Export Outsourcing and Foreign Direct Investment: Evidence from Taiwanese Exporting Firms

(preliminary draft)

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Abstract

Exporting and FDI have traditionally been two major firm-level responses to globalization. Export outsourcing (EO), a new strategy that gained in importance recently, has now become another alternative. This paper seeks to examine how firms choose between EO and outward FDI by looking into firm-level productivity differences. A special data set is constructed by consolidating two micro data sets of Taiwanese manufacturing firms. The paper contributes in four main ways. First, it provides a causality analysis of labor productivity and EO, whereas previous studies deal only with correlations. Second, it shows that EO can be interpreted as an indirect way of exporting. Third, it points out that outward FDI itself may not help with productivity if it is not linked with EO, which finding contradicts conventional wisdom. Finally, most evidences seem to imply that the intricate Taiwan-China interconnection is a significant factor that facilitates or contributes to all above-mentioned findings.

Keywords: *productivity, exports, foreign outsourcing, FDI, firm-level data*

JEL classification: F14, F23, L22, L23, D21

1. Outsourcing, FDI and Exporting

Exporting and foreign direct investment (FDI hereafter)[1] have traditionally been two major firm-level responses to globalization (Greenaway, 2004). During the current wave of globalization, a variety of new responses have emerged, given that fundamental changes have taken place in the nature of international trade and production. In addition to the deepening of vertical specialization in manufacturing (Hummels, et al., 2001) and the boom in moving services offshore (Dosanni, 2004), export outsourcing (EO hereafter) is an important new strategy of firms, when faced with changing comparative advantages (Liu, et al., 2005). In this new type of outsourcing, a firm that receives export orders may subcontract part of the order to low-wage countries, thus playing the dual role of a middleman and a manufacturer. The new strategy has now become another major response of a firm in serving foreign markets.

To be more precise, a firm can choose to produce onshore or offshore in order to export. A traditional way of exporting is to keep the production at home. The firm can produce in-house, or source out, or engage in imported-input-based outsourcing (import outsourcing hereafter) via vertical specialization. An alternative way to serve foreign markets is to pursue export outsourcing and produce abroad. If the firm chooses to produce abroad, it can send the export orders to its own foreign subsidiary, or to independent contractors. While EO and FDI are both alternatives to the conventional type of exporting, these two strategies are not mutually exclusive choices and may co-exist. Moreover, EO and FDI both mean the substituting away of jobs at home, but may involve different degree of flexibility and setup cost. The intricate relationship between exports, outward FDI, and EO thus deserve a more careful study, especially for export-oriented countries.

There has already been a large literature focusing theoretically on the choices between import outsourcing and FDI (e.g., Antràs and Helpman, 2004; Grossman and Helpman,

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[1] In this paper, we refer mainly to outward FDI of a firm in home country rather than the inward FDI by a foreign firm.

2003) or between FDI and exports (e.g., Helpman, et al., 2004). Due to data scarcity, only a handful of empirical studies look into the choices between FDI and exports (e.g., Head and Ries, 2004; Kim and Kang, 1997) or the productivity differences between firms that export, import outsource, or invest abroad (e.g., Girma, et al., 2004; Tomiura, 2004). These studies, however, have all neglected the fact that export outsourcing has gained rapidly in importance as a choice by an exporting firm. So the important questions of how firms choose between EO and outward FDI, and how the choice of strategy affects the labor productivity of the firm are left unanswered.

In view of this, the paper conducts an empirical analysis of productivity differences among exporting firms, which are classified into four types, according to whether or not they engage in EO and in outward FDI. The study is based on the pioneer work of Liu, et al. (2005), who have explored the nature and determinants of export outsourcing as a new response of exporting firms to the current wave of globalization. To have a better understanding of the consequences of EO on productivity, a special data set is constructed by consolidating two micro data sets of Taiwanese manufacturing firms. In addition to a statistical analysis, we engage in a series of econometric investigations on firm-level productivity as determined by their export strategies (EO or FDI) and firm characteristics.

The paper contributes in four main ways. First, it provides a causality analysis of labor productivity and export outsourcing, whereas previous studies deal only with correlations. Second, it shows that EO, which has not been adequately understood yet, is actually an indirect way of exporting, and is an effective way to cope with the changes in competitiveness. Third, it points out that outward FDI itself may not help with labor productivity if it is not linked with EO. This finding is probably against conventional wisdom and deserves further attention in the future. Finally, all the evidences seem to imply that the Taiwan-China interconnection is a significant factor that facilitates or contributes to all the above-mentioned findings.

2. Data and Statistics

2.1 Data Source

A special data set is constructed for this study, consolidating two micro data sets. The first set is the "Export Orders Survey, 2001" conducted by the Ministry of Economic Affairs with a survey. The survey contains information regarding the basic features of exporting firms in Taiwan, along with their FDI status and decisions on EO in 2001.[2] The other set is the "Industrial Statistical Survey, 2000", in which more detailed firm characteristics are available, but at a one-year lag from the former set of data. Consolidating the two sets and excluding pure traders, we obtain 1,336 firm-level observations of exporting firms in the manufacturing industries.[3]

2.2 Measuring Relative Labor Productivity

A common measurement of labor productivity is sales per employee (e.g., Girma, et al., 2004).[4] To ensure comparability across industries, we calculate the relative labor productivity, which is the labor productivity of a firm relative to that of the industry to which the firm belongs. The relative labor productivity of firm i is defined as follows:

$$RLP_i \equiv \frac{LP_i}{LP_j} \tag{1}$$

where $LP_i \,(\equiv sales_{ij} / employee_{ij})$ is the labor productivity of firm i,[5] and

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[2] It is worth mentioning that almost 78% of all manufacturing firms were exporters in Taiwan in 2001. And the value of export orders received by these 1,336 firms amounted to about 60% of national total. Therefore, the data set is rather representative of Taiwan's exporting firms in manufacturing.

