FDI, domestic sales and export intensity: A case study of China's manufacturing industries

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Abstract

Using panel data over the period 2005-2007, this paper explores the interrelationship among foreign presence, domestic sales and export intensity of local firms in three Chinese manufacturing industries. We find that the domestic sales and exports are complementary for local firms in China's pharmaceutical industry, whereas in the case of the textile and transportation equipment manufacturing industries, domestic sales and exports are substitutes. An increase in the average domestic sales increases foreign presence in all three industries. The same applies to the effect of an increase in the average export intensity. An increase in the level of competition in China's textile industry increases the export intensity as well as domestic sales of local textile firms. However, an increase in the level of competition in pharmaceutical industry leads to a very large decrease in export intensity of local pharmaceutical firms. In the case of China's transportation equipment manufacturing industry, an increase in the level of competition decreases domestic sales of local firms. Furthermore, an increase in the firm size increases domestic sales of Chinese firms in all three manufacturing industries.

Key Words: FDI-related spillovers; export intensity; domestic sales; China, GMM

1. Introduction

Since the opening up of the Chinese economy in late 1970s, there has been a significant increase in foreign direct investment (FDI) in China. Increase in FDI, which leads to an increase in foreign presence, has coincided with rapid economic growth in China. The Chinese economy can be described as an export-led economy.[1] However, the government is now attempting to transform the economy into a domestic consumption-led economy.

A large number of studies have argued that FDI can, among other things, affect the output as well as exports of domestic firms in host economies.[2] However, most existing studies tend to separately examine the impact of FDI on each variable. In a relatively recent study, using firm level data from Spain, Salomon and Shaver (2005) argue that export behaviour and domestic sales are interrelated. Indeed, profit maximising firms determine their sales in domestic and export markets simultaneously and hence domestic market and export market sales could be better analysed by means of a simultaneous equation model. The existing literature suggests that FDI can also affect the output of domestic firms through increased competition. The competition effect is likely to be negative. However, through the related productivity spillover effect, FDI can also increase the output of domestic firms (See Blomström and Kokko, 1998). A change in the output is bound to affect firm sales in both domestic and export markets. Furthermore fluctuations in sales can also affect FDI inflows. In other words, there is a clear link among FDI-related spillovers, domestic sales and exports. However, relatively few studies have focused on this interrelationship.

Using firm level panel data from three Chinese manufacturing industries over the period of 2005-2007, this paper aims to examine the complex interaction among foreign presence, domestic sales and exports. The industries considered in this paper are (i) textile industry, (ii) transportation equipment, and (iii) pharmaceutical manufacturing industry. The interrelationship is evaluated by means of a three-equation model. The model is estimated by means of System Generalised Method of Moments (GMM). This allows us to account for possible endogeneity of some variables.

[1] Owing to increase in net-exports, China's foreign exchange reserves were estimated to be close to US$3.8 trillion in early 2014 (Jacob, 2014).

[2] For example see Chen, Sheng, and Findlay (2013), Anwar and Nguyen (2014), Anwar and Sun (2014) and references therein.

Based on the results presented in this paper, we argue that the interrelationship among foreign presence, domestic sales and exports varies across Chinese manufacturing industries. We find that domestic sales and exports are substitutes for Chinese firms in the textile and transportation equipment manufacturing industries.[3] However, for Chinese firms in the pharmaceutical industry, domestic market sales and exports are complimentary. An increase in average domestic sales appears to have the smallest impact on foreign presence in transportation equipment industry. Except for the pharmaceutical industry, there is strong evidence of a positive and statistically significant relationship between (i) foreign presence and domestic sales and (ii) foreign presence and export intensity of Chinese firms in textile and transport equipment manufacturing industries. A decrease in the level of competition in China's pharmaceutical industry increases the export intensity of domestic firms but domestic sales decline. An increase in the level of competition in China's textile industry increases the export intensity as well as domestic sales of the local firms. The competition level has no impact on export intensity of domestic firms in transportation equipment manufacturing industry but it is negatively related to domestic sales. An increase in firm size increases the domestic sales of all three manufacturing industries.

The rest of this paper is organised as follows. Section 2 contains a review of related studies. Methodology is described in Section 3. Section 4 contains a discussion of the empirical results. Section 5 concludes the paper.

