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Foreign ownership structure, technology upgrading and exports: Evidence from Chinese firms
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Abstract: We examine the role of foreign ownership structure in stimulating technology and skill upgrading, and exporting in Chinese manufacturing firms that were taken over by foreign owners. The analysis considers the period 2001 to 2007. We use a propensity score reweighted least squares estimation to control for the possible endogeneity of the acquisition decision. Our results indicate that there are strong effects on export activity post-acquisition for all types of ownership share. We also find that targets that are taken over with a less than 100 per cent foreign ownership share experience increases in new product development and R&D upgrading due to the acquisition. Overall, our results suggest that joint ventures between foreign owners and Chinese firms can contribute positively to China's "science and technology take-off"..

Keywords: F23

JEL classification: foreign acquisition, technology upgrading, exports, propensity score reweighting

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1. Introduction

The performance of the Chinese economy has fascinated academic researchers and the public for a number of years, and continues to do so still. Apart from its growth performance, a number of issues have received particular attention, including its export performance, innovative activity, and inward foreign direct investment (FDI). China has, since the opening up of the economy, tremendously increased its export performance. It accounted for roughly 10 percent of world-wide exports in 2010, making it the world's top exporter in that year (WTO, World Trade Report 2011). Over the same time, China has begun what Jefferson (2005) terms its "science and technology (S&T) takeoff". Data available from the World Development Indicators show that, between 1996 and 2007, China increased its R&D expenditures from 0.5 to 1.4 percent of GDP – making it comparable to many industrialized countries. Finally, China has become one of the most important host countries for inward foreign direct investment. By 2010, about 14 percent of all foreign direct investment flows went into the Chinese economy.

One of the Chinese government's key goals in recent years has been to upgrade the technological capabilities of its firms in order to sustain exports and economic growth rates.[1] The Director of the National Development and Reform Commission China, Zhang Ping, recently stated that the Chinese government is "actively encouraging foreign investments in high-end manufacturing, high-tech industries, modern service industry, and international environmental industry" (People's Daily 2012). For a long time, China's government has been aware that attracting FDI is one channel to boost technology and growth. However, empirical evidence is still unclear on whether foreign investment in China helps to improve Chinese firms' technology and export performance at the same time. It is also unclear whether there are differences between different levels of foreign capital involvement (e.g. Joint Ventures or Wholly foreign owned companies) and what these different effects might look like.

[1] One reason for this is that rising wages and a stronger Renminbi make Chinese exports more expensive compared to low wages countries such as Vietnam, Cambodia etc. For example, wages have increased by 14% on average in the last decade (Forbes 2011) and the Renminbi has appreciated by more than 30% since 2005, putting pressure on lower value Chinese exports.

Hence, in this paper, we investigate whether the increasing levels of inward FDI have a direct impact on export performance and technology upgrading.[2] This is done using a comprehensive firm level database covering enterprises in the Chinese manufacturing sector. More specifically, we analyse whether the injection of foreign capital into a firm improves this firm's investment in R&D, training, new product development, and its export performance. In order to identify the effect of foreign capital inflows, we look at foreign acquisitions, i.e., firms that were previously domestic owned but were at some stage acquired (partly or wholly) by foreign firms. We pay particular attention to whether foreign ownership structure – that is, the degree of foreign ownership – matters for these effects. Also, we are interested in identifying causal effects rather than establishing correlations between these variables.

Looking at acquisitions is an important aspect in our strategy for disentangling correlation and causality. While, for example, papers such as Aitken and Harrison (1999) find that foreign-owned firms are more productive than domestic firms, such studies cannot distinguish whether this productivity advantage is due to foreign firms "cherry picking" highly productive domestic firms as targets for entry-by-acquisition, or whether these firms actually improve their performance after receiving the foreign capital inflow. Looking specifically at foreign acquisitions allows us to circumvent this problem by firstly examining what determines the acquisition decision, and then focusing on post-acquisition changes in performance controlling for pre-acquisition characteristics.

This is the strategy we follow in this paper, implementing a propensity score reweighting estimator as developed by Hirano et al. (2003). While a number of related papers use standard propensity score matching (e.g., Arnold and Javorik, 2009, Görg, Henry and Strobl, 2008), ours is one of the first applications of the propensity score reweighting estimator in this literature. Busso et.al (2009) show that, appropriately implemented, propensity score reweighting estimators

[2] We do not consider indirect effects through spillovers in this paper.

typically outperform propensity score matching estimators. We also compare our results with a standard propensity score matching approach.

Besides the focus on identifying causal relationships, our paper additionally contributes to the literature in a number of ways. Firstly, we investigate the effects on technology upgrading as well as exports. Thus far, the literature on the effects of foreign acquisitions has tended to concentrate on either technology or exporting.[3] However, as Bustos (2010) and Hanley and Monreal-Perez (2012) show theoretically and empirically, technology upgrading (through investments in R&D or skills) and exports are likely to be related. Firms may either upgrade technology pre-export entry to improve quality or post-export entry through learning effects.

Secondly, we look specifically at whether ownership structure matters for technology upgrading and exports. This has, to the best of our knowledge, not received much attention in the literature. The paper most closely related to ours is Guadalupe et al. (2010), who investigate the link between foreign acquisition and innovation activity using firm level data for Spain. They also use a propensity score reweighting estimator. However, in contrast to our paper, they do not consider skill upgrading or exports, and they also do not investigate whether ownership structure matters. In this regard, Thomas et al. (2008) provide a descriptive analysis showing that foreign owners forming contractual agreements with local partners through joint ventures, equity joint ventures and joint stock enterprises are more successful in inducing new product developments than wholly owned firms. However, in their empirical approach they cannot claim to establish causal relationships.

How should ownership structure affect technology upgrading and exports? There are two plausible arguments. Firstly, one may expect that a higher foreign ownership share should lead to higher levels of investment in technology and skills. There is case study evidence by Mansfield and Romeo (1980) that multinational parent firms transfer more up-to-date technology to wholly-

[3] For example, a number of papers employing propensity score matching show that foreign acquisitions lead to productivity increases (Arnold and Javorcik, 2009), where the implicit assumption is that technology improvements drive these increases in productivity. A number of studies also look at the relationship between acquisitions and exporting, see, for example, Du and Girma (2009) using firm level data for China.

owned affiliates than to joint ventures. Also, econometric studies by Asiedu and Efahani (2001) and Javorcik and Saggi (2010) show that multinationals with the highest level of technology enter host countries via wholly owned affiliates rather than joint ventures. This higher use of technology may arguably translate into technology upgrading and higher export activity in the foreign acquisition targets.

Secondly, however, one may also make a case that higher foreign ownership may be associated with lower technology and skill upgrading, if one assumes that there are different levels of technology gaps between purchaser and target depending on the level of foreign-ownership. If foreign owned firms tend to cherry pick the "best" targets for wholly-owned takeovers, then there may be only little need for technology upgrading as these firms are already operating close to the technology frontier. However, for partially-owned firms, which are initially operating using lower levels of technology, there would be a higher technology gap vis-a-vis the target and the purchaser, hence, a higher level of technology and skill upgrading would be possible after the acquisition. Another, less benevolent view, may be that foreign owners are more likely to integrate wholly-owned affiliates completely into their international production network, stripping the affiliate of its R&D activities and relocating it to the headquarters. This may be less likely if the Chinese partner is involved.

The theoretical expectation is, therefore, ambiguous and needs to be decided by empirical evidence. This is what we set out to do in this paper using firm level data for China on foreign acquisitions and technology and skill upgrading. The remainder of the paper is structured as follows. Section 2 describes the firm level data we use and presents some descriptive statistics. Section 3 outlines the empirical methodology used. Section 4 discusses our results and considers some extensions to the empirical model. Some concluding comments are presented in Section 5.