[3] Firms with employees below 10 people are also excluded.

[4] Both value-added per employee and total factor productivity are used as indicators of labor productivity in other studies (Girma et al., 2004). We do not adopt these measures here, however, because detailed data on labor cost, intermediate input purchases, and other expenditures are unavailable in the "Export Orders Survey, 2001".

[5] As each firm i is classified into one single industry j, the industry subscript j is dropped from RLP_i and LP_i ffor simplicity.

$LP_j (\equiv \sum_i sale_{ij} / \sum_i employee_{ij})$ is the weighted-average labor productivity of industry j.

We categorize the 1,336 firms into four groups, based on if a firm invests overseas or if it outsources abroad. Table 1 shows that about half (680) of these firms engage in foreign direct investment (referred to as FDI firms hereafter) and one-third (451) engage in outsourcing activities (referred to as outsourcing firms). Among the 680 FDI firms, the percentage share of firms sourcing offshore is roughly the same as that either sourcing onshore or not outsourcing (referred to as domestic firms), 52.06% and 47.94%, respectively. But among those 656 domestic firms that do not engage in FDI, the percentage share of firms sourcing abroad (14.79%) is significantly smaller than that of the firms (85.21%) which source onshore (referred to as non-outsourcing firms). These facts suggest two things. First, FDI firms and domestic firms may have different needs for outsourcing. Second, outsourcing firms (O_1) are more heterogeneous than non-outsourcing firms (O_0), but FDI firms (F_1) are more homogeneous than domestic firms (F_0), judging from standard deviation of each category.

The summary statistics of labor productivity of different groups of firms are shown in Table 1. While EO and FDI are both considered as the response of a firm when faced with changes in comparative advantages, we would expect that the outsourcing firms are more productive than non-outsourcing firms and FDI firms are also more productive than domestic firms. The results in Table 1 show that outsourcing firms do have a higher mean than the non-outsourcing firms with respect to labor productivity, which can be reasonably expected from past literature on import outsourcing (Antràs and Helpman, 2004). But contrary to conventional wisdom, which considers FDI firms to be more productive (Girma, et al., 2004; Antràs and Helpman, 2004), the labor productivity of domestic firms is found to be slightly higher than FDI firms.

To see if this unexpected result is due to over aggregation of the data, we further dividing firms according to both FDI status and outsourcing decision, into four categories, i.e., F_0O_0, F_0O_1, F_1O_0, and F_1O_1. It is clear that even at the disaggregate level, domestic firms appear to have higher labor-productivity than FDI firms (Table 1). Note that the standard deviation of F_0O_1 is the highest among the four groups and F_1O_0 is the lowest,

suggesting that the largest heterogeneity is among the domestic-outsourcing group while the FDI-but-non-outsourcing group is the least heterogeneous.

2.3 Comparing Labor Productivity Across Groups

Going beyond the analysis on means and standard deviations, we compare the entire distribution of labor productivity across the four groups of firms following Girma (2004). Figure 1 shows the cumulative distribution of the relative labor productivity of the four types of firms. The domestic firms engaging in outsourcing (F_0O_1) lie at the farthest right, indicating that this group is the most labor productive group, whereas the FDI firms without outsourcing (F_1O_0) is the least labor productive group. The other two groups lie in-between with the FDI-outsourcing group (F_1O_1) to the right of the domestic-non-outsourcing group (F_0O_0). These results are consistent with what are shown in Table 1.

The cumulative distribution function diagram shows the relative distributions of labor productivity for different groups, but it does not tell us whether the distribution of one group significantly differs from another. To test for the differences in all moments of the distributions, we perform the Kolmogorov-Smirnov (KS) test and report the test statistics of the two-sided and one-sided KS tests in Table 2. Each time, the cumulative distribution functions of two groups are compared.[6] In the pair of non-outsourcing firms (O_0) vs. outsourcing firms (O_1), there exist statistically significant productivity differences at the aggregate level. At the disaggregate level, the differences are also statistically significant, regardless of the FDI status. This is in line with the findings of Table 1 and Figure 1. In

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[6] The null and alternative hypothesis for the two-sided KS test are $H_0 : A(z) - B(z) = 0 \quad \forall z \in R$ and $H_1 : A(z) - B(z) \neq 0 \quad for \quad some \quad z \in R$, respectively. The two-sided KS test statistics is $KS_2 = \sqrt{\frac{nm}{N}} \max_{1 \le i \le N} \{A_n(z_i) - B_m(z_i)\}$, where *n* and *m* are the number of observations for groups A and B, and $N = n + m$. Similarly, the null and alternative hypothesis for the one-sided KS test are $H_0 : A(z) - B(z) \le 0 \quad \forall z \in R$ and $H_1 : A(z) - B(z) > 0 \quad for\ some\ z \in R$, respectively. The corresponding KS test statistics is $KS_1 = \sqrt{\frac{nm}{N}} \max_{1 \le i \le N} \left| A_n(z_i) - B_m(z_i) \right|$.

contrast, the null hypothesis of identical distributions of labor productivity between FDI firms and domestic firms cannot be rejected at either the aggregate or disaggregate levels. These results echo the findings from Table 1, but are against conventional wisdom.