2. Review of Related Literature

Rapid increase in FDI flows has generated tremendous interest in empirical analysis of their impact on a number of variables, notably on productivity and export behaviour of domestic firms in host economies.[4] Early studies that consider he relationship between export behaviour and FDI include Aitken, Gorg, and Strobl (1997) and Kokko, Zejan, and Tansini (2001). Using data from Mexican firms from 1986 to 1990, Aitken, Görg, and Strobl examined the impact of FDI on the export decision of local firms. They found that proximity to multinational activity has a positive effect on the probability that domestic firms in the same sector will engage in export activity. Using firm level data from Uruguay, Kokko, Zejan,

[3] Within the context of this paper, foreign presence is a measure of the spillover effect arising from FDI.

[4] A good review of empirical studies that deal with the impact of FDI on firm productivity can be found in Meyer and Sinani (2009). Wagner (2007) includes a comprehensive review of studies that deal with the impact of FDI on firm export behaviour. Sun (2009) examines the presence of FDI-related export spillovers in China.

and Tansini reported that FDI can enhance the probability that domestic firms will be involved in export activities.

As far as the empirical studies on China are concerned, Li, Liu, and Parker (2001) examine the impact of FDI on productivity in China's manufacturing sector. Among other things, they found that FDI led to technological improvement in state-owned firms. This study extends Buckley, Clegg and Wang (2002). Buckley, Clegg and Wang reported that, as compared to the state-owned firms, collectively-owned firms are relatively more capable of absorbing FDI-related productivity spillovers. Chuang and Hsu (2004), using the same dataset, re-confirmed the presence of positive FDI-related productivity spillovers. Buckley et al. (2007) also used the same dataset to explore the possibility of curvilinear FDI-related productivity spillovers. They found that the productivity of Chinese firms increases with spillovers. However, after reaching a certain threshold, any further increase in spillovers leads to a decline in productivity. Using firm level data from the Chinese manufacturing sector, Liu (2008) distinguishes between change in the level of productivity and the growth rate of productivity. Liu's empirical analysis suggests that the relationship between FDI and the level of productivity of domestic firms is negative in the short-term but the relationship between FDI and the growth rate of productivity is positive in the long-term. Using cross-sectional data collected in 2001 from Chinese firms in five cities and ten industries, Hale and Long (2011) re-investigated the link between FDI-related spillovers and productivity. However, they found mixed evidence, which could be attributed to the fact that some previous studies suffer from aggregation bias and/or fail to control for endogeneity of FDI.[5]

While highlighting the simultaneity between exports and domestic sales, Wei et al (2012) examine the impact of FDI on the two variables by means of single equation GMM. Based on highly aggregated data, they argue that presence of foreign firm in China decreases the domestic sales but its impact on exports is positive. Using data form China's manufacturing sector over the period 2000-03, Chen, Sheng and Findlay (2013) examine the impact of FDI on export value and export-to-sale ratio of domestic firms. They conclude that FDI has a positive impact on export performance of domestic firms. Chen et al, also distinguish between horizontal and vertical export spillovers. This study also contains an excellent review of previous studies that deal with the impact of FDI on export performance

[5] A good review of some studies on China can also be found in Table 1 of Hale and Long (2011). For a review of the broader literature, see for example, Blomström and Kokko (1998), Saggi (2002), Görg and Greenaway (2004), Wagner (2007), Smeets (2008) and Bodeman and Le (2013).

of Chinese firms. Using panel data from Chinese customs from 1997 to 2007, Mayneris and Poncet (2013) find that the presence of foreign firms encourages domestic firms to export. A number of existing studies have confirmed the presence of productivity slipover effect among Chinese firms. Anwar and Sun (2014) extend this literature by demonstrating that FDI-related spillovers in Chinese manufacturing industries are also heterogeneous.

While a number of studies have separately explored the impact of FDI and FDI-related spillovers on firm productivity and export behaviour in China, few studies have explored the interaction among FDI, domestic sales and export behaviour. Based on cross-sectional survey data collected in 2003 (for year 2002), Bao, Wang and Huang (2013) argue that FDI-invested firms in China experience improvement in productivity and sales in the domestic market but there was no statistically significant change in their export behaviour. However, these conclusions are based on a single equation model. In this paper, unlike the existing literature, by making use of a three equation model, we explore the link among foreign presence, domestic sales and exports of domestic firms. The empirical results presented in this paper are based on panel data from three Chinese manufacturing industries.

