5. Foreign Ownership, Foreign Technology and China's Economic Transition: A case study on firm performance

Yueting Tong
Department of Economics
University of California, San Diego
La Jolla, CA 92093
Phone: (858) 534-3383
Email: ytong@weber.ucsd.edu

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Introduction

Numerate empirical studies have documented a positive correlation between trade, or the "openness," of an economy and its economic growth. The exceptional performance of some developing economies in the past decades seems to have convinced economists as well as government policy makers that developing countries will benefit from opening up their economies. The traditional concerns over the foreign dominance in domestic economies and the loss of non-renewable resources have slowly subsided. China, like many developing economies have begun pursuing a more open trade framework. Despite the many difficulties China is still facing today, the economic reform started two decades ago has not only transformed the once centrally planned economy to a market-oriented economy, but brought impressive economic growth over a fairly long period of time as well. During this transition, foreign investment[1] and other forms of foreign participation in the economy have played a crucial role. China's experience is a unique opportunity for us to examine the relationship between the "openness" and the performance of an economy.

[1] Foreign investment and foreign knowledge in this context mean investment and knowledge originally from outside mainland China.

Various efforts have been made to analyze the role of trade in economic development. Many suggest that technology transfer associated with trade and foreign investment has a positive impact on the growth and, in particular, the export of local firms. However, few have explicitly studied the role of foreign technology. The present study, using survey based firm data, is an effort to investigate the effects of FDI and technology transfer separately and explicitly. The knowledge flow in this case is whether a firm receives foreign knowledge according to the firm's managers. The approach has the advantage of encompassing different forms of knowledge inflow. The disadvantage is that the answer could be somewhat objective. In this study, I am most interested in the impact of foreign investment and technology transfer on local firms' export activities. Furthermore, I also seek to identify factors that might contribute to attract foreign knowledge inflow.

The data used in the analysis are based on a survey conducted by the World Bank in early 1993 in eight cities in China.[2] The survey included about 500 randomly chosen firms.[3] Six of these cities are located in two coastal provinces in Southeast China, Guangdong and Fujian.[4] The remaining two are inland cities in the southwestern province of Sichuan that has received relatively less foreign investment and has limited foreign presence. The sample includes state-owned enterprises, urban collectives, foreign owned firms, as well as private firms.

The empirical results of this study are consistent with the other studies that foreign direct investment indeed contributes to local firms' exports and growth. The analysis suggests that the effect of foreign direct investment is being carried out through both direct technology transfer and indirect knowledge diffusion. Finally, the study suggests that market competition seems to be important in promoting technology transfer.

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[2] These are Chengdu (CD) and Chongqing (CQ) in Sichuan Province of Western inland, Guangzhou (GZ), Shenzhen (SZ), and Dongguan (DG) in Guangdong Province on Southeast coast, and Fuzhou (FZ), Xiamen (XM) and Quanzhou (QZ) in Fujian Province on Southern coast.

[3] The firms in the sample are randomly chosen within each type of ownership category, the state-owned enterprises, the collectively owned enterprises and others.

[4] Two of the coastal cities (Shenzhen and Xiamen) were Special Economic Zones (SEZs).

The following section is an empirical investigation on the effects of FDI and foreign knowledge on local firms' performance. Section III attempt to identify some contributing factors associated with foreign technology transfer. Section IV concludes.

Empirical Study on the Effects of FDI and Knowledge Inflow

It is widely believed that foreign investment and especially the associated foreign technologies bring about many positive outcomes to both local affiliates as well as local firms in general. In this section, I empirically investigate their effects on local Chinese firms' activities. This analysis concentrates on a firm's export activities. The hypothesis tested is whether foreign investment and knowledge inflow have significant positive impact on a firm's export. The questions asked here are whether foreign investment and foreign knowledge flow increase the probability that a firm exports, increase the total amount of export, or increase the share of total output exported.