3. The Empirical Model

Results of the statistical tests above can be summarized in two major points. Export outsourcing firms are more productive than non-outsourcing firms, while FDI firms may be less (or similarly) productive than domestic firms. These results, however, require further examination because of the self-selection problem. A firm may self-select itself into a certain group and shares similar firm- or industry-characteristics as other firms in the same group. In such cases, the results from the statistical analysis may only reflect the characteristics effect across groups rather than the pure group effect related with the decisions to FDI and to EO. We therefore engage in a series of labor productivity regressions, which control for firm-level and industry-level characteristics to sort out the group effect on labor productivity from the characteristics effect.

A couple of related questions to ask are whether or not a firm with higher productivity tends to self-select itself into an outsourcing group, and whether or not outsourcing helps a firm to increase its labor productivity. To illustrate the causality, we add an outsourcing equation to the model and treat the equations of labor productivity and outsourcing decision as jointly determined. The models are introduced below.

3.1 Labor Productivity Equation

Assume that a firm's relative labor productivity depends not only on whether it sources offshore and invests abroad but also on the structure of FDI (*FRE*) and on the characteristics of firm *i* (X_i) and its industry *j* (X_j). The relative labor productivity equation is formulated as follows:

$$RLP_i = \alpha_0 + \alpha_1 O_i + \alpha_2 F_i + \alpha_3 FRE_i + \alpha_4 X_i + \alpha_5 X_j + \varepsilon_i . \qquad (2)$$

where RLP_i is the relative labor productivity of firm *i* as defined in equation (1).

The variables O_i and F_i are respectively the outsourcing and *FDI* dummies, where a value of 1 indicates that firm *i* is an outsourcing (or FDI) firm, and 0 otherwise. Although there is no previous study on the relations between EO activity and parent firm's productivity,[7] it is reasonable to anticipate a positive association between the dummy O_i and RLP_i, as export outsourcing can be seen as an indirect way of exporting, and the EO firm can contract out the less-productive portion of the orders, or share the x-efficiency involved.[8] As for FDI, past studies have also shown that FDI firms have higher labor productivity than domestic firms, but our statistical result as discussed in the previous section implies the opposite. We therefore rely on the regression to affirm their relationship.

In addition to the *FDI* dummy, the structures of FDI (the type, location, and age) may also affect the firm-level labor productivity. We begin by considering the type of FDI. A firm that engages in vertical FDI is able to move the more labor-intensive production process overseas, whereas a firm that engages in horizontal FDI can move the manufacturing of low-end products (usually the more labor-intensive products) abroad. The labor productivity at home may rise in both cases. Whether the difference between the two types of FDI can be identified is therefore not too clear. Second, the destination of FDI matters. To invest in an advanced country may bring about technological externality and thus increase the labor productivity at home, while to invest in a low-wage developing country may not have such externalities. Third, the age of a foreign subsidiary can make a difference. The questions of whether or not FDI has an effect on labor productivity of the parent firm, and whether the effect is short-term or permanent need to be explored. These interesting issues are nevertheless little noticed in the literature. We shall formulate empirically tests in this paper.

Firm characteristics of firm *i* (X_i) may include variables as firm size, R&D intensity,

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[7] Firms that engage in import outsourcing are found to be more productive than those that do not (e.g., Antràs and Helpman, 2004; Girma and Görg, 2004)

[8] Ten Raa and Wolff (2001) have showed that the growth of labor productivity in manufacturing industries is positively related to an increased use of service outsourcing. Fixler and Siegel (1999), on the other hand, argue that the effect of outsourcing on the productivity of service sectors is negative in the short run but positive in the long run.

technology purchase, export-to-sales ratio and growth rate of export order. The empirical evidence on the relations between firm size and productivity has not been very clear. It will be left for our regression to answer. As for the other firm characteristics, high ratio of R&D or technology purchase, high intensity in export and high export growth rate presumably have a positive correlation with high productivity (Aw and Hwang, 1995; Hwang, 2003).

Some of the industry characteristics may not show up in the present setup, because the firm-level labor productivity is already calibrated by industry-level productivity. However, other industry characteristics, such as the export growth performance, may have an effect.[9] Liu, et al. (2005) have found that firms in both export-thriving and export-declining industries are more likely to resort to EO than if they are in the export-sluggish industries. We can stretch this finding and arrive at the implication that firms in these two groups have higher productivity because of the freedom to choose production sites. Whether this implication is tenable or not will be examined empirically.

3.2 The Outsourcing Decision

Unlike the outsourcing decision, which can vary year over year, the FDI decision is more of a permanent type. Whether or not a firm has a foreign subsidiary (F_i) at the beginning of time t is already determined and can be taken as given, but whether or not to outsource (O_i) is a choice variable that is yet to be determined. And the decision of a firm to EO is simultaneously made with the level of labor productivity.

