity in the year of foreign acquisition, though the effects disappear in the following two years. There is no evidence that exporting or importing boosts productivities within two years of starting to export or import. To verify that the results are not being driven by imprecisely measured capital stock, I also report estimates based on labor productivity. Similarly, there is some evidence that foreign ownership enhances productivities, though in the year following foreign acquisition in this case. And there is still no evidence of productivity effects of exporting, but importing appears to improve productivities starting from the year of foreign contact and the importing plants could maintain their productivity advantages in the following two years. This is similar to findings in Amiti and Konings (2007). They used a similarly defined labor productivity to ensure their results from using Olley-Pakes TFP are robust, and the estimated productivity effects of tariff reduction on raw materials are higher when labor productivity is used than when TFP is used.

The DD model relies on the assumption that the unobserved shocks are the same before and after the treatment for the treated and control groups. This could be a restrictive assumption given the fact that the treatment in this research is plant-level different from program evaluation literatures. Next I apply the panel data regression method on the matched sample to verify the results from DD model.

5.3 Regression on Matched Samples

I carried out regression analyses on the matched sample following models specified in section 3.3. Specifically, the year of foreign contact, one year forward, two years forward, and three years forward are used to track the trajectory of productivity improvements. All the equations include year fixed effects and the errors have been corrected for heteroskedasticity at pair levels.

Table 9 to table 11 present the results on the productivity effects of foreign ownership. Similar to the results from DD model, table 9 demonstrates that compared to plants with no foreign contacts at all, foreign ownership boosts productivities starting from the year of foreign acquisition and remains so until three years afterward. On average, in the year of foreign acquisition, the productivities of plants that are acquired by foreigners have 20 percentage points ($\left(e^{\hat{\beta}_{fdi}} - 1\right) * 100 = \left(e^{0.184} - 1\right) * 100 = 0.2$) higher than their matched plants without foreign ownership, after controlling the productivity differentials in one period before. Over time, the productivity advantages increase to 75 percentage points higher two years after foreign acquisition and have tripled three years after, though the number of plants remains solely foreign-owned decreases over time. Table 9 also suggests that the productivity effects of foreign ownership among exporters and importers are not clear, though both suffer from the limited size of sample. Foreign ownership is a rare phenomenon among plants. In general, 1.6% of observations have foreign ownership and slightly more have different combinations of foreign contacts including foreign ownership.

Table 10 gives the results on productivity effects of exporting. Consistent with findings from DD model, there is no evidence supporting the productivity effects of exporting, though there are some productivity effects three years after starting to export. This lends support the select-selection hypothesis (Bernard and Jensen 1999, Clerides et al 1998, Aw et al 2000), though Blalock and Gertler (2004) find support to the learning effects of exporting using a similar dataset on Indonesia. A number of reasons could have accounted for the differences in conclusions. Firstly, they excluded foreign-owned plants from their sample, but did not take into account of importing. Secondly, their analysis does not distinguish the trajectory of productivity effects following exporting. Thirdly, they use unmatched sample for the time period of 1990-1996 only.

Table 11 records the results on productivity effects of importing. There is no evidence that importing boosts productivities among plants with no foreign contacts, or foreign-owned, or exporters. The coefficients on importers are not significant at 10% level, though the sample size on foreign-owned and importing is very limited.

The seemingly unrelated regression (SUR) procedures have been experimented for the estimation. The results are robust. Since SUR puts more restraints on the sample size, the results are not reported and are available upon request. Additionally, I use normal regression model as a robustness check. The results are in the appendix (table A7 to table A9). Foreign ownership has positive effects on productivities among plants with no foreign contacts and importers. Exporting improves productivities three years after starting to export, compared to plants with no foreign contacts. And exporting does not have productivity effects among foreign owned plants and importers. There is some evidence that importing boosts productivities among exporters only. In general, more control variables are significant in the regressions on unmatched samples, indicating the systematic differences between treated and control units.

6. Conclusion

This paper investigates the relationship between international market linkage and productivity at plant levels. It addresses the question as to whether foreign contacts could improve productivities, and if so, which channel of foreign contacts has proven most effective. There are a number of empirical issues involved in related studies: consistent estimation of productivities, plant heterogeneity, and causality estimation on whether foreign contacts have an impact on productivities. Olley-Pakes measure of productivities have been employed to correct for simultaneous biases, endogenous exit, and endogenous entry into international market. As to the systematic differences among plants with and without foreign contacts, propensity score matching has been used to construct a matched sample. This helps the causality estimation later since it alleviates the biases arising from different characteristics of treated and control plants.

This research finds evidence that foreign ownership improve productivities relative to plants with no foreign contacts at all, and the improvement starts from the year of foreign acquisition and becomes stronger in the following three years. However, to exporters, or importers, foreign acquisition does not appear to boost productivities. In addition, there is no evidence that exporting, or importing, could enhance productivities over the short run. This lends support to the self-selection hypothesis.

For future research, a further comparison study could be carried out as to why exporting or importing fails to improve productivity. Various hypotheses could be tested including interacting foreign contact indicators with plant-level characteristics to find out whether some characteristics are related to changes in productivities, and experimenting different levels of key variables such as employment when combining DD on matched samples.