2. Description of the dataset

Our empirical analysis uses a comprehensive firm level dataset, the Annual Reports of Industrial Enterprise Statistics, compiled by the China National Bureau of Statistics. The dataset covers all firms in China with an annual turnover of more than 5 million yuan (about $785,000). These companies account for an estimated 85–90 percent of total output in most industries. The data set includes, amongst other things, information on the fraction of paid-in capital by foreign investors, R&D, employee training expenditure, new product development, exports, gross output, value added, employment, ownership structure, industry affiliation, and geographic location. The data available to us cover the period 2001 to 2007 and comprises more than 1.3 million observations from about 446,000 firms.

However, in view of the objective of this paper, our econometric analysis is confined to those firms that attracted foreign capital for the first time between 2002 and 2006 (our "treatment group") and those firms that remained domestic during the observational period (our "control group"). This leads us to a panel of 319,812 observations (65,195 firms) spanning the period 2001-2007. This panel allows us to control for pre-acquisition characteristics and evaluate the post-treatment effects on the year of acquisition and at least one period following acquisition.

We define a foreign acquisition in time *t* as a plant that has a zero foreign ownership share in *t-1*, and a positive share in *t*. In the Introduction we argue that acquisitions with "high" foreign ownership shares may have different implications that those with "low" foreign involvement. Rather than distinguishing two categories of shared and full ownership, as e.g., in Javorcik and Spatareanu (2008) we consider four foreign ownership categories based on the share of capital paid in by the foreign investors. These allow us a finer distinction, by providing for possible differences between minority and majority foreign ownership.

The first category comprises those acquired firms with a share of foreign capital lower than 25 per cent. This takes account of a specificity in China, namely, that these are defined by the Chinese authorities as local firms, but with some level of foreign capital. The second category includes firms with a foreign share higher than or equal to 25 per cent but lower than 50 per cent,

which are considered foreign firms with minority foreign ownership. Our third category contains firms with a foreign share higher than or equal to 50 per cent but lower than 100 per cent, that is, foreign firms with majority foreign ownership. Finally, our last category comprises those firms that were fully (i.e., 100%) acquired by the foreign investors.

Table 1 gives the frequency distribution of foreign acquired firms in the sample by year and foreign ownership structure. We ascertain that 3,014 firms received foreign capital for the first time between 2002 and 2006 (about 5 per cent of our sample of firms), with the number of foreign acquisitions showing a marked increase after 2004. Wholly owned foreign subsidiaries made up 35 per cent of total acquired firms during the observational period, foreign subsidiaries with majority foreign control accounted for 22 per cent, joint ventures with minority foreign participation represented 31 per cent and local firms that attracted low levels of foreign capital accounted for the remaining 12 per cent.

[Table 1 here]

The number of foreign acquisitions by industry and foreign ownership structure is presented in Table 2. It shows that the period 2002-2006 has been characterised by a considerable diversification of foreign acquisitions across different industries and foreign ownership structures.

[Table 2 here]

For the acquired firms, our dataset also allows us to distinguish the origin of the foreign investor (i.e. Chinese companies investing from Taiwan, Hong Kong and Macao versus multinational firms from the rest of the world) and the type of local partnership (i.e. private versus state-owned local partners). Table 3 shows the percentage of acquired firms according to these characteristics. Interestingly, although the majority of takeovers are Chinese ethnic investors across all foreign ownership categories, they are more prevalent in the group of firms that attracted low levels of foreign capital (i.e. less than 25 per cent). In contrast, investors from the rest of the world have showed a marked interest for higher levels of control.

[Table 3 here]

Table 4 provides information on some firm characteristics for acquired firms in the pre-acquisition year. Compared to firms that remained domestic, future recipients of foreign capital were on average younger, larger and more productive. Also, a lower percentage of firms with state participation were observed amongst future acquired firms, whereas a significant higher fraction of exporters was prevalent in the groups of firms that attracted foreign capital, regardless their foreign ownership structure. In general, we observe that amongst acquired firms there is a negative relationship between the degree of engagement in technological activities in the pre-acquisition period and the level of foreign ownership attracted.

[Table 4 here]

Overall, this description points out the necessity of adjusting for differences in observable characteristics in the treated and control groups in order to accurately identify our post-acquisition effects.

3. Empirical methodology

The research question is whether a firm *i* is more likely to become an exporter and upgrade its technological capacity when it receives foreign capital. A second question is whether the degree of foreign ownership plays a role in stimulating these changes.

Our longitudinal data over the period 2001-2007 allow us to compare the post-acquisition performance of acquired firms with a control group of firms that remained domestic during the period of analysis. To control for temporal trends or the effect of events, other than acquisition, that occurred during the period of analysis we focus on the difference-in-difference between the change in the technological/exporting status for the two groups of firms before and after acquisition. The difference-in-difference (DID) approach also allows us to control for time-invariant unobserved factors that influence the decision to export, invest in technology and

attract foreign capital. However, we acknowledge that the level of participation offered to the foreign investor might be highly correlated with the firm's potential to innovate and export.

To control for this well-known selection bias we combine the DID methodology with a propensity score reweighting estimator that allow us to improve comparability between acquired and non-acquired firms based on observed characteristics in the pre-acquisition period.

a. Basic set up

For a firm *i* that has been in domestic hands up to year *t-1*, let F={1,2,3,4}be an indicator of the degree of foreign capital attracted at time period *t*. As described in Section 2, these four categories are (i) ownership share of less than 25 percent, (ii) 25 – 49 percent, (iii) 50 – 99 percent, (iv) 100 percent, i.e., wholly foreign-owned.

Using the language of the microeconometric evaluation literature, let Y_{it+s}^{f} be the set of potential *outcomes* for all mutually exclusive *treatments* $f \in F$ at time $t+s$, $s \geq 0$. Also denote Y_{it+s}^{0} as the outcome of the firm had it not received foreign capital (purely domestic firms). For each firm, only one outcome is observed, the remaining four outcomes are *counterfactuals*. In our empirical approach these outcomes refer to the *change* in the firm's technology/exporting status between time *t* and time *t+s*. We consider three types of technology upgrading, namely investments in research and development, new product development and employee training expenditure. In our empirical approach we evaluate the post-investment effects on the year of acquisition and up to three subsequent periods ($s \leq 3$).

We are interested in evaluating the effects of FDI on the population of firms that receive a specific type of foreign ownership, $f \in F$, compare to no receiving any FDI during the observational period (i.e. the average treatment effects on the treated, ATT). This causal effect is defined as the difference between the mean outcome of all firms receiving *type-f* FDI and the mean outcome of the *same* group of firms had they not become foreign subsidiaries:

$$\theta_{t+s}^{f\,0} = E\left\{Y_{it+s}^{f} - Y_{it+s}^{0} \mid F = f\right\} = E\left\{Y_{it+s}^{f} \mid F = f\right\} - E\left\{Y_{it+s}^{0} \mid F = f\right\}$$

The fundamental problem of causal inference is that the quantity $E\{Y_{it+s}^0 \mid F = f\}$ is unobservable. That is, we cannot observe the technology and exporting status of firms that received foreign capital had they not received FDI inflows. Taking the mean outcome of all domestic firms as an approximation is inappropriate because it is most likely that firms' characteristics that determine the equity position of the foreign investor also determine their future performance.