Assume that firm i's decision on whether or not to outsource abroad depends on the value of O_i^*, which is a function of a set of independent variables w_i:

$$O_i^* = \beta' w_i + u_i \qquad (3)$$

where O_i^* is an latent variable. Although O_i^* is unobservable, we can infer firm i's

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[9] Following Liu, et al. (2005), all industries are divided into three groups by their average annual growth rate of exports in 1990~2000. The export-thriving industries include those industries with a growth rate greater than or equal to the world average of 7% for all industries. Those with a rate between 0% and 7% are the export-sluggish industries, and those with a rate below 0% are the export-declining. The *Thriving* and *Declining* dummies are in the regression, as export-sluggish industries are taken as the base of comparison.

decision on outsourcing from its sign. When $O_i^* > 0$, firm *i* decides to source offshore (O_i =1); otherwise it sources onshore (O_i =0):

$$O_i = 1, \text{ if } O_i^* > 0,$$

$$O_i = 0, \text{ if } O_i^* \le 0. \quad (4)$$

Suppose that the error terms of equations (1) and (2) (i.e., u and ε) have a bivariate normal distribution with zero means and correlation $\rho : [0,0,1,\sigma_\varepsilon,\rho]$. Then

$$RLP_i \left| O_i^* > 0 = E[RLP_i \right| u_i > -\beta' w_i] + v_i$$

$$= \alpha' z_i + \beta_\lambda \lambda_i(\beta_u) + v_i \quad (5)$$

where z_i (α') denote the matrix (the coefficient) of the right-hand side variables in equation (2) and $\beta_\lambda = \rho\sigma_\varepsilon$. $\lambda_i(\beta_u)(\equiv \phi(\beta' w_i)/\Phi(\beta' w_i))$ is the inverse of the Mills' ratio (Heckman, 1979). Equation (5) implies that the least-squares estimates α from regression (2) will be inconsistent if the correlation between *u* and ε (i.e., ρ) is significantly different from zero (Greene, 2000).

The variable O_i^* is a function of a set of independent variables w_i, such as lagged labor productivity ($RLP_{i,\,t-1}$), FDI (F_i), FDI related variables (FRE_i), the characteristics of firm *i* (X_i) and industry *j* (X_j). The variables are defined in the same way as in the labor productivity equation.

4. The Empirical Results

The empirical results are reported in Table 4, where column (1) is the OLS estimates from equation (2), and columns (2) and (3) are the maximum likelihood estimates from equations (3) to (5). The likelihood ratio tests for regression (2) or (3) suggest that the equations of labor productivity and outsourcing are negatively correlated at 1% significance level. The maximum likelihood estimates serve to correct for the downward bias of the

estimate for OUTSOURCE derived from the OLS regression. The implications are therefore drawn mainly from the maximum likelihood estimates.

4.1 Labor Productivity

Table 4 shows that the coefficients of most firm-level characteristics are statistically significant. Small firms are found to correlate with higher labor productivity than medium-size firms, and medium-sized firms are higher than large firms. As for the technology related terms, the coefficient of *TEC* is positive but insignificant, while that of *RD* is negative. The negative relation between R&D and productivity is unexpected, but the cross term (*RDLARGE*) is large and the coefficient is larger than that of *RD*. That is to say, if a firm is large in size, a higher spending on R&D can help to improve labor productivity. The coefficient of export ratio (*EXRATIO*) has a negative sign, which is contradictory to the conventional wisdom that a firm who is more export-intensive tends to perform better and have higher productivity (Girma, et al., 2004; Greenaway and Kneller, 2004). However, when combing with the positive effect of the squared term of export ratio (*EXRATIO2*), the result indicates that if a firm derives a large enough portion of total revenue from exporting (≥70%), its labor productivity is likely to be higher than a firm that exports proportionally less.[10] Finally, the growth rate of the export order over the previous year has a positive sign, showing that the better growth perspective the firm has, the higher its labor productivity is.

The two industry characteristics, after controlling for firm characteristics, turn out to be insignificant in affecting a firm's labor productivity. This may be due to the fact that labor productivity is already defined as a relative term net of certain industry characteristics. The estimated industry effect is therefore negligible.

The coefficient of the *FDI* dummy is negative and counter-intuitive but that of the FDI to the U.S. is positive in sign and a high value. These results imply that firms that have

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[10] Note that the *EXRATIO* and *EXRATIO2* variables include only the exports from the parent firm in the home country. If these two variables are replaced by the ratio of total export inclusive of offshore exports to sales, the signs remain the same, but the critical value for the export ratio to exert positive impact on productivity decreases to about 38%. In other words, if "indirect" exports are also accounted for, export activity is more closely correlated with productivity improvements.

been able to invest in industrial countries are the most productive firms, while those that go elsewhere (mainly to China) are less productive. The variables related to the vertical FDI (*DOWN* and *UP*) are both negative, with the former significantly different from zero. This is to say that horizontal FDI is more helpful to improve the efficiency of parent firm than vertical FDI. The age of foreign subsidiary has a negative sign, but the square term is positive, implying that the age has a depressing effect on productivity in the short run, but an enhancing effect in the long run. These results indicate that in the first 15 years or so of an investment abroad, the labor productivity of the parent firm is adversely associated, but the negative correlation turns into a positive relation later on. These results may be connected with the negative sign of FDI, which will be examined again in Section 4.3.