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Table 1: Estimates of Production Functions

Industry	Labor		Materials		Capital	
	OLS	OP	OLS	OP	OLS	OP
Food products (311)	0.363	0.337	0.670	0.674	0.119	0.060
Food products, nes (312)	0.419	0.349	0.458	0.435	0.244	0.100
Beverages (313)	0.879	0.688	0.315	0.231	0.272	0.134
Tobacco (314)	0.286	0.239	0.795	0.756	0.074	0.008
Textiles (321)	0.438	0.336	0.535	0.522	0.164	0.060
Clothing (322)	0.471	0.369	0.537	0.562	0.110	0.049
Leather goods, nes (323)	0.395	0.276	0.623	0.644	0.107	0.010
Leather footwear (324)	0.451	0.370	0.556	0.573	0.073	0.023
Wood and cork, except furniture (331)	0.342	0.285	0.620	0.612	0.097	0.029
Furniture (332)	0.390	0.383	0.595	0.572	0.082	0.016
Paper and paper products (341)	0.299	0.270	0.670	0.636	0.104	0.037
Printing, publishing, and allied industries (342)	0.511	0.375	0.551	0.536	0.093	0.048
Industrial chemicals (351)	0.254	0.301	0.537	0.394	0.278	0.095
Other chemical products (352)	0.445	0.482	0.586	0.479	0.143	0.127
Rubber products (355)	0.270	0.238	0.661	0.647	0.077	0.081
Plastic products, nes (356)	0.318	0.231	0.640	0.642	0.117	0.039
Pottery, china and earthwear (361)	0.332	0.296	0.605	0.520	0.148	0.066
Glass and glass products (362)	0.517	0.385	0.621	0.556	0.082	0.132
Cement (363)	0.432	0.313	0.666	0.623	0.104	0.070
Clay products (364)	0.554	0.517	0.407	0.390	0.178	0.091
Other nonmetallic mineral products (369)	0.463	0.333	0.558	0.536	0.179	0.168
Iron and steel industries (371)	0.358	0.292	0.692	0.735	0.072	0.023
Nonferrous metal basic industries (372)	0.404	0.253	0.598	0.489	0.172	0.176
Fabricated metal products, except machinery (381)	0.349	0.264	0.639	0.619	0.108	0.019
Nonelectrical machinery (382)	0.414	0.313	0.563	0.530	0.175	0.088
Electrical machinery (383)	0.308	0.293	0.661	0.646	0.125	0.120
Transport equipment (384)	0.448	0.383	0.577	0.530	0.142	0.052
Professional, scientific, and equipment (385)	0.572	0.372	0.582	0.514	0.098	0.082
Miscellaneous manufacturing (390)	0.492	0.451	0.511	0.446	0.118	0.106

Table 2: Average Productivities of Indonesian Plants by International Linkages, 1993-2001

Dynamics of International Linkages	Olley-Pakes	Value-added/Employment
Always IMP	1.07	1.09
Always FDI	1.24	1.21
Always EXP	1.06	1.03
None → EXP	1.06	1.06
IMP → IMPEXP	1.15	1.15
FDI → FDIEXP	1.07	1.16
None → IMP	1.07	1.08
FDI → FDIIMP	1.25	1.25
EXP → EXPIMP	1.15	1.12
None → FDI	1.11	1.10
IMP → IMPFDI	1.22	1.23
EXP → EXPFDI	1.03	1.13
Always None[1]	1	1

Note: 1. "Always None" refers to the plants that do not have any foreign contacts in the sample period. This group serves as the base for comparison.

Table 3: Summary Statistics by Dynamics of International Linkages, 1993-2001

Dynamics of International Linkages	No of Plants (% of Total)	Employment	Capital (per worker)	Ratio of White-collar Workers
Always IMP	3.82	2.4	1.9	1.6
Always FDI	0.27	2.1	4.1	1.9
Always EXP	1.25	2.5	1.2	1.1
None → EXP	8.11	4.0	1.9	1.3
IMP → IMPEXP	2.15	12.9	3.9	1.4
FDI → FDIEXP	0.42	6.2	3.9	1.6
None → IMP	3.72	3.2	2.4	1.4
FDI → FDIIMP	0.21	5.4	4.9	2.0
EXP → EXPIMP	0.80	11.0	2.0	1.2
None → FDI	0.34	3.2	3.8	1.5
IMP → IMPFDI	0.18	6.7	5.5	2.0
EXP → EXPFDI	0.11	5.7	1.4	1.2
Always None[1]	49.23	1	1	1

Note: 1. "Always None" refers to the plants that do not have any foreign contacts in the sample period. This group serves as the base for comparison.

Table 4: Pair-wise Logit Model: Propensity Scores

	Effects of FDI			Effects of EXP			Effects of IMP		
	Non → FDI	IMP → IMPFDI	EXP → EXPFDI	Non → EXP	IMP → IMPEXP	FDI → FDIEXP	Non → IMP	FDI → FDIIMP	EXP → EXPIMP
Age	-0.039**	-0.066**	-0.121**	-0.043***	-0.022***	-0.023	0.006	-0.037	0.050***
	[0.019]	[0.027]	[0.047]	[0.003]	[0.007]	[0.023]	[0.005]	[0.031]	[0.016]
Employment	0.725	4.320***	1.881	1.771***	2.033***	-2.227	1.150***	-4.352**	1.562**
	[0.666]	[1.442]	[1.341]	[0.135]	[0.280]	[1.522]	[0.205]	[1.845]	[0.638]
Employment Squared	-0.013	-0.373***	-0.122	-0.088***	-0.099***	0.304**	-0.061***	0.480***	-0.071
	[0.066]	[0.139]	[0.128]	[0.013]	[0.025]	[0.152]	[0.021]	[0.181]	[0.057]
Ratio of White-collar Workers	0.715	-1.358	2.985**	0.057	-2.381***	-0.967	0.480**	2.364**	-1.011
	[0.656]	[1.007]	[1.344]	[0.147]	[0.345]	[0.935]	[0.203]	[1.004]	[0.866]
Capital Intensity	0.267***	0.589***	0.328*	0.058***	0.088**	-0.354***	0.234***	0.277*	0.218**
	[0.096]	[0.131]	[0.191]	[0.018]	[0.038]	[0.117]	[0.027]	[0.167]	[0.085]
Raw Materials	0.136*	0.148	0.539***	0.178***	0.099***	0.030	0.064***	0.224	0.200**
	[0.079]	[0.113]	[0.189]	[0.016]	[0.036]	[0.114]	[0.024]	[0.139]	[0.082]
Energy Intensity	0.067	0.081	-0.19	-0.029**	0.018	0.114	0.094***	-0.068	0.066
	[0.075]	[0.121]	[0.148]	[0.014]	[0.033]	[0.110]	[0.022]	[0.127]	[0.073]
Productivity at t'	0.189*	-0.03	-0.551**	0.126***	0.024	-0.543***	0.05	-0.094	0.017
	[0.114]	[0.132]	[0.262]	[0.023]	[0.045]	[0.125]	[0.034]	[0.131]	[0.117]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of Observations	43,734	3,952	582	39,933	4,161	283	44,628	231	786
Chi-squared	106	95	51	3,396	1,129	104	732	35	265
Pseudo R-squared	0.093	0.194	0.2097	0.1788	0.2803	0.2664	0.0787	0.1424	0.2823