Various methods based on the propensity score have been proposed to adjust for differences in observable characteristics in the treated and control groups. Empirical studies are often based on matching or reweighting using an estimate of the propensity score (i.e. the conditional probability of treatment given pre-treatment characteristics).[4] In this paper we identify the causal effects using the propensity score reweighing estimator due to Hirano et. al. (2003), who show that reweighing by the inverse of the propensity score, rather than the true propensity score, leads to and efficient estimate of the average treatment effects. Busso et.al (2009) further prove that, appropriately implemented, propensity score reweighting estimators typically outperform propensity score matching estimators.

b. Propensity score reweighing

We consider an estimator based on a weighted least squares estimation of the regression function

$Y_{i,t+s} = \alpha_0 + \tau * f + e_{i,t+s}$ for all $f \in F$

where $Y_{i,t+s}$ is change in the firm's technology/exporting status between time *t* and time *t*+*s* and τ is the difference-in-differences estimate of the impact of foreign ownership structure *f*. In our empirical approach we set $Y_{i,t+s}$ equal to 1 if the firm starts exporting/investing in technology and zero otherwise.

[4] In the international trade literature, examples are Arnold and Javorcik (2009), Girma and Görg (2007), Görg et al. (2008) and Guadalupe et al. (2010).

Intuitively, the propensity score reweighing method adjust for differences between groups of firms by assigning greater (lower) weights to firms that are more (less) similar to firms in the other group. Since our aim is to estimate the average treatment effects on the acquired firms, we want to find control groups of domestic firms that are as close as possible to each group of firms that were acquired under each foreign ownership structure, $f \in F$. To this end, we weight each acquired firm by 1 and each non acquired firm by $\hat{P}_{f0}/(1-\hat{P}_{f0})$, where $\hat{P}_{f0}$ is the conditional probability of being acquired under type-*f* foreign ownership structure (i.e. our propensity score index)[5].

c. Estimation of the propensity score

Lechner (2002) provides a practical guidance to estimate the propensity score in a multi-treatment framework. Following his approach, we first estimate an ordered probit model of foreign ownership structure to obtain the vector of marginal probabilities, $\hat{P}_0$ and $\hat{P}_f$ for all $f \in F$. Then, we compute our propensity score index as $\hat{P}_{f0} = \frac{\hat{P}^f}{\hat{P}^f + \hat{P}^0}$ for all $f \in F$.

Thus, for firm *i* we model the foreign ownership structures to arise sequentially as the latent variable, F*, crosses progressively higher thresholds:

$$F_{it}^* = \alpha + \beta X_{it-1} + d_t + d_s + d_r + v_{it} \qquad F_{it} = \begin{cases} 0 & if \quad F_{it}^* = 0\% \\ 1 & if \quad 0\% < F_{it}^* < \%25\% \\ 2 & if \quad 25\% \le F_{it}^* < \%50 \\ 3 & if \quad 50\% \le F_{it}^* < \%100 \\ 4 & if \quad F_{it}^* = \%100 \end{cases}$$

Where F^* is the share of foreign participation in the capital of the firm and X is a vector of pre-acquisition covariates that are hypothesised to impact on the choice of the foreign ownership structure. This vector consists of firm size, age, productivity and a set of dummy variables indicating whether the firm exports, invests in R&D, invest in employee training, has developed

[5] An estimation of the population average treatment effects (ATE) would require weighting the treatment observations by $1/\hat{P}_{f0}$ and the control observations by $1/(1-\hat{P}_{f0})$ (see Hirano and Imbers, 2001).

new products or has state participation. The definition of these variables and their summary statistics are presented in Table 5. We also include interaction terms between the variables in *X* and control for a full set of time (d_t) and sectoral (d_s) dummy variables.[6] The choice of these covariates is guided by the empirical literature on foreign acquisitions, such as Harris and Robinson (2002), Conyon et al. (2002).

[Table 5 here]

The marginal effects from the ordered probit model of the determinants of the foreign ownership structure are reported in Table 6.[7] Consistent with a large body of empirical work showing that foreign firms have strong preferences for the best performing firms ("cherry picking"), we find that younger, larger, more productive and exporting firms are more likely to be the target of acquisition of foreign investors. However, multinational firms do not show a preference for firms that are already engaged in technology and skill upgrading or for state-owned firms.

[Table 6 here]

d. Common support and balancing condition

An important requirement to identifying causal treatment effects is the common support or overlap condition: $\varsigma < \hat{P}_{f0}(X) < 1-\varsigma$ for every x in X. That is, firms with the same value of the covariates, *X*, should have a positive probability of receiving and no receiving FDI. We impose the common support condition to ensure that any combination of characteristics observed in the group of acquired firms, *f*, can also be observed among the group of domestic firms. Thus, we restrict our attention to the group of domestic firms that fall within the support of the propensity score distribution of the group of foreign firms, *f*.

[6] This specification allows to control successfully for firm-specific differences in the acquisition period. We also used other specifications to verify that our post-acquistion effects were robust to the choice of our ordered probit model.
[7] The full estimated coefficients, including the interaction terms between the covariates, are reported in Table A1 in the Annex.

In addition, to check that the propensity score is successful in controlling for firm differences in the pre-acquisition period we provide a balancing test. We divide the sample by propensity score deciles and use a regression framework to test that for each subsample the pre-treatment differences in covariates between acquired and non-acquired firms are not significant. Table A2 in the Appendix reports these balancing test results. It is reassuring that the balancing condition is satisfied, indicating that our estimated propensity score successfully randomizes firms at each propensity score decile. Thus, at each propensity score decile acquired and non-acquired firms are comparable in terms of all observable characteristics other than their acquisition status and we can estimate the mean *counterfactual* outcome of acquired firms by the mean *observed* outcome of non-acquired firms.

4. Econometric Estimations

4.1 Estimates from the propensity score reweighting estimator

Having established that conditional on the propensity score, acquired and non-acquired firms are comparable, we now present in Table 7 the reweighted least square estimates of the causal effects of foreign acquisitions on firms' exporting, technology and skill upgrading. The table consists of four panels, showing the effects (i) in the year of acquisition, (ii) one year, (iii) two years and (iv) three years after acquisition, respectively.

Note, firstly, that for all years we find statistically significant and positive effects of the foreign acquisition on the probability to export in the target. This is true for all four forms of ownership share, though we find stronger effects for majority and fully-owned affiliates in all years. Hence, a foreign takeover unambiguously boosts export performance in the acquired target.

The effects on technology upgrading vary with the type of technology upgrade and the degree of foreign ownership structure. We find evidence of technology upgrading via R&D and new product developments amongst joint ventures between foreign owners and Chinese firms. These effects are stronger amongst targets with minority foreign ownership and occur during the first

two years following the acquisition. In contrast, we fail to find any evidence that fully-owned foreign affiliates experience any increases in R&D or new product development due to the takeover. Instead, these activities have a statistically significant negative effect. This finding is in line with our explanations advanced in the Introduction. Firstly, it suggests that the technology gap between foreign acquirer and domestic target may play a role. The foreign acquirer may be engaging in joint ventures with local partners in firms where the level of technology is below the level of the acquirer. Hence, there is a strong potential for technology upgrading post-acquisition. For targets that are 100% taken over the technology gap between foreign acquirer and target may be relatively low, thus not necessitating strong efforts in technology upgrading. Indeed, one explanation for the negative effect could be that foreign owners dismantle technology activity in the new foreign affiliate and relocate it to their headquarters. This makes sense if the affiliate is fully integrated in the international production network, and may now be merely one production plant in that network.

We also identify a negative effect on skill upgrading following acquisition. On the one hand this shows that foreign owners might rely less on training than the former Chinese owners by hiring high skilled workers (e.g. university graduates) from the external market. On the other hand, there is a wide-spread perception that training expenditures were sometimes used for non-training purposes (such as dinners for hosting guests / day-out trips etc.) and post-acquisition there might have been a stronger cost control for this type of expenses.[8] Unfortunately, our data does not allow us to investigate this conjecture in more detail.