Finally, the outsource dummy has a positive sign and is very significant, indicating a strong and positive relationship between a firm's productivity and its engagement in EO activity. Although the sign fits with our expectation, we cannot jump to the conclusion that the high productivity is the result of an EO activity. A more detailed study is necessary.

4.2 Export Outsourcing

In the outsourcing equation, Table 4 (columns (2) and (3)) shows that firms are more likely to practice EO if they are small, in export-thriving or export-declining industries, invest abroad (in particular to China), engage in vertical-specialization type of FDI, and are experienced (but not too experienced) in FDI. These results conform to the findings in Liu, et. al. (2005).

The most important message in columns (2) and (3) is the existence of a virtuous circle in engaging in EO. Highly productive firms in the previous year are more likely to choose to outsource their export orders this year; and if they do engage in EO, the labor productivity will further be improved. The causal relationship is clear and logical.

In addition to the analysis on the level of labor productivity, a regression on the first-difference of productivity is presented in Table 5. Two extra variables are added on the right-hand side. Although the first difference of employment is significantly positive in column (4), the absence of the variable does not affect the other result much, so we shall focus on column (5). Based on the concept of conditional beta-convergence, the first

difference, RLP_{diff}, should be negatively related to the starting level of relative productivity, to which RLP_{-1} serves as a proxy. Indeed these two variables are negative associated. The coefficients of most other variables are qualitative the same as in the regressions on levels as summarized in Table 4. In particular, the coefficient of FDI remains negative in sign at 1% significance level, confirming the finding in Table 4 that FDI tends to lower the productivity of the parent firm at home. In sum, the findings of the first difference of productivity confirm the robustness of the regression results on the level regressions.

4.3 Explaining FDI

A key question left to be answered is why the *FDI* dummy and some FDI-related variables exhibit unexpected signs. We run a set of maximum-likelihood regressions to decompose the changes in labor productivity to relative sales and relative employment. The results are reported in Table 6.[11]

A striking result is that although the coefficient of *FDI* is still significantly negative in the relative sales equation, it is positive (yet insignificant) in the relative employment equation; and the signs of the coefficients for outsourcing is significantly positive in the relative sales equation, but significantly negative in the relative employment equation. These findings indicate that setting up a foreign subsidiary may not take away domestic jobs for the moment, but sales are unfavorably affected. Export outsourcing, by contrast, involves immediate job loss at home, but is ironically positively related with relative sales. As the relative sales effect dominate the employment effect for both *FDI* and *OUTSOURCE* dummies, the combined effects shown in columns (2) and (3) in Table 4 are negative for *FDI* and positive for *OUTSOURCE*.

5. Summary and Concluding Remarks

Four interesting points stand out from the above discussion. First, the paper provides a

[11] In the case relative employment, as the result of the likelihood-ratio test of the employment equation and the outsourcing equation indicates no correlation between the two equations, we report only the OLS results.

causality analysis of labor productivity and export outsourcing, whereas previous studies in similar areas deals only with correlations. Further, these results are robust, as confirmed by both the level regressions and first-difference regressions.

Second, the results indicate the important contribution of EO to labor productivity. This implies that EO is an effective way to cope with changes in competitiveness, as it is actually an indirect way of exporting, which would supplement the direct (or conventional) exporting that is faced with intensified competition under the new wave of globalization.

Third, our study points out that outward FDI itself would not help with the improvement of labor productivity, if the investment is not linked with EO activities. This finding makes an interesting contrast with previous studies on import outsourcing and FDI, which are considered as substitutes in many studies (e.g., Helpman, et al., 2004).

A related and final point is that, the Taiwan-China interconnection appears to be an important factor that facilitates or contributes to all the above-mentioned findings. A rationale may be that China helps to lengthen the life of uncompetitive firms in Taiwan, through either FDI or EO activities. As the China connection seems to be unique to Taiwan (and Hong Kong), the implication to other economies is yet to be found out.

In sum, the first two of the four major points are well-supported in the paper, but the last two points obviously demand further study, as they are quite unique, and we need to sort out between commonality and exception in drawing lessons from such studies.

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Table 1 Basic Statistics of Relative Labor Productivity

	No. of Observations	Mean	Standard Deviation[a]
Outsourcing firms vs. Non-outsourcing firms:			
O_1	451	1.265	1.715
O_0	885	0.903	1.147
FDI firms vs. Domestic firms:			
F_1	680	1.014	1.327
F_0	656	1.037	1.424
Disaggregate Data:			
F_1O_1	354	1.213	1.694
F_1O_0	326	0.798	0.687
F_0O_1	97	1.456	1.786
F_0O_0	559	0.964	1.340
Total	1336	1.025	1.375