The general model can be represented as following:

$$Y_i = \alpha + \beta X_i + \gamma FDI_i + \zeta TECH_i + \varepsilon_i$$
$$H_0 : \gamma = 0 \text{ and/or } \zeta = 0$$
$$H_1 : \gamma > 0 \text{ and/or } \zeta > 0$$

Where Y_i, the dependent variable, is some index for a firm's performance, and X_i is a vector that contains a firm's characteristics such as geographic location, industry, age, etc.

Before getting into the specific empirical models, I shall talk a little about the firms included in the study. The attached Box 1 lists the definitions of major variables used in the study. About 30% of all the firms in the sample report having a foreign joint-venture status and the average share of foreign ownership is about 20%.[5] Firms on the coast are more likely to have foreign joint ventures and to have higher shares of foreign ownership. They are more likely to experience foreign knowledge inflow sources as well. A similar disparity between the two groups appears in firms' export. The simple description suggests that foreign ownership, technology diffusion and the Chinese firms' export seem to be closely related. A correlation analysis also indicates that

[5] Although foreign joint ventures usually have foreign partner(s) owning a share of the equity, this need not always be the case. There are, for example, joint ventures set up for imported material processing. Joint ventures could also exist in the form of joint-management, etc.

positive and significant correlation exists among the three. What follows is a more formal analysis of the above relationships using various multivariable regression techniques.

The first question is whether foreign investment and the associated foreign knowledge inflow will increase the chance that a firm exports in the future. The dependent variable, EXPT_D is a dummy variable indicating whether a firm exports in 1991. On the right side of the equation, there are five variables that we want to examine closely, plus variables that signalize the firm's basic characteristics. TECH indicates whether a firm received some form of foreign knowledge inflow before 1990. FJV takes 1 when a firm has a foreign joint venture partner and 0 otherwise. The share of foreign ownership FRN is also included. CONTACT is another binary variable that takes the value of 1 when the firm, in the recent past, had informal contacts with foreign businesses and zero otherwise. EXPT0[6] is a dummy variable included to control for the effect of a firm's initial export situation. Since the dependent variable is a binary variable that takes the values of 1 and zero, a logistic specification is used for estimation.[7] Thus, the empirical model I estimate is the following:

$$\text{logit}(EXPT\_D_i) = \alpha + \beta_1 TECH_i + \beta_2 FJV_I + \beta_3 FRN + \beta_4 CONTACT_I + \beta_5 EXPT0_I + \gamma Z_i + \varepsilon_I$$

The results are summarized in Table 1. The first two columns are the estimates for the coefficients and the stand error. The next two columns are the average marginal effect and the marginal effect calculated at the sample mean.[8] The result shows that knowledge inflow from foreign sources is positively correlated with the probability that a firm will export in the subsequent years. At the sample mean, a firm with foreign knowledge inflow is about 25% more likely to export compare to one without foreign knowledge inflow. In addition, the share of foreign ownership also has a positive and significant coefficient, meaning foreign ownership

[6] When TECH is 1 for a firm, EXPT0 takes the value of 1 if the firm export when foreign knowledge inflow began. When TECH is 0 for a firm, EXPT0 takes the values of 1 if the firm exports in 1980 (or first year of operation when the firm was established after 1980) and 0 otherwise.

[7] A logistic regression assumes an S-shape curve and has the following functional form, . In other word, the X's are linearly related to the logit transformation of the y's, where logit(Yi)=ln(yi/(1-yi)).

[8]

$$\text{marginal effect} = \frac{\partial E[y \mid \mathbf{X}]}{\partial \mathbf{X}} = \Lambda(\beta^T X)[1 - \Lambda(\beta^T X)]\beta$$

$$\text{where } \Lambda(\beta^T X) = \frac{1}{1 + \exp(-\beta^T \mathbf{X})}$$

benefit local firms not only through technology but other means as well, such as access to the world market. The result also indicates that informal contact with foreign firms may be helpful in facilitating export but the effect is not statistically significant.