Regression is carried using the information at one period before the foreign contact. Robust standard errors are in the brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01

Table 5: Balancing Test between Always None and None-->FDI

Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
		Means				t-test
Age	Unmatched	9.56	11.34	-25.54		-2.27
	Matched	9.56	9.73	-2.50	90.2	-0.17
Capital Intensity	Unmatched	8.33	7.45	58.02		5.75
	Matched	8.33	8.22	7.70	86.7	0.64
Employment	Unmatched	4.44	3.73	69.73		7.76
	Matched	4.44	4.45	-0.39	99.4	-0.04
Employment Squared	Unmatched	21.14	14.59	67.94		8.04
	Matched	21.14	21.23	-0.77	98.9	-0.07
Ratio of White-collar Workers	Unmatched	7.11	6.07	51.31		4.50
	Matched	7.11	6.91	10.53	79.5	0.92
Energy Intensity	Unmatched	7.69	6.98	48.65		4.26
	Matched	7.69	7.50	11.13	77.1	0.83
Raw Materials	Unmatched	4.30	3.97	29.85		2.96
	Matched	4.30	4.43	-10.27	65.6	-1.49
Productivity	Unmatched	0.20	0.13	43.03		4.30
	Matched	0.20	0.21	-3.96	90.8	-0.27

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table 6: Balancing Test between Always None and None-->EXP

Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
		Means				t-test
Age	Unmatched	10.43	11.34	-13.30		-6.54
	Matched	10.43	9.48	14.29	-7.4	5.61
Capital Intensity	Unmatched	7.68	7.46	15.66		8.03
	Matched	7.67	7.59	5.51	64.8	2.08
Employment	Unmatched	4.73	3.73	95.99		59.72
	Matched	4.73	4.67	5.46	94.3	5.19
Employment Squared	Unmatched	23.94	14.59	90.55		61.59
	Matched	23.90	23.14	6.24	93.1	5.38
Ratio of White-collar Workers	Unmatched	6.70	6.07	32.00		15.24
	Matched	6.70	6.65	2.59	91.9	1.04
Energy Intensity	Unmatched	7.61	6.98	41.56		21.11
	Matched	7.61	7.59	0.94	97.7	0.37
Raw Materials	Unmatched	4.19	3.97	22.56		11.04
	Matched	4.19	4.16	3.28	85.5	2.10
Productivity	Unmatched	0.16	0.13	17.01		9.00
	Matched	0.16	0.15	5.16	69.7	1.96

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table 7: Balancing Test between Always None and None-->IMP

Variables	Sample	Means: Treated	Control	SDiff	%reduct in Sdiff	t-test: t-stat
Age	Unmatched	11.83	11.34	6.92		2.17
	Matched	11.83	11.76	1.00	85.5	0.23
Capital Intensity	Unmatched	8.18	7.46	51.35		16.51
	Matched	8.18	8.22	-2.73	94.7	-0.80
Employment	Unmatched	4.42	3.73	69.68		26.12
	Matched	4.42	4.35	6.53	90.6	2.74
Employment Squared	Unmatched	20.87	14.59	65.61		26.57
	Matched	20.87	20.07	7.30	88.9	2.89
Ratio of White-collar Workers	Unmatched	7.07	6.07	52.56		15.09
	Matched	7.07	7.10	-1.67	96.8	-0.50
Energy Intensity	Unmatched	7.51	6.98	36.18		11.12
	Matched	7.51	7.53	-1.51	95.8	-0.40
Raw Materials	Unmatched	4.17	3.97	19.04		6.04
	Matched	4.17	4.11	5.71	70.0	2.53
Productivity	Unmatched	0.19	0.13	35.66		11.61
	Matched	0.19	0.19	-1.68	95.3	-0.41

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table 8: Estimated Effects of Foreign Contact on Productivity (ATT), Propensity Score Matching

	None → FDI		None → EXP		None → IMP	
	DD	Std. Error	DD	Std. Error	DD	Std. Error
Olley-Pakes						
Year of Foreign Contact	0.208**	0.099	0.002	0.015	0.017	0.023
One Year After Foreign Contact	0.091	0.103	0.000	0.018	0.035	0.031
Two Year After Foreign Contact	0.074	0.138	0.009	0.025	0.054	0.038
Labor Productivity						
Year of Foreign Contact	0.204	0.147	-0.015	0.024	0.100***	0.039
One Year After Foreign Contact	0.258*	0.156	-0.023	0.031	0.099**	0.046
Two Year After Foreign Contact	0.291	0.180	0.057	0.036	0.130**	0.051