3. Empirical Specification and Data

While the focus of this paper is on the interrelationship among foreign presence, domestic sales and exports, in order to ensure that each of the three variables is identified, we specify a three-equation model, which includes some control variables as follows:

$$\ln(dsales) = \alpha_0 + \alpha_1 eintensity + \alpha_2 fp + \alpha_3 \ln(firmsize) + \alpha_4 rdint + \alpha_5 adint + \alpha_6 herfindahl + \alpha_7 dyear + \varepsilon_1 \quad (1)$$

$$eintensity = \beta_0 + \beta_1 \ln(dsales) + \beta_2 fp + \beta_3 \ln(firmsize) + \beta_4 rdint + \beta_5 \ln(k) + \beta_6 herfindahl + \beta_7 dyear + \varepsilon_2 \quad (2)$$

$$fp = \gamma_0 + \gamma_1 meintensity + \gamma_2 \ln(mdsales) + \gamma_7 dyear + \varepsilon_3 \quad (3)$$

where *dsales* is the sales of a domestic firm as a proportion of its total sales; *eintensity* is the sales of a domestic firm in export market as a proportion its total sales; *fp*, which measures foreign presence in a four-digit industry, is calculated as the output of the foreign-invested firms in the four-digit industry; *firmsize* is measured by the number of employees; *rdint* is the firm research and development (R&D) intensity, which is the share of a firm's R&D

expenditure as a proportion of its total sales; *adint* is the advertising expenses as a proportion of sales; *herfindahl* is the Herfindahl index (i.e., the firm market share in a four digit industry) which captures the level of competition within the industry; *k* denotes the capital intensity, measured by the fixed assets per employee; *meintensity* is the mean export intensity in a four-digit industry; *mdsales* is the mean domestic sales in a four-digit industry; *dyear* is a set of year dummies; and ε_1, ε_2, and ε_3 are three correlated error terms.

Equations (1) and (2) reflect the interrelationship between domestic sales and exports. These equations indicate that foreign presence affect both variables. However, foreign presence is not exogenous. FDI tends to flow into industries with higher domestic sales (i.e., industries with bigger domestic market) and higher export intensity. Equation (3) controls for the endogeneity of foreign presence in that the error term ε_3 is correlated with error terms ε_1 and ε_2. In other words, the model specified in the above appears to be partially recursive. The inclusion of control variables ensures that all equations are identified.

Equations (1) to (3) are estimated using data from three two-digit manufacturing industries. These industries include textile, transportation equipment manufacturing, and pharmaceutical industries. The data are collected from China's National Bureau of Statistics, and cover the period of 2005-2007. As per usual, the dataset is cleaned to exclude firms with negative sales. This dataset has also been used by a number studies, such as Liu, Wei and Wang (2009) and Anwar and Sun (2013 & 2014). The useable dataset consists of unbalanced panels. Data summary statistics are reported in Tables 1-3.

--- insert Tables 1 to 3 about here ---

Equations (1) to (3) are estimated by using System GMM, which allows us to take into account the possible endogeneity problem.[6] As indicated in Tables (1) to (3), the sample includes a large number of firms. Some firms are small, whereas some firms are very large. As the sample includes both large and small firms, we use logarithm of domestic sales, firm size, the mean domestic sales and capital intensity in our empirical analysis. This allows us to reduce the bias that may arise because large firms tend to have higher sales in dollar value

[6] In order to control for endogeneity within the context of a single equation model, Wei et al. (2012) have used one period lag of several variables including FDI. In this paper, we use a three-equation model, which allows three variables to be endogenous.

terms and they also employ a large number of workers. Furthermore, large firms are likely to have higher value of fixed assets.[7]

4. Empirical Results

The empirical results for each of the three manufacturing industries are reported in Tables 4 to 6. Table 4 shows the empirical results for China's textile manufacturing industry. The estimated results shows that an increase in export intensity in China's textile industry decreases the domestic sales, suggesting that textile industry exports and domestic sales are substitutes. An increase in foreign presence in textile industry increases the domestic sales as well as export intensity of Chinese firms in the same industry. The impact of an increase in R&D intensity of domestic firms on their domestic sales and export intensity is positive. However, within the context of the textile industry, an increase in the level of competition (as measured by the Herfindahl index) increases both domestic sales as well export intensity of domestic firms.[8] Table 4 also shows that an increase in average export intensity increases foreign presence in the textile industry, which contributes to a very large increase in domestic sales and its effect on the export intensity of domestic firms is also positive.

--- insert Table 4 about here ---

Table 5 shows that, within the context of the transportation equipment industry, an increase in the level of competition within the industry increases domestic sales but its impact on export intensity of domestic firms is statistically insignificant. Domestic sales and exports appear to be substitutes. An increase in foreign presence in China's transportation equipment industry has a positive effect on domestic sales and the export intensity of local firms. The same applies to an increase in R&D intensity of domestic firms. An increase in advertising intensity increases domestic sales. A decrease in the level of market competition increases the domestic sales but its impact on export intensity is statistically insignificant. Finally, an increase in the average export intensity leads to a large increase in foreign presence in China's transportation equipment manufacturing industry but a large increase in average sales in domestic leads to a relatively small increase in foreign presence. In recent years China has restricted FDI in its transportation industry.