Next, I will further explore the extent of the positive effect that technology transfer has on the export of local Chinese firms. I examine first the total amount of a firm's sale going to the world market and then the share of total output exported.

The dependent variable is the log of a firm's total export. I start with a linear model. Since many of the firms do not export, these observations will be dropped when I use log specification. If we assume the desired level of export based on a firm's characteristics is zero or negative, we have a censored sample problem. Dropping these observations could lead to inconsistency in estimation. Unfortunately, it is not feasible to apply the Tobit specification while maintaining the log linear structure, as the logarithm of zero is undefined. To overcome this problem, I use a modified Tobit model introduced by Eaton and Tamura.

The modified Tobit specification is defined as following:

$$\begin{aligned} \ln(EXPT91_i + A) &= \mathbf{X}\beta + \mu_i \qquad \text{if } \mathbf{X}\beta + \mu_i > \ln(A) \\ &= \ln(A) \qquad \text{if } \mathbf{X}\beta + \mu_i \le \ln(A) \end{aligned}$$

Where A is a threshold parameter to be estimated, u is an i.i.d normally distributed variable with mean zero and variance □ ^{2}. The model is estimated by the maximum likelihood method. The results for both the ordinary least square and the modified Tobit model are listed in Table 1.[9] The results from both the OLS and Tobit are mostly consistent but the coefficients in the linear model are less significant. As shown by the results from the Tobit model, technology transfer experienced in the 1990s has a positive and marginally significant effect on the amount of a firm's total export in 1991. The coefficient is 0.767. This is to say that given everything else the same, the desired level of export in 1991 is at least 77% higher for a firm that experienced foreign knowledge inflow earlier compared to one with no foreign knowledge inflow. Similarly,

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[9] The OLS estimation only includes with positive export while the TOBIT estimation includes firms with no export. For TOBIT regression, I first estimate an ordinary least square using ln(EXPT+1). The resulting coefficients (not reported) are used as the initial values for the tobit estimation. The results from both are qualitatively the same but the tobit regression seems to yield better estimates (results not reported in the paper).

the percentage of imported machines, the share of foreign ownership, and informal contact with foreign businesses are all positively correlated with a firm's export.

Finally, I look at the share of export in total output. This is important. Suppose that a firm is associated with foreign businesses such as equity involvement and as a result receives technology transfer; based on the results from above, the firm will be likely to start exporting and export more. There exit two alternative ways to achieve this outcome. The firm could divert part of its domestic sale to the world market. The firm could also increase its production and export. In the first case, the share of export in total output will increase dramatically while in the second case it need not. Both outcomes are good for the domestic market if we are more concerned with export but the second case is more desirable since it brings more growth.

The dependent variable in this section is the share of export in total sale in 1991. Since the value of the dependent variable is censored on both 0 and 100 percent, the dependent variable is transformed into a continuous variable.[10] The empirical results (Table 1) indicate that the share of export in total output is not significantly higher for firms that have experienced foreign knowledge inflow during the 1980s.

The results from the three sections indicate that foreign knowledge inflow brings positive effects on local firms' export activity. Firms that have received foreign knowledge during the 1980s are more likely to export and to export more in the early 1990s. More importantly, this is likely to be the result of expanded production rather than from diverting sales from domestic to international markets. Analysis also suggests that foreign knowledge inflow seems to have positive effect on a firm's future employment and output growth. The effects, however, may only be present within the short run. Furthermore, I found that foreign knowledge also benefit local firms indirectly through more training provided by their local recipients.[11]

Study on the Factors Associated with Technology Transfer

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[10] The new variable is LN[PCEXPT/(1-PCEXPT)]. PCEXPT=1 is replaced with 0.9999. Cases with PCEXPT=0 are excluded from the regression. One sided as well as two-sided Tobit regressions are also performed and the results are primarily the same.