Figure 1 The Cumulative Distribution Functions of Different Types of Firms

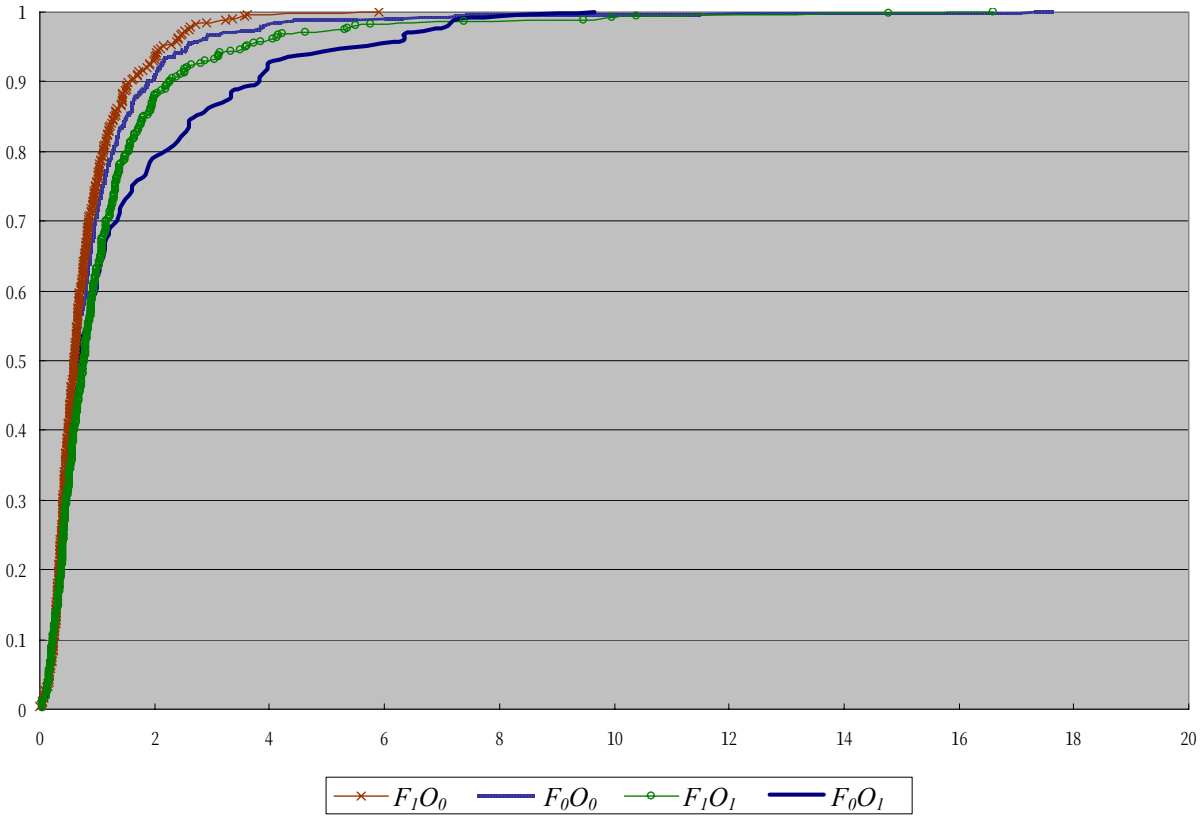

Table 2 Kolmogorov-Smirnov Tests for Different Types of Firms

	$A = B$		$A \leq B$		$A \geq B$	
Outsourcing firms vs. Non-outsourcing firms:						
O_0 vs. O_1	0.117	(0.001)***	0.117	(0.000)***	-0.002	(0.997)
F_0O_0 vs. F_0O_1	0.140	(0.078)**	0.140	(0.039)**	-0.004	(0.998)
F_0O_0 vs. F_1O_1	0.111	(0.009)***	0.113	(0.005)***	-0.004	(0.994)
F_1O_0 vs. F_0O_1	0.170	(0.027)***	0.170	(0.010)***	-0.012	(0.980)
F_1O_0 vs. F_1O_1	0.156	(0.001)***	0.156	(0.000)***	-0.014	(0.938)
FDI firms vs. Domestic firms:						
F_0 vs. F_1	0.041	(0.623)	0.037	(0.405)	-0.019	(0.792)
F_0O_0 vs. F_1O_0	0.071	(0.251)	0.035	(0.600)	-0.071	(0.126)*
F_0O_1 vs. F_1O_1	0.103	(0.399)	0.057	(0.611)	-0.103	(0.201)

Note: ***, **, and * indicate significance at the one-tailed levels of 1%, 5%, and 10%, respectively.