Note: Bootstrapped standard errors. *=0.10, **=.05, ***=.01

Table 9: Productivity Effects of Foreign Ownership (FDI), Matched Samples

	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year
None → FDI	0.184**	0.291	0.562**	1.493***								
	[0.092]	[0.182]	[0.281]	[0.504]								
EXP → EXPFDI					0.016	0.151	0.364	0.548				
					[0.165]	[0.376]	[0.413]	[0.586]				
IMP → IMPFDI									0.238**	0.127	-0.197	-0.008
									[0.116]	[0.227]	[0.391]	[0.477]
Age	0.003	0.003	-0.018	-0.032	0.009	0.052	0.071	0.042	-0.002	-0.002	-0.028	-0.003
	[0.009]	[0.010]	[0.019]	[0.026]	[0.025]	[0.043]	[0.053]	[0.026]	[0.010]	[0.012]	[0.023]	[0.030]
Employment	-0.12	-0.791	-1.507*	0.77	-0.323	-1.065	-1.404	-1.389	-0.31	0.197	0.476	0.486
	[0.267]	[0.673]	[0.897]	[1.204]	[0.548]	[0.878]	[0.951]	[1.013]	[0.514]	[0.803]	[1.029]	[1.101]
Employment Squared	0.014	0.085	0.150*	-0.091	0.035	0.09	0.113	0.12	0.028	-0.015	-0.048	-0.044
	[0.027]	[0.067]	[0.087]	[0.124]	[0.051]	[0.074]	[0.081]	[0.094]	[0.049]	[0.074]	[0.094]	[0.106]
Ratio of White-collar Workers	0.016	0.401	-0.517	-0.569	0.419	-0.209	0.485	1.303	-0.142	0.969*	1.213	0.951
	[0.277]	[0.362]	[0.795]	[0.800]	[0.649]	[0.629]	[1.209]	[0.947]	[0.357]	[0.558]	[0.958]	[1.092]
Capital Intensity	0.036	-0.002	-0.004	0.046	0.319*	0.304	0.217	0.021	-0.007	0.011	-0.088	-0.048
	[0.028]	[0.056]	[0.130]	[0.151]	[0.167]	[0.178]	[0.198]	[0.096]	[0.044]	[0.056]	[0.097]	[0.097]
Raw Materials	0.017	0.012	0.022	0.031	-0.234*	-0.413	-0.645	-0.314	-0.003	-0.096	-0.003	-0.007
	[0.046]	[0.065]	[0.079]	[0.089]	[0.131]	[0.347]	[0.510]	[0.263]	[0.038]	[0.062]	[0.089]	[0.104]
Energy Intensity	-0.014	-0.005	0.026	-0.071	-0.024	-0.019	0.058	-0.048	-0.004	-0.021	-0.053	0.019
	[0.029]	[0.035]	[0.067]	[0.090]	[0.049]	[0.069]	[0.117]	[0.124]	[0.071]	[0.083]	[0.069]	[0.085]
Productivity at t'	0.842***	0.882***	0.821***	0.695***	0.619***	0.727***	0.767	1.084***	0.986***	1.024***	0.904***	0.707***
	[0.049]	[0.046]	[0.106]	[0.149]	[0.205]	[0.247]	[0.437]	[0.229]	[0.044]	[0.071]	[0.102]	[0.147]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of Observations	143	79	75	58	41	26	20	15	83	57	46	39
R-squared	0.82	0.87	0.66	0.53	0.72	0.79	0.80	0.99	0.89	0.89	0.79	0.79

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01

Table 10: Productivity Effects of Exporting (EXP), Matched Samples

	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year
None → EXP	0.020	0.006	-0.003	0.163*								
	[0.016]	[0.023]	[0.047]	[0.095]								
FDI → FDIEXP					-0.003	-0.005	-0.094	0.023				
					[0.039]	[0.054]	[0.064]	[0.092]				
IMP → IMPEXP									-0.009	0.066	-0.008	0.142
									[0.095]	[0.157]	[0.215]	[0.384]
Age	-0.001	0.000	0.001	-0.004	0.001	-0.001	-0.012**	-0.002	-0.005	-0.043***	-0.015	-0.024
	[0.001]	[0.002]	[0.003]	[0.003]	[0.002]	[0.003]	[0.005]	[0.006]	[0.007]	[0.015]	[0.015]	[0.028]
Employment	0.078	0.004	0.049	-0.088	0.054	-0.024	-0.032	-0.224	-0.141	1.751*	-0.541	-0.907
	[0.050]	[0.070]	[0.109]	[0.133]	[0.077]	[0.105]	[0.145]	[0.197]	[0.426]	[0.940]	[1.076]	[3.140]
Employment Squared	-0.007	-0.001	-0.006	0.01	-0.002	0.005	0.012	0.027	0.014	-0.152	0.047	0.075
	[0.005]	[0.007]	[0.011]	[0.014]	[0.007]	[0.009]	[0.012]	[0.017]	[0.039]	[0.092]	[0.106]	[0.283]
Ratio of White-collar Workers	-0.029	-0.085	0.001	0.107	-0.025	-0.139	0.384*	0.474	0.137	1.265**	1.003	0.514
	[0.057]	[0.086]	[0.165]	[0.180]	[0.116]	[0.160]	[0.206]	[0.313]	[0.248]	[0.476]	[0.691]	[1.968]
Capital Intensity	0.013**	0.017*	0.009	-0.026	0.028**	0.042***	0.018	0.011	0.045*	0.124*	0.001	0.091
	[0.007]	[0.009]	[0.014]	[0.018]	[0.012]	[0.016]	[0.019]	[0.029]	[0.023]	[0.067]	[0.076]	[0.110]
Raw Materials	0.016*	0.013	0	-0.014	-0.016	-0.018	-0.033	-0.058*	0.064	0.160*	0.073	-0.07
	[0.009]	[0.012]	[0.016]	[0.018]	[0.014]	[0.019]	[0.026]	[0.033]	[0.047]	[0.082]	[0.081]	[0.179]
Energy Intensity	-0.005	0.004	0.019*	0.029**	0.004	-0.003	-0.011	-0.005	-0.056	-0.111**	-0.033	-0.023
	[0.006]	[0.008]	[0.011]	[0.014]	[0.009]	[0.015]	[0.017]	[0.024]	[0.037]	[0.042]	[0.082]	[0.166]
Productivity at t'	0.879***	0.840***	0.782***	0.664***	0.897***	0.891***	0.846***	0.724***	0.965***	1.149***	1.077***	0.941***
	[0.014]	[0.021]	[0.032]	[0.034]	[0.019]	[0.029]	[0.039]	[0.054]	[0.047]	[0.080]	[0.110]	[0.272]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of Observations	3,763	2,551	1,520	1,439	1,024	658	375	323	89	42	29	28
R-squared	0.77	0.72	0.61	0.46	0.81	0.77	0.75	0.60	0.88	0.91	0.96	0.84