[Table 7 here]

4.2 Robustness Check: Estimates from propensity score matching

[8] The Chinese government sees a potential problem with the cost control of training expenditure, for example, the People's Government of Zhejiang Province made an announcement on 28th May 2007 to request restrictions on training expenditure. http://www.zjzfcg.gov.cn/new/sysej/257230.html

To make sure that our results are robust to the choice of the propensity score method, we employ a difference-in-difference matching estimator based on the nearest neighbour matching algorithm with replacement. The results are reported in Table 8.

Note that the results on the impact of foreign acquisition on exporting and skill upgrading are remarkably similar, in terms of both magnitude of coefficients and their statistical significance, to those reported in Table 7. One difference between Table 7 and Table 8 is that the positive impact on R&D and new product development amongst targets with a less than 25 per cent foreign ownership share is not significant in the year of acquisition. Even despite this difference, the two estimation approaches give a fairly similar picture on the importance of technology upgrading in targets that retain high levels of local participation.

[Table 8 here]

4.3 Extensions of the empirical model

Our previous results constrain the effects of the foreign ownership structure to be the same within each group of acquired firms. However, the role of foreign acquisitions on exporting and technology and skill upgrading might vary under certain circumstances. For instance the technology gaps between the acquirer and the target might vary with the origin of the foreign investor and, as we have discussed in the Introduction, this might have important post-acquisition implications. Our dataset allow us to distinguish between foreign acquires of Chinese origin or "ethnic Chinese" (which account for nearly 67 percent of total acquirers) from foreign investors from the "rest of the world". To examine whether these two sources of FDI matter, we interact our foreign ownership structure variable with a dummy variable that takes the value of one if the source of FDI comes from the "rest of the world" and zero otherwise.

The results from this experiment are reported in Table 9 and show that the positive effects on exporting, new product development and R&D found in Tables 7 and 8 are mainly attributed to investments made by ethnic Chinese investors. There are two likely factors explaining these

findings: a) Ethnic Chinese investors tend to invest in lower end manufacturing (the R&D level is only about 61% of the R&D level of foreign invested firms), where it is easier to improve R&D and NPD, b) Ethnic Chinese investors can be mainland Chinese investors who invest through especially Hong Kong and Macao to gain preferential tax treatments for R&D and NPD expenditure. These preferential tax treatments are to a degree conditional on the investor coming from outside of mainland China.

[Table 9 here]

The post-acquisition effects can also be affected by the ownership of the local partner, i.e., whether it is private or state-owned (SOE). There are two conflicting views on choosing SOE as local partners. One view argues that the performance of state owned firms remains unsatisfactory (e.g. Lin et al, 1998, Xu and Wang, 1999) due to the historical social legacy, for example, maintaining low levels of unemployment which often meant keeping unskilled labour. On the other hand, according to Sun et al, (2002), the government has a positive impact on firm performance by sending a positive signal to markets, by being connected to insider connections and by having better opportunities to receive government subsidies.

To allow for potential differential impacts associated with the type of local partnership, we also interact our foreign ownership variable with a dummy variable equal to one if the domestic partner is a state-owned firm and zero otherwise. The results from these estimations indicate that the positive effects on exporting, new product development and R&D are mainly confined to joint-ventures with local private enterprise (Table 10).

[Table 10 here]

5. Conclusions

Using a comprehensive firm level database from the Chinese manufacturing sector, this paper evaluates the direct impact of the foreign ownership structure of FDI projects on export performance and technology upgrading. To identify causal relationships we implement a

propensity score reweighting estimator. Our results indicate that the degree of foreign participation plays an important role in promoting these activities. We unambiguously confirm that all acquisition forms entail a strong boost to export activity after the incidence of acquisition, though these effects are stronger for majority and wholly-owned foreign subsidiaries.

We also find that joint ventures between foreign and local firms experience an increase in R&D and new product development that is due to the incidence of takeover. However, we do not find evidence that firms that were fully acquired experience any increase in technology upgrading following acquisition. This is in line with an explanation that fully acquired targets are completely integrated into the international production network of the multinational and that its R&D and new product development activities are relocated to the headquarters of the new owner abroad.

Importantly, for policy makers, our overall results indicate that joint ventures are potentially important venues for technology upgrading in China. These effects also suggest that coherence between industrial policies aimed at attracting FDI and science & technology policies are important for maximizing the benefits of inward FDI.

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Tables

Table 1: Number of acquisitions by foreign ownership structure, 2002-2006

Year	Category of foreign ownership structure				Total
	1	**2**	**3**	**4**	
2002	55	123	84	113	**375**
2003	28	99	88	95	**310**
2004	60	211	135	271	**677**
2005	99	233	158	255	**745**
2006	116	283	184	324	**907**
Total	**358**	**949**	**649**	**1,058**	**3,014**

Source: Authors' analysis based on data from China National Bureau of Statistics

Table 2: Number of acquisitions by industry and foreign ownership structure, 2002-2006

Two-digit industry classification	Foreign ownership structure				Total
	1	2	3	4	
Food processing	15	54	27	47	143
Food production	6	25	19	42	92
Beverage industry	5	10	16	21	52
Tobacco processing	0	0	0	0	0
Textile Industry	44	87	53	94	278
Garments and other fibre products	27	55	50	110	242
Leather, furs, down and related products	6	25	25	49	105
Timber processing	5	11	8	14	38
Furniture manufacturing	1	15	7	24	47
Papermaking and paper products	8	23	18	28	77
Printing and record medium reproduction	5	15	11	6	37
Cultural, educational, and sports goods	4	20	12	23	59
Petroleum refining and coking	4	8	2	5	19
Raw chemical materials and chemical products	37	102	37	51	227
Medical and pharmaceutical products	11	35	23	33	102
Chemical fibre	3	5	4	6	18
Rubber products	6	5	3	16	30
Plastic products	13	31	33	60	137
Non-metal mineral products	17	47	48	32	144
Smelting and pressing of ferrous metals	13	13	7	14	47
Smelting and pressing of nonferrous metals	3	16	11	13	43
Metal products	15	53	31	63	162
Ordinary machinery	19	80	38	38	175
Special purpose equipment	17	26	30	36	109
Transport equipment	12	40	34	28	114
Other electronic equipment	32	78	46	80	236
Electric equipment and machinery	16	36	29	76	157
Electronic and telecommunications	7	8	12	12	39
Instruments and meters	7	25	15	37	84
Total	**358**	**948**	**649**	**1,058**	**3,013**

Source: Authors' analysis based on data from China National Bureau of Statistics

Table 3: Characteristics of foreign acquisitions in the year of acquisition
Percentage of firms

Category of foreign ownership structure	Type of foreign Investor		Type of local partner	
	Ethic Chinese	Other	Private	State-owned
1	82	18	86	14
2	69	31	95	5
3	56	44	94	6
4	62	38		

Table 4: Summary statistics of Pre-treatment characteristics

		SIZE	PROD	AGE	SOEs	RD	TRAINING	NPD	EXPORTS
Domestic firms	Mean	8.48	0.98	14.44	0.10	0.15	0.45	0.09	0.21
	Std. Dev.	1.64	1.99	13.38	0.30	0.36	0.50	0.28	0.41
Foreign ownership structure of acquired firms:									
1	Mean	9.95	2.25	13.32	0.05	0.26	0.52	0.23	0.48
	Std. Dev.	1.92	10.02	13.56	0.22	0.44	0.50	0.42	0.50
2	Mean	8.86	1.36	9.34	0.03	0.18	0.44	0.12	0.38
	Std. Dev.	1.69	3.40	10.60	0.16	0.39	0.50	0.33	0.49
3	Mean	8.66	2.09	7.72	0.02	0.14	0.35	0.11	0.40
	Std. Dev.	1.91	7.89	9.18	0.15	0.35	0.48	0.31	0.49
4	Mean	8.46	1.35	6.38	0.02	0.10	0.24	0.08	0.45
	Std. Dev.	1.77	2.53	7.46	0.13	0.31	0.42	0.27	0.50