Table 3 Variable Definitions

Variable	Definition	Mean	Standard deviation	Min.	Max.
Labor productivity, sales and number of employees					
RLP	= a firm's labor productivity relative to the industry's average labor productivity to which the firm belongs	1.024	1.375	0.007	17.623
RLP_{-1}	= RLP lagged one year	0.968	0.990	0.023	15.162
Relative sales	= a firm's sales relative to the industry's average sales per firm to which the firm belongs	0.986	3.334	0.003	78.35
Relative number of employees	= a firm's number of employees relative to the industry's average number of employees per firm to which the firm belongs	1.00	2.112	0.021	34.19
RLP_{diff}	= first difference of RLP (= $RLP - RLP_{-1}$)				
Export outsourcing					
OUTSOURCE	= 1, if export orders are sent abroad = 0, otherwise	0.338	0.473	0	1
Firm scale					
LARGE	= 1, if the number of employees in the home country is greater or equal to 200 = 0, otherwise	0.457	0.498	0	1
(medium firms)	= 1, if the number of employees in the home country is below 200 and greater or equal to 100 = 0, otherwise	0.263	0.440	0	1
SMALL	= 1, if the number of employees in the home country is below 100 = 0, otherwise	0.280	0.449	0	1
L_{diff}	= first difference of employment (in 1000)				
R&D and technology purchase					
RD	= R&D expenditure / Sales	0.017	0.033	0	0.482
RDLARGE	= *RD* x *LARGE*	0.009	0.020	0	0.243
TEC	= Technology purchase / Sales	0.002	0.013	0	0.227
Export ratio (exclusive of offshore exports)					
EXRATIO	= Exports from home country/ Sales	0.559	0.331	0	1
EXRATIO2	= *EXRATIO* x *EXRATIO*	0.422	0.366	0	1
Growth Rate of the Value of Export Orders					
ORDER	= growth rate of the value of export orders in 2000~2001	-0.06	0.414	-2.52	6

Industry groups by average annual export growth rate in 1990~2000					
THRIVING	= 1, if in industries whose 10-year average export growth rate is greater or equal to the world average of 7%, which includes electronics, information and communications, chemicals, basic metals, precision instruments, electrical equipment, and plastics and rubber	0.591	0.492	0	1
	= 0, otherwise				
(export-sluggish industries)	= 1, if in industries whose 10-year average export growth rate is non-negative but less than world average of 7%, which includes machinery, transportation equipment, textiles, furniture, and miscellaneous manufacturing	0.306	0.461	0	1
	= 0, otherwise				
DECLINING	= 1, if in industries whose 10-year average export growth rate is negative, which includes footwear, plywood, household appliances, processed food, toys, games and sports, animal and plant products, leather, and ceramic products	0.103	0.303	0	1
	= 0, otherwise				
Foreign direct investment					
FDI	= 1, if has foreign subsidiaries	0.509	0.500	0	1
	= 0, otherwise				
CHINA	= 1, if foreign subsidiaries locate in China	0.385	0.487	0	1
	= 0, otherwise				
USA	= 1, if foreign subsidiaries locate in Southeast Asia	0.057	0.232	0	1
	= 0, otherwise				
UP	= 1, if foreign subsidiaries produce the upstream products for the parent firm;	0.013	0.115	0	1
	= 0, otherwise				
DOWN	= 1, if foreign subsidiaries produce the downstream products for the parent firm;	0.041	0.199	0	1
	= 0, otherwise				
AGE	= the number of years the foreign subsidiaries have operated	2.380	3.885	0	37
AGE2	= *AGE* × *AGE*	20.75	71.70	0	1369

Table 4 Regression Results for Labor Productivity

	(1)		(2)[a]		(3)[b]	
The Labor Productivity Equation						
SMALL	0.42	(0.10)***	0.34	(0.11) ***	0.36	(0.10)***
LARGE	-0.24	(0.10)***	-0.16	(0.10)*	-0.18	(0.10)**
RD	-2.23	(1.32)**	-1.77	(1.26)*	-1.97	(1.25)*
RDLARGE	3.79	(2.38)*	3.48	(2.27)*	3.47	(2.27)*
TEC	3.09	(2.90)	3.27	(2.75)	3.20	(2.74)
EXRATIO	-3.60	(0.47)***	-3.44	(0.45)***	-3.52	(0.45)***
EXRATIO2	2.56	(0.42)***	2.47	(0.41)***	2.53	(0.41)***
ORDER	0.30	(0.09)***	0.30	(0.09)***	0.29	(0.09)***
THRIVING	0.17	(0.08)**	-0.01	(0.09)		
DECLINING	0.20	(0.13)*	0.11	(0.14)		
FDI	-0.11	(0.17)	-0.38	(0.18)**		
CHINA	-0.05	(0.15)	-0.15	(0.16)	-0.42	(0.11)***
USA	0.30	(0.21)*	0.50	(0.23)***	0.23	(0.19)
UP	-0.11	(0.31)	-0.25	(0.34)	-0.29	(0.34)
DOWN	-0.21	(0.19)	-0.41	(0.20)**	-0.46	(0.20)***
AGE/10	0.07	(0.22)	-0.55	(0.20)***	-0.72	(0.23)***
AGE2/100	-0.04	(0.10)	0.18	(0.11)**	0.22	(0.11)**
OUTSOURCE	0.22	(0.09)***	1.65	(0.13)***	1.62	(0.13)***
CONSTANT	1.83	(0.15)***	1.68	(0.15)***	1.67	(0.14)***
The Outsourcing Equation						
RLP_{-1}			0.31	(0.04)***	0.30	(0.04)***
SMALL			0.08	(0.10)	0.07	(0.10)
LARGE			-0.19	(0.09)**	-0.19	(0.09)**
THRIVING			0.42	(0.09)***	0.41	(0.08)***
DECLINING			0.32	(0.14)***	0.37	(0.13)***
FDI			0.53	(0.17)***	0.37	(0.15)***
CHINA			0.28	(0.15)**	0.40	(0.14)***
USA			-0.37	(0.20)**	-0.25	(0.19)*
UP			0.18	(0.33)	0.20	(0.33)
DOWN			0.35	(0.19)**	0.37	(0.18)**
AGE/10			1.16	(0.22)***	1.23	(0.21)***
AGE2/100			-0.37	(0.10)***	-0.04	(0.10)***
CONSTANT			-1.52	(0.11)***	-1.51	(0.11)***
No. of Observations	1336		1336		1336	
R-squared	0.1172					
Log Likelihood			-2912.6679		-2915.4277	
ρ			-0.62		-0.61	
σ			1.42		1.42	
λ			-0.88		-0.87	

[a]: The likelihood-ratio test of the independent equations of labor productivity and outsourcing (ρ=0) is: $\chi^2(1)$ =54.45, prob>$\chi^2(1)$=0.0000.