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01

Table 11: Productivity Effects of Importing (IMP), Matched Samples

	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year
None--> IMP	0.030	0.051	-0.036	-0.074								
	[0.022]	[0.035]	[0.044]	[0.062]								
FDI--> FDIIMP					0.022	0.262	0.041					
					[0.109]	[0.273]	[0.578]					
EXP--> EXPIMP									-0.033	0.099	0.082	-0.246
									[0.054]	[0.101]	[0.121]	[0.208]
Age	-0.002	-0.003	0.002	0.001	0.002	-0.007	-0.031		-0.007**	-0.006	-0.002	0.013
	[0.002]	[0.002]	[0.003]	[0.004]	[0.011]	[0.036]	[0.083]		[0.003]	[0.006]	[0.011]	[0.012]
Employment	-0.027	0.132	-0.092	-0.054	-0.898	-4.773**	1.776		-0.275*	-0.101	-0.474	0.206
	[0.086]	[0.112]	[0.138]	[0.224]	[0.940]	[2.173]	[8.324]		[0.149]	[0.240]	[0.424]	[0.512]
Employment Squared	0.004	-0.014	0.01	0.012	0.098	0.492**	-0.176		0.021*	0.01	0.048	-0.01
	[0.009]	[0.012]	[0.014]	[0.024]	[0.090]	[0.209]	[0.847]		[0.012]	[0.019]	[0.037]	[0.045]
Ratio of White-collar Workers	-0.107	-0.325***	-0.071	-0.191	-0.069	1.006	-0.293		-0.194	0.103	-0.602	-1.402*
	[0.101]	[0.105]	[0.120]	[0.154]	[0.512]	[0.950]	[3.556]		[0.194]	[0.352]	[0.656]	[0.728]
Capital Intensity	-0.004	0.009	-0.003	-0.003	0.108	0.300**	-0.281		0.001	0.089**	-0.026	-0.015
	[0.013]	[0.016]	[0.017]	[0.022]	[0.085]	[0.131]	[0.489]		[0.020]	[0.043]	[0.061]	[0.078]
Raw Materials	0.014	0.002	-0.012	-0.007	0.009	-0.11	0.2		0.03	-0.06	-0.094	-0.191**
	[0.012]	[0.014]	[0.015]	[0.020]	[0.100]	[0.089]	[0.215]		[0.032]	[0.045]	[0.063]	[0.079]
Energy Intensity	0.007	0.032***	0.007	0.015	0.047	0.198***	0.223		0.012	-0.037	0.087	0.160*
	[0.010]	[0.012]	[0.014]	[0.018]	[0.046]	[0.065]	[0.347]		[0.017]	[0.031]	[0.054]	[0.082]
Productivity at t'	0.870***	0.835***	0.829***	0.785***	0.960***	1.166***	0.805**		0.878***	0.780***	0.563***	0.319**
	[0.019]	[0.022]	[0.026]	[0.031]	[0.060]	[0.134]	[0.336]		[0.045]	[0.089]	[0.120]	[0.129]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
# of Observations	1,691	1,125	915	809	36	23	20		253	140	106	82
R-squared	0.78	0.73	0.70	0.59	0.97	0.98	0.83		0.8	0.62	0.51	0.42

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. The sample size on foreign-owned and importing plants are too small to estimate the effects in three years forward. *=0.10, **=.05, ***=.01

Appendix I

1. Data Cleaning Operation

The dataset has been cleaned to minimize nonreporting and obvious typing mistakes during data input. The major adjustments include the following. First, I filled in the gaps if a plant reported for a particular variable no value in a given year using the information before and after that year. This applies to ownership, province and industry classification. Second, plants with unrealistically large spikes in the data are dropped (e.g., employment growth is above the 99 percentile). Third, the capital stock is measured by the replacement value of fixed assets, however, for the year 1996 this information was missing. The capital stock for the year 1996 is then interpolated using the 1997 and 1995 values.

2. Deflators

Output deflators: The wholesale price indices (WPI) are published monthly in the Buletin Statistik Bulanan Indikator Ekonomi of the Indonesian Statistical Agency (Badan Pusat Statistic, BPS), the Monthly Statistical Bulletin of Economic Indicators. I used an unpublished concordance from the BPS to map the 192 WPI commodity codes into the five-digit ISIC industry codes.

Material Input deflators: Nominal material values are deflated using the WPI for the nearest corresponding commodity at four-digit ISIC level.

Capital deflator: The capital price deflator was constructed by making use of the aggregate price index of imported electrical and non-electrical machinery and equipment, imported transport goods, and the wholesale price index of manufactured construction materials. I used the information from the SI to compute the shares of vehicles, buildings and equipment at the four-digit ISIC level. Those shares are used to weight each of the individual aggregate deflator to obtain a capital deflator at the sector level.