Source: Authors' analysis based on data from China National Bureau of Statistics

Table 5: Definition of variables and some summary statistics

Variable	Definition	Mean	Std. Dev.
Size	Log of total assets	8.49	1.65
Productivity	Log of value added per worker	1.00	2.27
Age	Firm age since incorporation	14.16	13.30
Research and Development (RD)	Dummy variable equal to 1 if the firm invest in R&D, and 0 otherwise	0.14	0.35
Training	Dummy variable equal to 1 if the firm invest in labour training, and 0 otherwise	0.44	0.49
New product development NPD	Dummy variable equal to 1 if the firm has developed a new product, and 0 otherwise	0.09	0.28
Exports	Dummy variable equal to 1 if the firm exports, and 0 otherwise	0.22	0.41
State Owned Enterprise (SOEs)	Dummy variable equal to 1 if the State holds shares in the firm's capital, 0 otherwise	0.09	0.27

Table 6: The determinants of foreign ownership structure: estimates from the ordered probit model

Marginal effects

	Category of foreign ownership structure			
	1	2	3	4
Size	0.0007*	0.0018*	0.0011*	0.0019*
	(0.000)	(0.000)	(0.000)	(0.000)
Productivity	0.0004***	0.0010***	0.0006***	0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)
R&D expenditure	0.0000	0.0001	0.0001	0.0001
	(0.000)	(0.001)	(0.001)	(0.001)
Exports	0.0033***	0.0083***	0.0053***	0.0092***
	(0.000)	(0.001)	(0.000)	(0.001)
State owned	-0.0015***	-0.0037***	-0.0023***	-0.0039***
	(0.000)	(0.001)	(0.001)	(0.001)
Age	-0.0004***	-0.0010***	-0.0006***	-0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)
Training expenditure	-0.0017**	-0.0045**	-0.0029**	-0.0053**
	(0.000)	(0.000)	(0.000)	(0.001)
New product development	-0.0003	-0.0008	-0.0006	-0.0015
	(0.000)	(0.001)	(0.001)	(0.001)
Number of observations	65688	65688	65688	65688

* p<0.1, ** p<0.05, *** p<0.01

Table 7: Effects of foreign ownership structure on technology investments and exporting: Results based on an inverse probability weighted least square estimation

In the year of acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0367**	0.0358**	-0.0147	0.0415***	48019
	(0.015)	(0.014)	(0.021)	(0.015)	
Minority (II)	0.0196**	0.0114	-0.0094	0.0470***	46715
	(0.009)	(0.007)	(0.013)	(0.009)	
Majority	-0.0012	0.0034	-0.0048	0.0805***	37863
	(0.009)	(0.008)	(0.016)	(0.013)	
Wholly owned	-0.0207***	-0.0076	-0.0577***	0.0869***	37137
	(0.007)	(0.006)	(0.012)	(0.011)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One year after acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0559***	0.0367**	-0.0243	0.0563***	47665
	(0.019)	(0.017)	(0.021)	(0.018)	
Minority (II)	0.0365***	0.0235**	-0.0231*	0.0777***	46369
	(0.011)	(0.010)	(0.013)	(0.012)	
Majority	0.0101	0.0004	-0.0028	0.1165***	37564
	(0.012)	(0.010)	(0.017)	(0.016)	
Wholly owned	-0.0053	-0.0207***	-0.0397***	0.1094***	36854
	(0.009)	(0.007)	(0.013)	(0.012)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Two years after acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0598**	0.0478*	-0.0461	0.0556**	47698
	(0.026)	(0.025)	(0.029)	(0.024)	
Minority (II)	0.0164	0.0387***	-0.0018	0.0852***	46205
	(0.013)	(0.014)	(0.019)	(0.016)	
Majority	0.0346**	0.0065	0.0051	0.1251***	37475
	(0.017)	(0.015)	(0.024)	(0.021)	
Wholly owned	-0.0043	-0.0191*	-0.0494***	0.1192***	36624
	(0.011)	(0.011)	(0.018)	(0.016)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Three years after acquisition				
Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0523	0.0349	0.0024	0.0886**	21013
	(0.036)	(0.035)	(0.044)	(0.037)	
Minority (II)	0.0721***	0.0138	-0.0182	0.0861***	20525
	(0.021)	(0.018)	(0.024)	(0.020)	
Majority	0.0053	0.0146	-0.0217	0.1528***	17031
	(0.020)	(0.022)	(0.029)	(0.028)	
Wholly owned	-0.0312**	-0.0277*	-0.0192	0.1730***	16756
	(0.014)	(0.015)	(0.024)	(0.023)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Results from a DID matching estimator based on the nearest neighbour matching algorithm with replacement

Effects in the year of acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0113	0.0188	-0.0019	0.0620***	63167
	(0.020)	(0.022)	(0.041)	(0.020)	
Minority (II)	0.0412*	0.0214	-0.0027	0.0522***	63735
	(0.022)	(0.022)	(0.055)	(0.013)	
Majority	0.0033	0.0082	-0.0188	0.0809***	63440
	(0.017)	(0.014)	(0.074)	(0.017)	
Wholly owned	-0.0269**	0.0000	-0.0503*	0.0814***	63809
	(0.011)	(0.010)	(0.028)	(0.014)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effects one year after acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0817***	0.0467**	0.0117	0.0700***	62669
	(0.028)	(0.024)	(0.038)	(0.023)	
Minority (II)	-0.0741	0.0479**	0.0423	0.0813***	63234
	(0.077)	(0.020)	(0.055)	(0.016)	
Majority	-0.1141	0.0126	0.0579	0.1141***	62935
	(0.080)	(0.018)	(0.046)	(0.018)	
Wholly owned	-0.0007	-0.0126	-0.0084	0.1109***	63312
	(0.014)	(0.014)	(0.022)	(0.019)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effects two years after acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0698**	0.0726***	-0.0475	0.0698***	62763
	(0.033)	(0.026)	(0.043)	(0.024)	
Minority (II)	0.0142	0.0531***	0.0142	0.0863***	63111
	(0.018)	(0.015)	(0.025)	(0.016)	
Majority	0.0423**	0.0046	0.0081	0.1125***	62929
	(0.018)	(0.019)	(0.027)	(0.024)	
Wholly owned	-0.0035	-0.0168	-0.0398*	0.1193***	63151
	(0.014)	(0.015)	(0.022)	(0.021)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Effects three years after acquisition

Foreign Ownership Structure of ACQ	R&D	NPD	TRAINING	EXPORTS	N
Minority (I)	0.0260	0.0104	-0.0625	0.1042**	27653
	(0.051)	(0.041)	(0.055)	(0.040)	
Minority (II)	0.0726***	0.0242	-0.0242	0.0855***	27867
	(0.027)	(0.023)	(0.036)	(0.022)	
Majority	0.0231	0.0093	0.0046	0.1458***	27774
	(0.027)	(0.031)	(0.047)	(0.033)	

Wholly owned	-0.0329	-0.0400*	-0.0386	0.1729***	27907
	(0.025)	(0.022)	(0.032)	(0.028)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Does the source of FDI matter? Ethnic Chinese vs. Foreign MNEs
Results based on an inverse probability weighted least square estimation