[11] The study on growth and training provided by MNC's local affiliates are in the original paper but not included in this version.

The previous sections show that foreign knowledge inflow conveys positive effects to local affiliates and other related firms in general. Related to this finding, it is important to know what are the important elements associated with foreign knowledge inflow. In a word, what can be done to encourage more technology transfer. The goal of this part is to empirically identify and test some possible contributing factors related with foreign knowledge inflow.

Theoretical analysis and empirical studies have suggested some predictions regarding the factors affecting foreign technology influx to domestic firms. First, both foreign investment and buyer and supplier linkages lead to knowledge flow from foreign sources to local firms. Second, competition in the domestic market promotes technology transfer from foreign to domestic firms. Third, the human capital in the local firms, which represents the absorptive capacity of the firm, also affects technology transfer.

I define an empirical model to test the assumption that the above factors are of importance for foreign knowledge inflow. The dependent variable is TECH, whether a firm received foreign knowledge inflow. The dependent variables include foreign ownership, competition intensity, and the level of weighted average education level of a firm's employees, as well as other firm characteristics. As the dependent variable is a binary variable, a logistic specification is used for estimation. The dependent variable can be viewed as the probability that a firm experiences foreign knowledge inflow.

$$\text{logit}(TECH_i) = \alpha + \beta_1 FRN_i + \beta_2 FJV_i + \beta_3 COMPITITION_i + \beta_4 EDU_i + \gamma \mathbf{X}_i + \varepsilon_i$$

The results are summarized in Table 2 and consistent with the prediction. Foreign ownership and foreign joint venture partnership are closely associated with foreign knowledge infusion. Competition intensity perceived by the firm seems to be positively related with the probability that foreign technology transfer would occur, though the coefficient is not significant, however. The weighted average education level of the employees is also positively associated with foreign knowledge inflow.

Some may argue that foreign investment originating from different source countries may differ in transferring technology. For example, investments from industrial countries may be more likely to bring in new technology than that from developing countries. Thus I replace the foreign investment with three new variables: investment from Hong Kong/Macao, Taiwan, investment

from Japan and US, and investment from elsewhere. The introduction of the new variables improves the model marginally. The coefficient on JP_US is almost twice as high as that on HK_MC_TW. Statistically, however, the two are not different from each other. It might be the case that investment from industrial countries is more likely to bring in new technology. However, The sample does not produce strong support.

Conclusions

This empirical study serves two separate but related purposes. On one hand, I examine the positive effect on local Chinese firms derived from business associations with foreign firms. The role of foreign knowledge flow is in the center of the analysis. On the other hand, I try to identify contributing factors that are associated with foreign technology transfer from which policy implications may be drawn.

The empirical results suggest that there exist a positive effect on local firms following foreign knowledge inflow. Foreign technology transfer not only increases the probability that a firm will export in subsequent years, it also increases the amount of total export. In addition, the exports induced by foreign knowledge inflow result from higher production rather than from diverting sale from a domestic market to the international market.

Identifying factors associated with foreign knowledge inflow, the findings are consistent with theoretical predictions. Close associations with foreign businesses are strongly related to foreign knowledge. A firm's perceived competition intensity is also positively related to foreign knowledge inflow. And the overall education level of a firm's employees is positively correlated with the likelihood that the firm receives foreign knowledge. From a policy point of view, it is beneficial to maintain an open economic environment, to encourage competition and cooperation between local firms and foreign affiliates.