Appendix II

Table A1: Balancing Test between Always EXP and EXP-->EXPFDI

Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
		Means				t-test
Age	Unmatched	5.84	7.53	-32.22		-1.69
	Matched	5.75	7.57	-31.74	1.5	-1.37
Capital Intensity	Unmatched	8.10	7.78	23.97		1.31
	Matched	8.07	7.80	20.11	16.1	0.72
Employment	Unmatched	4.96	4.58	34.79		1.84
	Matched	4.92	4.73	16.78	51.8	0.63
Employment Squared	Unmatched	25.62	22.24	30.73		1.65
	Matched	25.39	23.80	13.52	56.0	0.50
Ratio of White-collar Workers	Unmatched	6.86	6.55	16.70		1.03
	Matched	6.67	6.74	-3.60	78.4	-0.13
Energy Intensity	Unmatched	8.35	7.44	64.85		3.80
	Matched	8.15	8.70	-47.58	26.6	-1.73
Raw Materials	Unmatched	3.95	4.19	-27.10		-1.61
	Matched	3.98	3.82	17.67	34.8	1.32
Productivity	Unmatched	0.21	0.13	46.14		3.36
	Matched	0.19	0.17	17.13	62.9	0.73

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A2: Balancing Test between Always IMP and IMP-->IMPFDI

Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
		Means				t-test
Age	Unmatched	9.24	13.10	-54.04		-3.71
	Matched	9.24	9.93	-10.35	80.9	-0.63
Capital Intensity	Unmatched	9.73	8.07	114.21		7.53
	Matched	9.73	9.73	-0.08	99.9	-0.01
Employment	Unmatched	5.12	4.28	81.69		5.14
	Matched	5.12	4.98	14.86	81.8	0.74
Employment Squared	Unmatched	27.08	19.52	73.33		4.83
	Matched	27.08	25.64	14.60	80.1	0.73
Ratio of White-collar Workers	Unmatched	8.39	7.15	72.45		4.35
	Matched	8.39	8.03	21.91	69.8	1.30
Energy Intensity	Unmatched	9.12	7.64	81.10		5.62
	Matched	9.12	8.82	17.90	77.9	1.04
Raw Materials	Unmatched	4.61	4.20	35.42		2.59
	Matched	4.61	4.61	0.42	98.8	0.05
Productivity	Unmatched	0.25	0.20	26.55		1.70
	Matched	0.25	0.24	3.06	88.5	0.19

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A3: Balancing Test between Always IMP and IMP-->IMPEXP

		Means				t-test
Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
Age	Unmatched	12.77	13.10	-4.79		-1.23
	Matched	12.77	11.77	14.90	-211.3	3.07
Capital Intensity	Unmatched	8.48	8.07	26.69		7.12
	Matched	8.47	8.45	1.20	95.5	0.26
Employment	Unmatched	5.87	4.28	134.07		37.12
	Matched	5.86	5.55	25.35	81.1	8.90
Employment Squared	Unmatched	36.13	19.52	126.36		38.35
	Matched	35.89	32.15	26.69	78.9	8.88
Ratio of White-collar Workers	Unmatched	7.96	7.15	43.47		11.14
	Matched	7.95	7.63	18.13	58.3	4.23
Energy Intensity	Unmatched	8.43	7.64	49.21		11.92
	Matched	8.42	8.08	21.53	56.2	5.12
Raw Materials	Unmatched	4.53	4.20	32.18		8.17
	Matched	4.53	4.47	5.02	84.4	1.87
Productivity	Unmatched	0.17	0.20	-18.43		-4.57
	Matched	0.18	0.18	-3.44	81.3	-0.74

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A4: Balancing Test between Always FDI and FDI-->FDIEXP

		Means				t-test
Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
Age	Unmatched	10.51	10.24	3.71		0.34
	Matched	10.57	9.14	18.30	-392.9	1.16
Capital Intensity	Unmatched	8.52	9.34	-60.74		-5.85
	Matched	8.82	8.99	-11.77	80.6	-0.89
Employment	Unmatched	5.39	4.73	69.65		6.60
	Matched	5.18	4.91	32.32	53.6	2.23
Employment Squared	Unmatched	30.11	23.08	71.25		6.85
	Matched	27.65	24.77	32.42	54.5	2.23
Ratio of White-collar Workers	Unmatched	7.81	8.50	-42.19		-3.96
	Matched	8.04	7.89	8.84	-79.0	0.60
Energy Intensity	Unmatched	8.40	8.48	-5.39		-0.51
	Matched	8.73	8.17	35.02	-549.5	2.49
Raw Materials	Unmatched	4.11	4.89	-59.42		-5.28
	Matched	4.02	3.93	7.06	88.1	0.94
Productivity	Unmatched	0.19	0.23	-23.91		-2.23
	Matched	0.21	0.28	-37.48	-56.7	-2.30

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A5: Balancing Test between Always EXP and EXP-->EXPIMP

		Means				t-test
Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
Age	Unmatched	11.07	7.53	57.75		8.07
	Matched	10.13	9.88	4.03	93.0	0.43
Capital Intensity	Unmatched	8.32	7.78	38.93		5.20
	Matched	8.28	8.07	16.19	58.4	1.77
Employment	Unmatched	5.83	4.58	104.40		14.28
	Matched	5.87	5.54	27.53	73.6	4.34
Employment Squared	Unmatched	35.64	22.24	101.28		14.53
	Matched	36.03	31.84	30.34	70.0	4.69
Ratio of White-collar Workers	Unmatched	7.46	6.55	51.57		7.14
	Matched	7.22	6.96	15.04	70.8	1.65
Energy Intensity	Unmatched	8.02	7.44	44.99		5.92
	Matched	7.95	7.83	9.47	79.0	0.99
Raw Materials	Unmatched	4.41	4.19	25.13		3.49
	Matched	4.40	4.27	15.50	38.3	2.73
Productivity	Unmatched	0.15	0.13	11.80		1.55
	Matched	0.14	0.12	13.57	-15.0	1.38

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A6: Balancing Test between Always FDI and FDI-->FDIIMP

		Means				t-test
Variables	Sample	Treated	Control	SDiff	%reduct in Sdiff	t-stat
Age	Unmatched	10.25	10.24	0.20		0.01
	Matched	10.41	10.00	6.32	-3,046.4	0.22
Capital Intensity	Unmatched	9.60	9.34	21.47		1.47
	Matched	9.72	9.41	22.76	-6.0	0.78
Employment	Unmatched	5.19	4.73	45.36		3.27
	Matched	5.17	4.64	58.25	-28.4	1.89
Employment Squared	Unmatched	28.22	23.08	48.90		3.67
	Matched	27.44	22.38	56.34	-15.2	1.81
Ratio of White-collar Workers	Unmatched	8.00	8.50	-31.17		-2.08
	Matched	8.06	9.03	-54.88	-76.1	-2.00
Energy Intensity	Unmatched	8.91	8.48	28.32		1.93
	Matched	8.61	8.65	-1.91	93.2	-0.06
Raw Materials	Unmatched	4.77	4.89	-7.88		-0.50
	Matched	5.24	5.18	4.02	48.9	0.35
Productivity	Unmatched	0.30	0.23	31.01		2.25
	Matched	0.25	0.23	9.73	68.6	0.53

Note: SDiff is calculated based on the formula in section 3.2. The t-statistics are obtained by regressing each covariate on the foreign contact indicator.