On the year of acquisition

		R&D	NPD	TRAINING	EXPORTS	N
Minority I	Ethnic Chinese	0.0383**	0.0378**	-0.0245	0.0410**	48019
		(0.017)	(0.016)	(0.022)	(0.016)	
	Foreign MNEs	-0.0090	-0.0116	0.0560	0.0027	
		(0.039)	(0.034)	(0.058)	(0.038)	
Minority II	Ethnic Chinese	0.0125	0.0112	-0.0183	0.0446***	46715
		(0.010)	(0.008)	(0.015)	(0.011)	
	Foreign MNEs	0.0238	0.0006	0.0297	0.0082	
		(0.020)	(0.015)	(0.029)	(0.020)	
Majority	Ethnic Chinese	0.0064	-0.0065	-0.0046	0.0718***	37863
		(0.013)	(0.008)	(0.022)	(0.017)	
	Foreign MNEs	-0.0174	0.0226	-0.0005	0.0196	
		(0.018)	(0.016)	(0.032)	(0.027)	
Wholly Owned	Ethnic Chinese	-0.0124	-0.0048	-0.0525***	0.0973***	37137
		(0.009)	(0.007)	(0.015)	(0.014)	
	Foreign MNEs	-0.0219**	-0.0074	-0.0139	-0.0275	
		(0.011)	(0.010)	(0.023)	(0.021)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One year after acquisition

		R&D	NPD	TRAINING	EXPORTS	N
Minority I	Ethnic Chinese	0.0703***	0.0492**	-0.0518**	0.0548***	47665
		(0.022)	(0.020)	(0.022)	(0.020)	
	Foreign MNEs	-0.0693*	-0.0603*	0.1329**	0.0074	
		(0.038)	(0.033)	(0.060)	(0.044)	
Minority II	Ethnic Chinese	0.0376***	0.0247**	-0.0319**	0.0720***	46369
		(0.013)	(0.012)	(0.016)	(0.014)	
	Foreign MNEs	-0.0032	-0.0035	0.0250	0.0161	
		(0.022)	(0.020)	(0.028)	(0.025)	
Majority	Ethnic Chinese	0.0368**	-0.0092	0.0133	0.0988***	37564
		(0.018)	(0.013)	(0.024)	(0.021)	
	Foreign MNEs	-0.0558**	0.0202	-0.0337	0.0371	
		(0.022)	(0.020)	(0.034)	(0.032)	
Wholly Owned	Ethnic Chinese	0.0023	-0.0241***	-0.0488***	0.1143***	36854
		(0.011)	(0.008)	(0.016)	(0.016)	
	Foreign MNEs	-0.0190	0.0085	0.0225	-0.0124	
		(0.016)	(0.013)	(0.026)	(0.025)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Two years after acquisition

		R&D	NPD	TRAINING	EXPORTS	N
Minority I	Ethnic Chinese	0.0659**	0.0766**	-0.1075***	0.0381	47698
		(0.031)	(0.033)	(0.028)	(0.026)	
	Foreign MNEs	-0.0222	-0.1056**	0.2250***	0.0639	
		(0.056)	(0.045)	(0.076)	(0.060)	
Minority II	Ethnic Chinese	-0.0011	0.0442**	0.0008	0.0809***	46205
		(0.015)	(0.020)	(0.025)	(0.021)	
	Foreign MNEs	0.0393	-0.0125	-0.0056	0.0095	
		(0.026)	(0.029)	(0.038)	(0.032)	
Majority	Ethnic Chinese	0.0184	-0.0280	0.0218	0.1039***	37475
		(0.023)	(0.017)	(0.036)	(0.030)	
	Foreign MNEs	0.0304	0.0648**	-0.0315	0.0398	
		(0.034)	(0.030)	(0.048)	(0.042)	
Wholly Owned	Ethnic Chinese	0.0005	-0.0265**	-0.0666***	0.1106***	36624
		(0.015)	(0.013)	(0.023)	(0.021)	
	Foreign MNEs	-0.0113	0.0175	0.0405	0.0202	
		(0.021)	(0.021)	(0.035)	(0.033)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Three years after acquisition

		R&D	NPD	TRAINING	EXPORTS	N
Minority I	Ethnic Chinese	0.0807*	0.0572	-0.0149	0.0563	21013
		(0.048)	(0.046)	(0.053)	(0.041)	
	Foreign MNEs	-0.0784	-0.0618	0.0480	0.0892	
		(0.068)	(0.067)	(0.092)	(0.081)	
Minority II	Ethnic Chinese	0.0561**	0.0215	0.0165	0.0962***	20525
		(0.028)	(0.026)	(0.035)	(0.029)	
	Foreign MNEs	0.0328	-0.0155	-0.0708	-0.0207	
		(0.042)	(0.036)	(0.047)	(0.041)	
Majority	Ethnic Chinese	-0.0117	-0.0211	-0.0162	0.1338***	17031
		(0.026)	(0.026)	(0.042)	(0.039)	
	Foreign MNEs	0.0332	0.0699	-0.0106	0.0371	
		(0.040)	(0.043)	(0.057)	(0.056)	
Wholly Owned	Ethnic Chinese	-0.0406**	-0.0289	-0.0165	0.1645***	16756
		(0.016)	(0.019)	(0.031)	(0.029)	
	Foreign MNEs	0.0230	0.0030	-0.0064	0.0209	
		(0.027)	(0.029)	(0.047)	(0.047)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Does the local partner matter? Private vs. State presence
Results based on an inverse probability weighted least square estimation

In the year of acquisition

		R&D	NPD	TRAINING	EXPORTS	N
	Private	0.0307*	0.0273*	-0.0055	0.0414***	48019
Minority I		(0.016)	(0.014)	(0.023)	(0.016)	
	State presence	0.0450	0.0635	-0.0677	0.0011	
		(0.052)	(0.052)	(0.051)	(0.043)	
	Private	0.0176**	0.0070	-0.0092	0.0469***	46715
Minority II		(0.009)	(0.007)	(0.013)	(0.009)	
	State presence	0.0429	0.0960*	-0.0037	0.0039	
		(0.051)	(0.055)	(0.061)	(0.045)	
	Private	-0.0001	0.0017	0.0006	0.0798***	37863
Majority		(0.009)	(0.008)	(0.017)	(0.014)	
	State presence	-0.0182	0.0283	-0.0889*	0.0110	
		(0.030)	(0.041)	(0.051)	(0.057)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One year after acquisition

		R&D	NPD	TRAINING	EXPORTS	N
	Private	0.0573***	0.0350*	-0.0165	0.0560***	47665
Minority I		(0.020)	(0.018)	(0.023)	(0.019)	
	State presence	-0.0117	0.0145	-0.0642	0.0032	
		(0.055)	(0.054)	(0.056)	(0.054)	
	Private	0.0371***	0.0195**	-0.0245*	0.0782***	46369
Minority II		(0.011)	(0.010)	(0.014)	(0.012)	
	State presence	-0.0145	0.0930	0.0329	-0.0117	
		(0.049)	(0.064)	(0.069)	(0.055)	
	Private	0.0143	-0.0042	0.0040	0.1195***	37564
Majority		(0.012)	(0.010)	(0.018)	(0.016)	
	State presence	-0.0796***	0.0885	-0.1305**	-0.0579	
		(0.012)	(0.067)	(0.052)	(0.061)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Two years after acquisition

		R&D	NPD	TRAINING	EXPORTS	N
	Private	0.0668**	0.0608**	-0.0346	0.0673**	47698
Minority I		(0.028)	(0.028)	(0.032)	(0.027)	
	State presence	-0.0717	-0.1342***	-0.1187*	-0.1208***	
		(0.067)	(0.028)	(0.068)	(0.027)	
	Private	0.0178	0.0371**	0.0012	0.0889***	46205
Minority II		(0.013)	(0.015)	(0.019)	(0.016)	
	State presence	-0.0357	0.0387	-0.0727	-0.0913*	
		(0.050)	(0.081)	(0.082)	(0.051)	
	Private	0.0368**	-0.0023	0.0077	0.1245***	37475
Majority		(0.018)	(0.015)	(0.025)	(0.022)	
	State presence	-0.0431	0.1774	-0.0534	0.0126	
		(0.063)	(0.109)	(0.101)	(0.100)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