References[12]

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Appendix 1: Definitions of major variables

EXPT_D:	1 if the firm exports in 1991 and 0 otherwise.
EXPT0_D:	1 if the firm exports at the time when foreign technology transfer began and 0 otherwise.
PCEXPT91:	The percentage of a firm's output being exported in 1991.
LEXPT91:	The log of firm export amount in 1991 (=log(export91+1).
LEXPT0:	The log of firm export at the time when foreign technology transfer began (=log(export0+1)).
EDU	The weighted average years of education employees have.
SOE	The share of state ownership in 1991.
PVT	The share of private ownership in 1991.
FRN	The share of foreign ownership in 1991.
FJV	1 if a firm has a foreign joint venture partner in 1991 and 0 otherwise.
TECH	1 if the firm has in the past experienced substantial foreign knowledge inflow, and 0 otherwise.
IMPORT	The percentage of the firm's machinery that is imported.
CONTACT	1 if the firm' typical high-level manager in the firm having business lunches with foreign buyers and suppliers or foreign machinery suppliers in 1991, 0 otherwise.
CONTD	1 if the firm's high-level manager in the firm having business lunches with domestic buyers and suppliers or competitors in 1991, and 0 otherwise.
COMPETITION	Domestic competition intensity perceived by the firm, ranging from 1-3.

Table 1: Regression on effects of technology transfer on export

	EXPT_D				Log of EXPT91				LN[PCEXPT91/(1-PCEXPT91)]	
	Estimates		Marginal effect		OLS		TOBIT			
	B	S.E.	@mean	ave	B	S.E.	B	S.E.	B	t-stat
TECH	0.938**	0.456	0.234	0.113	0.496	1.196	0.767*	1.67	-0.095	-0.113
IMPORT					0.006	1.20	0.008	1.52	4.355***	3.858
FRN	0.017*	0.009	0.004	0.002	0.008	1.24	0.020***	3.27	-0.011	0.073
FJV	0.422	0.608	0.105	0.051	-0.090	-0.22	0.406	0.91	-0.939	-1.100
CONTACT	0.509	0.431	0.127	0.061	-0.297	-0.84	0.768**	2.00		
EXPT0_D	2.968***	0.580	0.739	0.356	0.967***	2.91	2.850***	8.98	0.042	0.059
LEMPL	0.712***	0.217	0.177	0.085	0.978***	5.65	1.194***	6.84	1.067*	1.926
SOE	0.000	0.005	0.000	0.000	0.000	0.005	0.006	1.25	-0.006	-0.626
PVT	0.851	2.017	0.212	0.102	0.004	0.90			-0.046	-0.453
OLD	0.153	0.514	0.038	0.018	0.051	1.32	0.100*	1.87	-2.132*	-1.703
CONTD	-0.313	0.483	-0.078	-0.038	-0.482	-1.15	-0.890**	-2.22		
C	-4.096	1.350			1.455	1.16	-2.040	-1.75		
AI							186.53	5.34		
SIGI							2.93			
CITY included	Y				Y		Y			
INDUSTRY included	Y				Y		Y			

R2					0.36				0.581	
# of firms	302				164		307		115	

Notes: 1. Estimation on EXPT_D includes firms that either have TECH and FJV between 1980 and 1990, or have neither.

2: Estimation on PCEXPT91 includes firms with positive export, where either TECH=1 and experienced inflow between 80 and 90, or FJV=1 and stated between 1980 and 1990, or TECH=0 and FJV=0. 1 is replaced with 0.9999 in the transformation.

3. ***, **, *, and # denote the significance of 1%, 5%, 10% and 15% respectively.

Table 2: Regression on factors associated with technology transfer Dependent variable: TECH

	Model 1		Model 2	
	B	S.E.	B	S.E.
LEMPL	0.8823***	0.2252	0.9300***	0.2310
FRN				
HK_MACAU_TW	]		} 0.481***	0.0098
JP_US	}0.0425***	0.0080	} 0.885***	0.0270
OTHER	]		0.335***	0.0112
FJV	1.0774**	0.4489	0.9424**	0.4611
COMPETITION	0.2218	0.1714	0.2697#	0.1735
EDU	0.7982**	0.3654	0.7555**	0.3748
CONTACT	0.9027***	0.3695	0.9895***	0.3764
significance	<1%		>10%	
# of firms	363			