Table A7: Productivity Effects of Foreign Ownership (FDI), Unmatched Samples

	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of FDI	Forward 1st year	Forward 2nd year	Forward 3rd year
None → FDI	0.150**	0.183	0.507**	1.363***								
	[0.063]	[0.128]	[0.226]	[0.331]								
EXP → EXPFDI					0.171	0.268	0.577	-0.114				
					[0.143]	[0.261]	[0.451]	[0.087]				
IMP → IMPFDI									0.247***	0.359**	0.221	0.509*
									[0.087]	[0.176]	[0.191]	[0.297]
Age	-0.001***	-0.001***	-0.002***	-0.002***	-0.001	-0.001	-0.001	-0.001	-0.001	-0.003**	-0.004**	-0.006**
	[0.000]	[0.000]	[0.001]	[0.001]	[0.003]	[0.003]	[0.003]	[0.003]	[0.001]	[0.001]	[0.002]	[0.002]
Employment	0.01	0.043*	0.048	0.065	0.085	0.106	0.064	0.067	-0.022	-0.006	0.12	0.058
	[0.017]	[0.024]	[0.038]	[0.045]	[0.076]	[0.077]	[0.068]	[0.068]	[0.038]	[0.062]	[0.099]	[0.128]
Employment Squared	0.001	-0.003	-0.004	-0.007	-0.008	-0.01	-0.005	-0.006	0.004	0.002	-0.012	-0.006
	[0.002]	[0.003]	[0.004]	[0.005]	[0.007]	[0.008]	[0.006]	[0.006]	[0.004]	[0.006]	[0.010]	[0.013]
Ratio of White-collar Workers	-0.008	-0.029	-0.044	-0.060*	0.124	0.03	0.098	0.09	0.034	0.153**	0.142	0.05
	[0.015]	[0.021]	[0.028]	[0.033]	[0.147]	[0.140]	[0.136]	[0.128]	[0.035]	[0.067]	[0.104]	[0.119]
Capital Intensity	0.005***	0.015***	0.019***	0.025***	0.024	0.024	0.015	0.011	0.003	0.015*	0.026**	0.029**
	[0.002]	[0.003]	[0.003]	[0.004]	[0.015]	[0.015]	[0.014]	[0.013]	[0.005]	[0.009]	[0.013]	[0.015]
Raw Materials	-0.005***	-0.014***	-0.020***	-0.028***	-0.023	-0.011	-0.014	0	-0.003	-0.008	-0.003	-0.006
	[0.002]	[0.002]	[0.003]	[0.004]	[0.019]	[0.017]	[0.018]	[0.014]	[0.005]	[0.008]	[0.011]	[0.013]
Energy Intensity	0.010***	0.012***	0.012***	0.011***	-0.001	-0.006	-0.002	-0.007	0.002	-0.010*	-0.018**	-0.018*
	[0.001]	[0.002]	[0.002]	[0.003]	[0.014]	[0.013]	[0.014]	[0.013]	[0.004]	[0.006]	[0.009]	[0.010]
Productivity at t'	0.918***	0.872***	0.829***	0.800***	0.931***	0.949***	0.950***	0.968***	0.929***	0.860***	0.790***	0.731***
	[0.003]	[0.004]	[0.005]	[0.006]	[0.043]	[0.041]	[0.041]	[0.036]	[0.009]	[0.015]	[0.021]	[0.025]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of Observations	42,816	38,131	35,915	34,829	512	495	488	483	3,760	3,331	3,084	2,971
R-squared	0.86	0.77	0.69	0.64	0.81	0.82	0.82	0.85	0.85	0.73	0.64	0.56