		Three years after acquisition				
		R&D	NPD	TRAINING	EXPORTS	N
Minority I	Private	0.0474	0.0406	0.0128	0.0952**	21013
		(0.036)	(0.036)	(0.045)	(0.038)	
	State presence	0.1167	-0.1333***	-0.2444***	-0.1556***	
		(0.219)	(0.036)	(0.045)	(0.038)	
Minority II	Private	0.0747***	0.0111	-0.0168	0.0916***	20525
		(0.022)	(0.018)	(0.025)	(0.021)	
	State presence	-0.0706	0.0753	-0.0381	-0.1512***	
		(0.089)	(0.118)	(0.119)	(0.021)	
Majority	Private	-0.0082	0.0025	-0.0058	0.1526***	17031
		(0.020)	(0.022)	(0.031)	(0.029)	
	State presence	0.2053*	0.1852	-0.2412***	0.0032	
		(0.122)	(0.123)	(0.030)	(0.113)	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix

Table A1. Estimated coefficients from the ordered probit model

Size	-0.0768*
	(0.044)
Productivity	0.0476***
	(0.015)
R&D	0.2329
	(0.168)
EXPORTS	0.5983***
	(0.116)
SOE	-0.1724***
	(0.043)
Age	-0.0689***
	(0.006)
TRAINING	-0.2683**
	(0.128)
NPD	-0.0242
	(0.191)
Size_Size	0.0099***
	(0.003)
Size_Productivity	-0.0016
	(0.002)
Size_R&D	-0.0270
	(0.019)
Size_EXPORTS	-0.0204
	(0.014)
Size_Age	0.0006
	(0.001)
Size_TRAINING	-0.0013
	(0.015)
Size_NPD	-0.0060
	(0.022)
Productivity_Productivity	-0.0004***
	(0.000)
Productivity_R&D	0.0230***
	(0.009)
Productivity_EXPORTS	0.0303***
	(0.007)
Productivity_Age	-0.0001
	(0.000)
Productivity_TRAINING	0.0074
	(0.007)
Productivity_NPD	-0.0222**
	(0.009)
R&D_EXPORTS	-0.0479
	(0.065)
R&D_Age	0.0018
	(0.002)
R&D_TRAINING	-0.0563
	(0.067)
R&D_NPD	-0.0459
	(0.080)
EXPORTS_Age	-0.0006

	(0.002)
EXPORTS_TRAINING	-0.1234***
	(0.048)
EXPORTS_NPD	-0.1045
	(0.073)
Age_Age	0.0007***
	(0.000)
Age_TRAINING	0.0089***
	(0.003)
Age_NPD	0.0032
	(0.003)
TRAINING_NPD	0.2038**
	(0.083)
Sector==14	0.2379***
	(0.074)
Sector==15	0.2492***
	(0.087)
Sector==16	-4.1085***
	(0.203)
Sector==17	0.0568
	(0.055)
Sector==18	0.4040***
	(0.062)
Sector==19	0.3910***
	(0.074)
Sector==20	-0.0352
	(0.093)
Sector==21	0.3241***
	(0.096)
Sector==22	0.0444
	(0.073)
Sector==23	-0.0074
	(0.092)
Sector==24	0.3877***
	(0.095)
Sector==25	-0.1020
	(0.132)
Sector==26	0.0352
	(0.057)
Sector==27	0.2550***
	(0.074)
Sector==28	-0.0552
	(0.152)
Sector==29	0.0854
	(0.106)
Sector==30	0.1610**
	(0.065)
Sector==31	-0.1905***
	(0.059)
Sector==32	-0.2013**
	(0.085)
Sector==33	-0.0538
	(0.088)
Sector==34	0.1301**
	(0.062)
Sector==35	0.0146

	(0.059)
Sector==36	0.0474
	(0.070)
Sector==37	0.0353
	(0.067)
Sector==39	0.2406***
	(0.058)
Sector==40	0.5826***
	(0.068)
Sector==41	0.2110**
	(0.097)
Sector==42	0.2510***
	(0.078)
Sector==43	-0.2663***
	(0.057)
year==2002	-1.6515***
	(0.039)
year==2003	-2.2261***
	(0.038)
year==2004	-2.2994***
	(0.032)
year==2005	-2.6064***
	(0.032)
Number of observations	65,688

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: some interaction terms have been omitted because of collinearity

Table A2. Balancing condition: test for differences in observed pre-treatment characteristics

a) Domestic firms versus acquired firms under category 1

	SIZE	PROD	RD	EXPORTING	SOEs	AGE	TRAINING	NP
1	1.5474	-0.1804	0.2698	0.4867**	0.1663	10.1571*	0.1486	0.2026
	(0.925)	(0.244)	(0.152)	(0.171)	(0.180)	(4.902)	(0.150)	(0.171)
2	-	0.5808	-	-0.3125	-0.2663	-8.5857	0.1339	-
	0.9816		0.2669					0.1391
	(1.110)	(0.567)	(0.200)	(0.233)	(0.180)	(6.078)	(0.218)	(0.214)
3	0.6308	0.1927	-	-0.0567	-0.0591	2.1428	0.0782	-
			0.2791					0.0758
	(1.082)	(0.295)	(0.181)	(0.212)	(0.211)	(5.786)	(0.192)	(0.203)
4	-	0.4288	0.0861	-0.3450	-0.0308	-4.1364	0.2459	-
	0.4540							0.1053
	(1.095)	(0.426)	(0.216)	(0.229)	(0.225)	(6.696)	(0.181)	(0.221)
5	0.0903	0.3614	-	-0.2858	-0.0371	-5.2730	0.0608	-
			0.1697					0.1402
	(1.067)	(0.553)	(0.207)	(0.222)	(0.213)	(5.907)	(0.205)	(0.204)
6	0.3872	-0.0225	-	-0.2041	-0.0328	-1.9752	0.1788	0.0445
			0.0671					
	(1.009)	(0.336)	(0.185)	(0.204)	(0.203)	(6.075)	(0.185)	(0.203)
7	-	0.4478	-	-0.3785	-0.1607	-5.9435	0.0396	0.0590
	0.6431		0.1037					
	(1.048)	(0.344)	(0.186)	(0.209)	(0.192)	(5.602)	(0.195)	(0.206)
8	0.0294	0.2594	-	-0.2513	0.0689	-3.0328	0.0693	0.1142
			0.1701					
	(1.006)	(0.351)	(0.181)	(0.217)	(0.207)	(5.580)	(0.185)	(0.206)
9	-	0.2393	-	-0.3553	-0.1039	-7.1021	-0.0764	-
	0.7672		0.2334					0.0950
	(0.967)	(0.379)	(0.168)	(0.195)	(0.188)	(5.213)	(0.171)	(0.188)
10	-	3.1651	-	-0.5012**	-0.1417	-7.8435	0.0285	-
	0.4203		0.2000					0.1467
	(0.946)	(1.914)	(0.158)	(0.178)	(0.182)	(5.117)	(0.158)	(0.174)
Observations	48019	48019	48019	48019	48019	48019	48019	48019