[b]: The likelihood-ratio test of the independent equations of labor productivity and outsourcing (ρ=0) is: $\chi^2(1)$=54.54, Prob>χ^2=0.0000.

[c]: ***, **, and * indicate significance at the one-tailed levels of 1%, 5%, and 10%, respectively.

Table 5 Regression Results for Labor Productivity in First-Difference

(independent variable)	RLP_{diff} (4) [a]	RLP_{diff} (5) [b]
SMALL	0.18 (0.09)**	0.18 (0.09)**
LARGE	-0.17 (0.08)**	-0.17 (0.08)**
L_{diff}	0.08 (0.05)*	
RLP_{-1}	-0.44 (0.03)***	-0.44 (0.03)***
EXRATIO	-2.72 (0.42)***	-2.73 (0.42)***
EXRATIO2	1.96 (0.38)***	1.98 (0.38)***
ORDER	0.24 (0.08)***	0.23 (0.08)***
THRIVING	0.07 (0.08)	0.07 (0.08)
DECLINING	0.15 (0.12)	0.15 (0.12)
FDI	-0.35 (0.16)***	-0.35 (0.16)***
CHINA	0.08 (0.14)	0.08 (0.14)
USA	0.39 (0.19)**	0.39 (0.19)**
UP	-0.33 (0.29)	-0.33 (0.29)
DOWN	-0.32 (0.17)**	-0.32 (0.17)**
AGE/10	-0.30 (0.22)*	-0.31 (0.22)*
AGE2/100	0.11 (0.10)	0.11 (0.10)
OUTSOURCE	0.97 (0.20)***	0.98 (0.20)***
CONSTANT	1.02 (0.14)***	1.03 (0.14)***
Number of Observations	1336	1336
Log Likelihood	-2806.5624	-2807.5563
ρ	-0.38	-0.38
σ	1.21	1.22
λ	-0.46	-0.46

[a]: The likelihood-ratio test of the independent equations of sales and outsourcing (ρ=0) is: $\chi^2(1)$=4.30, Prob>χ^2=0.0381. The results indicate a correlation between the two equations at 5% significance level, we therefore run the maximum-likelihood estimation for both equations. Since the results from the outsourcing equation are qualitatively the same as those from Table 4, we do not report their results.

[b]: ***, **, and * indicate significance at the one-tailed levels of 1%, 5%, and 10%, respectively.

Table 6 Regression Results for Sales and Number of Employees

(independent variable)	Relative Sales (6) [a]	Relative Employment (7) [b]
SMALL	-0.34 (0.28)	-0.18 (0.15)
LARGE	1.48 (0.27)***	1.37 (0.15)***
RD	-1.83 (2.97)	-1.13 (1.98)
RDLARGE	5.22 (5.37)	2.68 (3.56)
TEC	7.72 (6.39)	10.85 (4.34)***
EXRATIO	-1.08 (1.08)	0.62 (0.70)
EXRATIO2	0.41 (0.98)	-0.79 (0.63)*
ORDER	0.33 (0.21)*	0.01 (0.13)
THRIVING	-0.64 (0.23)***	-0.09 (0.12)
DECLINING	-0.06 (0.37)	0.28 (0.20)*
FDI	-1.07 (0.47)***	0.05 (0.25)
CHINA	-0.11 (0.43)	-0.06 (0.23)
USA	1.41 (0.58)***	0.08 (0.31)
UP	-0.99 (0.89)	-0.16 (0.47)
DOWN	-1.10 (0.52)**	-0.26 (0.28)
AGE/10	-1.07 (0.62)**	0.82 (0.33)***
AGE2/100	0.35 (0.28)*	-0.26 (0.15)**
OUTSOURCE	4.22 (0.25)***	-0.28 (0.13)**
CONSTANT	0.53 (0.38)*	0.37 (0.22)**
No. of Observations	1336	1336
R-squared		0.1584
Log Likelihood	-4097.3957	
ρ	-0.76	
σ	3.69	
λ	-2.81	

[a]: The likelihood-ratio test of the independent equations of sales and outsourcing (ρ=0) is: $\chi^2(1)$=114.30, Prob>χ^2=0.0000. The results indicate a significant correlation between the two equations, we therefore run the maximum-likelihood estimation for both equations. However, we do not report the results for the outsourcing equation to save space.

[b]: The likelihood-ratio test of the independent equations of employees and outsourcing (ρ=0) is: $\chi^2(1)$=0.04, Prob>χ^2=0.8471. The results indicate no correlation between the two equations, we therefore report the OLS results here.

c: ***, **, and * indicate significance at the one-tailed levels of 1%, 5%, and 10%, respectively.