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01

Table A8: Productivity Effects of Exporting (EXP), Unmatched Samples

	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of EXP	Forward 1st year	Forward 2nd year	Forward 3rd year
None → EXP	0.007	0.02	0.058	0.187**								
	[0.010]	[0.015]	[0.039]	[0.084]								
FDI → FDIEXP					0.014	0.03	0.026	0.125				
					[0.020]	[0.032]	[0.064]	[0.086]				
IMP → IMPEXP									0.030	-0.154	-0.310*	-0.026
									[0.055]	[0.120]	[0.182]	[0.301]
Age	-0.001***	-0.001***	-0.002***	-0.001*	0.000	-0.003*	-0.005**	-0.006**	0.003	-0.014*	-0.020*	-0.013
	[0.000]	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.004]	[0.007]	[0.010]	[0.014]
Employment	0.036**	0.049**	0.048	0.048	0.027	-0.042	-0.027	-0.14	0.393*	0.618	0.358	2.875**
	[0.016]	[0.022]	[0.036]	[0.044]	[0.032]	[0.045]	[0.076]	[0.096]	[0.201]	[0.373]	[0.929]	[1.087]
Employment Squared	-0.002	-0.004	-0.004	-0.005	-0.001	0.006	0.005	0.016*	-0.041**	-0.054	-0.016	-0.263**
	[0.002]	[0.002]	[0.004]	[0.005]	[0.003]	[0.004]	[0.008]	[0.010]	[0.019]	[0.036]	[0.096]	[0.116]
Ratio of White-collar Workers	-0.012	-0.027	-0.042	-0.057*	0.045	0.117*	0.125	0.126	0.092	0.468*	0.482	-0.082
	[0.015]	[0.021]	[0.028]	[0.032]	[0.036]	[0.064]	[0.097]	[0.116]	[0.124]	[0.251]	[0.296]	[0.488]
Capital Intensity	0.007***	0.016***	0.020***	0.026***	0.012**	0.021***	0.026**	0.037***	0.015	0.024	0.059	0.054
	[0.002]	[0.002]	[0.003]	[0.004]	[0.005]	[0.008]	[0.012]	[0.014]	[0.019]	[0.038]	[0.058]	[0.076]
Raw Materials	-0.005**	-0.013***	-0.020***	-0.028***	-0.008	-0.011	-0.006	-0.016	0.029	0.081**	0.002	0.019
	[0.002]	[0.002]	[0.003]	[0.004]	[0.005]	[0.007]	[0.011]	[0.013]	[0.019]	[0.032]	[0.051]	[0.072]
Energy Intensity	0.009***	0.011***	0.012***	0.012***	0.001	-0.008	-0.022**	-0.027***	-0.047***	-0.067**	0.03	0.056
	[0.001]	[0.002]	[0.002]	[0.003]	[0.003]	[0.006]	[0.008]	[0.010]	[0.018]	[0.030]	[0.052]	[0.068]
Productivity at t'	0.917***	0.873***	0.832***	0.804***	0.923***	0.860***	0.791***	0.731***	0.967***	0.953***	0.808***	0.679***
	[0.003]	[0.004]	[0.005]	[0.006]	[0.009]	[0.014]	[0.019]	[0.024]	[0.020]	[0.037]	[0.056]	[0.078]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of Observations	45,215	39,443	36,317	35,248	4,478	3,711	3,167	3,030	293	179	140	128
R-squared	0.85	0.77	0.69	0.64	0.85	0.75	0.65	0.57	0.92	0.88	0.79	0.69

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01

Table A9: Productivity Effects of Importing (IMP), Unmatched Samples

	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year	Year of IMP	Forward 1st year	Forward 2nd year	Forward 3rd year
None → IMP	0.011	0.011	-0.057	-0.066								
	[0.017]	[0.031]	[0.037]	[0.055]								
FDI → FDIIMP					0.066	-0.051	-0.446*	-0.159				
					[0.086]	[0.123]	[0.233]	[0.387]				
EXP → EXPIMP									-0.007	0.151**	0.223**	0.425
									[0.045]	[0.076]	[0.096]	[0.269]
Age	-0.001***	-0.001***	-0.002***	-0.001**	0.001	-0.004	-0.028***	-0.014	-0.002	-0.010**	-0.003	-0.004
	[0.000]	[0.000]	[0.001]	[0.001]	[0.005]	[0.007]	[0.011]	[0.013]	[0.003]	[0.004]	[0.006]	[0.007]
Employment	0.005	0.043*	0.041	0.06	0.615	0.2	-0.686	1.423	-0.002	0.007	-0.16	-0.307*
	[0.017]	[0.024]	[0.037]	[0.045]	[0.412]	[0.484]	[0.887]	[1.043]	[0.067]	[0.097]	[0.151]	[0.177]
Employment Squared	0.001	-0.003	-0.004	-0.007	-0.059	-0.013	0.096	-0.116	0.000	0.003	0.017	0.030*
	[0.002]	[0.003]	[0.004]	[0.005]	[0.044]	[0.049]	[0.093]	[0.110]	[0.006]	[0.009]	[0.015]	[0.018]
Ratio of White-collar Workers	-0.009	-0.019	-0.011	-0.035	0.132	0.376	0.497*	0.165	-0.073	-0.066	-0.224	0.008
	[0.015]	[0.022]	[0.031]	[0.037]	[0.202]	[0.237]	[0.291]	[0.385]	[0.143]	[0.290]	[0.404]	[0.390]
Capital Intensity	0.005***	0.014***	0.019***	0.025***	-0.056	0.075	0.08	0.058	0.011	0.054***	0.055	0.081**
	[0.002]	[0.003]	[0.003]	[0.004]	[0.060]	[0.050]	[0.059]	[0.075]	[0.013]	[0.021]	[0.035]	[0.034]
Raw Materials	-0.005***	-0.014***	-0.019***	-0.026***	0.060*	0.043	0.009	0.017	0.012	-0.072***	-0.076**	-0.067**
	[0.002]	[0.002]	[0.003]	[0.004]	[0.031]	[0.033]	[0.051]	[0.070]	[0.015]	[0.022]	[0.032]	[0.033]
Energy Intensity	0.010***	0.012***	0.012***	0.011***	0.012	-0.045	-0.009	0.013	0.010	-0.004	-0.019	-0.042
	[0.001]	[0.002]	[0.002]	[0.003]	[0.028]	[0.037]	[0.043]	[0.059]	[0.012]	[0.022]	[0.028]	[0.029]
Productivity at t'	0.917***	0.871***	0.828***	0.799***	0.921***	0.926***	0.849***	0.667***	0.927***	0.745***	0.596***	0.519***
	[0.003]	[0.004]	[0.005]	[0.006]	[0.034]	[0.043]	[0.056]	[0.081]	[0.031]	[0.082]	[0.121]	[0.108]
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
# of Observations	43,686	38,594	36,240	35,147	208	153	142	126	704	487	442	459
R-squared	0.85	0.76	0.69	0.63	0.90	0.90	0.78	0.67	0.82	0.56	0.41	0.35

Robust standard errors corrected for clustering at the pair level in brackets. Except for age and ratio of white-collar workers, all the other independent variables are in logs. Productivity at t' controls the productivity at one period before the foreign contact. *=0.10, **=.05, ***=.01