* p < 0.05, ** p < 0.01, *** p < 0.001

b) Domestic firms versus acquired firms under category 2

	SIZE	PROD	RD	EXPORTING	SOEs	AGE	TRAINING	NP
1	0.0998	0.1495	0.1026	0.1005	-0.0830*	2.0892	0.1052	0.1019
	(0.399)	(0.164)	(0.092)	(0.082)	(0.040)	(2.779)	(0.100)	(0.084)
2	0.3227	-0.0336	0.0524	0.0097	0.1292	-	0.1263	-
						2.2222		0.0028
	(0.480)	(0.259)	(0.122)	(0.118)	(0.069)	(3.081)	(0.128)	(0.110)
3	-	0.2111	-0.0986	-0.0603	0.0923	-	0.0253	-
	0.0667					1.9960		0.1217
	(0.515)	(0.367)	(0.110)	(0.107)	(0.063)	(3.161)	(0.132)	(0.094)
4	0.4284	-	-0.1584	-0.0012	0.1116	-	-0.1387	-
		0.4286*				0.2959		0.0742
	(0.451)	(0.183)	(0.111)	(0.115)	(0.063)	(3.216)	(0.137)	(0.101)
5	0.0295	-	-0.1468	-0.1588	0.0200	-	-0.1033	-

		0.4554*				3.3473		0.0788
	(0.468)	(0.220)	(0.109)	(0.105)	(0.043)	(2.915)	(0.133)	(0.102)
6	-	-0.4029	-0.0997	-0.0464	0.0772	-	0.0601	-
	0.0572					2.3836		0.0527
	(0.450)	(0.211)	(0.117)	(0.110)	(0.067)	(3.147)	(0.131)	(0.105)
7	0.2072	-0.1966	0.0222	0.0163	0.0587	-	0.1080	-
						1.1693		0.1111
	(0.451)	(0.227)	(0.112)	(0.104)	(0.052)	(3.095)	(0.124)	(0.095)
8	-	0.0494	-0.0768	-0.0896	0.0813	-	0.0520	-
	0.4453					3.7618		0.0709
	(0.449)	(0.277)	(0.103)	(0.100)	(0.049)	(2.958)	(0.115)	(0.093)
9	-	-0.3231	-0.0384	-0.1453	0.0310	-	-0.1055	-
	0.1048					3.1519		0.1253
	(0.426)	(0.245)	(0.100)	(0.096)	(0.042)	(2.846)	(0.110)	(0.089)
10	-	-0.3151	-0.1455	-0.1326	0.0765	-	-0.1175	-
	0.0859					4.3503		0.1314
	(0.414)	(0.422)	(0.095)	(0.087)	(0.044)	(2.856)	(0.104)	(0.087)
Observations	46715	46715	46715	46715	46715	46715	46715	46715

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

c) Domestic firms versus acquired firms under category 3

	SIZE	PROD	RD	EXPORTING	SOEs	AGE	TRAINING	NP
1	-0.1813	0.2124	0.3263	0.0014	0.0585	-1.1716	-0.1099	0.1481
	(0.563)	(0.292)	(0.171)	(0.097)	(0.097)	(1.798)	(0.170)	(0.133)
2	0.4155	0.0934	-0.3481	0.0120	-0.1065	0.4222	0.2940	-0.2299
	(0.688)	(0.487)	(0.196)	(0.146)	(0.097)	(2.269)	(0.231)	(0.133)
3	0.2786	-0.3801	-0.2391	0.2320	-0.0222	4.1034	0.3430	-0.1243
	(0.672)	(0.336)	(0.189)	(0.131)	(0.114)	(3.091)	(0.192)	(0.144)
4	0.0699	-0.1682	-0.2505	0.0510	0.0036	2.1583	0.1912	0.0049
	(0.874)	(0.489)	(0.200)	(0.150)	(0.130)	(3.184)	(0.209)	(0.170)
5	-0.5888	-0.2552	-0.2464	-0.0435	-0.0392	-0.7035	-0.0616	-0.2368
	(0.682)	(0.381)	(0.191)	(0.124)	(0.111)	(1.981)	(0.192)	(0.133)
6	-0.5703	0.0538	-0.3593*	0.0805	-0.1145	1.1718	0.0121	-0.1259
	(0.655)	(0.419)	(0.182)	(0.133)	(0.097)	(2.078)	(0.193)	(0.146)
7	0.2024	-0.4451	-0.3250	-0.1688	-0.0775	-1.2818	0.2050	-0.1323
	(0.639)	(0.358)	(0.185)	(0.116)	(0.103)	(1.935)	(0.191)	(0.146)
8	0.1232	-0.3311	-0.2863	-0.0324	-0.0958	0.3961	0.2339	-0.1583
	(0.633)	(0.377)	(0.181)	(0.117)	(0.100)	(2.119)	(0.182)	(0.139)
9	0.2336	0.0431	-0.3879*	-0.2811*	-0.0869	-0.0735	-0.0272	-0.2207
	(0.603)	(0.394)	(0.175)	(0.110)	(0.100)	(2.033)	(0.176)	(0.136)
10	-0.0081	1.4472	-0.3775*	-0.0674	-0.0490	-1.5714	0.1092	-0.1926
	(0.580)	(1.011)	(0.173)	(0.104)	(0.099)	(1.884)	(0.173)	(0.134)
Observations	37863	37863	37863	37863	37863	37863	37863	37863

* p < 0.05, ** p < 0.01, *** p < 0.001

d) Domestic firms versus acquired firms under category 4

	SIZE	PROD	RD	EXPORTING	SOEs	AGE	TRAINING	NP
1	0.3809	0.0959	-0.0555	0.0270	-0.0268	2.8308	0.0241	-0.0463
	(0.451)	(0.242)	(0.081)	(0.089)	(0.059)	(2.830)	(0.115)	(0.053)
2	-0.8791	-0.3201	0.1046	-0.0782	0.0213	-5.7192	-0.1634	0.0318
	(0.534)	(0.370)	(0.124)	(0.122)	(0.080)	(2.923)	(0.161)	(0.080)
3	-0.6866	-0.2664	-0.0345	0.0161	0.0980	-3.8418	-0.1095	-0.0429
	(0.653)	(0.316)	(0.110)	(0.137)	(0.103)	(3.237)	(0.184)	(0.055)
4	-0.8471	-0.2165	0.0441	-0.0378	0.0987	-5.1936	0.0090	0.0036
	(0.575)	(0.324)	(0.108)	(0.122)	(0.092)	(2.955)	(0.158)	(0.076)

5	-1.1337	-0.4747	0.0209	-0.1605	0.0083	-5.1600	-0.1703	-0.0393
	(0.607)	(0.292)	(0.105)	(0.112)	(0.073)	(2.957)	(0.152)	(0.055)
6	-0.5050	0.0517	0.0319	-0.0367	0.0688	-3.7315	-0.1183	-0.0418
	(0.492)	(0.395)	(0.096)	(0.114)	(0.074)	(2.893)	(0.136)	(0.059)
7	-0.9558	-0.0905	-0.0244	-0.1061	-0.0011	-4.7483	-0.1347	0.0421
	(0.522)	(0.298)	(0.092)	(0.112)	(0.063)	(2.934)	(0.133)	(0.072)
8	-1.0984*	-0.4757	-0.0099	-0.1973	-0.0145	-5.3729	-0.1912	-0.0328
	(0.493)	(0.277)	(0.088)	(0.107)	(0.059)	(2.895)	(0.125)	(0.058)
9	-0.6222	-0.2564	-0.0059	-0.1746	0.0055	-4.7484	-0.0733	0.0397
	(0.478)	(0.304)	(0.085)	(0.099)	(0.059)	(2.858)	(0.121)	(0.060)
10	-0.4789	-0.5318	-0.0170	-0.0525	0.0169	-5.3196	-0.1039	0.0120
	(0.464)	(0.340)	(0.083)	(0.093)	(0.059)	(2.870)	(0.117)	(0.055)
Observations	37137	37137	37137	37137	37137	37137	37137	37137

* p < 0.05, ** p < 0.01, *** p < 0.001