[7] As the export intensity of some firms included in our sample is zero, it is not feasible to use logarithm of export intensity.

[8] A decrease in the value of Herfindahl index represents an increase in market competition.

--- insert Table 5 about here ---

Table 6 shows the empirical results for China's pharmaceutical industry. It is interesting to note that, unlike other industries, domestic sales and exports in pharmaceutical industry appear to be complementary; an increase in domestic sales increases the export intensity of local firms. Foreign presence has a positive impact on domestic sales but its impact on export intensity of local pharmaceutical firms is negative. However this conclusion is not very strong as the estimated results are statistically insignificant at the 5% level of significance (the relevant estimated *p*-values are 0.064 and 0.082). Larger firms appear to sell more in the domestic market but smaller firms appear to be more successful in the export market. An increase in R&D intensity contributes to increase in export intensity of domestic firms. Furthermore, the impact of advertising intensity on domestic sales is statistically insignificant. An increase in the level of competition increases domestic sales but its impact on export intensity of domestic firms is negative. Chinese customers are more likely to know the Chinese firms and hence increased competition through a decrease in the price of pharmaceutical products can have a positive impact on domestic sales. However, foreign customers would be reluctant to buy pharmaceutical products from new and unknown Chinese firms.

5. Concluding Remarks

Using firm level panel data from China's three manufacturing industries over the period 2005-2007, we consider the interrelationship among domestic sales, exports and foreign presence. The manufacturing industries considered in this paper are (i) the textile, (ii) transportation equipment, and (iii) pharmaceutical manufacturing industries. The empirical estimation based on System Generalised Method of Moments (GMM) suggest that an increase in average domestic sales and average export intensity increases foreign presence in each of the three manufacturing industries, which leads to increase in domestic sales and export intensity of domestic firms. Furthermore, except for the pharmaceutical industry, domestic sales and exports are substitutes for local firms. We find that for local firms in China's pharmaceutical industry, domestic sales and exports are complementary. Except for the pharmaceutical industry, an increase in foreign presence increases the domestic sales and export intensity of local firms in both textile and transport equipment manufacturing industries. The impact of an increase in foreign presence on domestic sales and export intensity of Chinese firms in pharmaceutical industry is positive but this effect is statistically

less significant. An increase in the level of competition in China's textile industry increases the export intensity as well as domestic sales of local textile firms. However, an increase in the level of competition in pharmaceutical industry leads to a very large decrease in the export intensity of local pharmaceutical firms. In the case of China's transportation equipment manufacturing industry, an increase in the level of competition decreases domestic sales of local firms. Finally, an increase in firm size increases the domestic sales of Chinese firms in all three industries.

The results presented in this paper suggest that FDI is China's pharmaceutical industry is not contributing to a statistically significant increase in domestic sales of local firms and their export intensity. In other words, the interrelationship among foreign presence, domestic sales and exports varies across Chinse manufacturing industries. Increased competition helps the textile industry but it can reduce the export intensity of domestic pharmaceutical firms and domestic sales of local transport equipment manufacturing firms. Chinese firms intending to form partnerships with foreign firms need to take these varying impacts into account.

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Table 1: Summary statistics of the textile industry

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(domestic sales)	53204	9.9044	1.2887	-0.0600	17.7939
export intensity	56699	0.1477	0.3166	0	1
foreign presence	56699	0.2841	0.1260	0.0368	0.6078
ln(firm size)	56699	-2.2369	1.0465	-4.8283	5.0174
R&D intensity	56699	0.0004	0.0063	-0.0650	1.1399
advertising intensity	56699	0.0003	0.0028	0	0.2149
Herfindahl	56699	0.0101	0.0113	0.0030	0.0849
ln(capital intensity)	56699	3.5688	1.2102	-4.2449	8.1831
mean export intensity	56699	0.1962	0.1454	0.0647	0.4833
ln(mean domestic sales)	56699	10.6714	0.4450	9.5971	11.2859

Source: NBS, 2005-2007; negatives values in logarithms in this and other tables reflect the small size of the variable in non-logarithm form.

Table 2: Summary statistics of the transportation equipment manufacturing industry

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(domestic sales)	28112	10.0380	1.3723	-0.0600	17.2540
export intensity	28551	0.0628	0.2034	0	1
foreign presence	28551	0.3797	0.1687	0	0.7475
ln(firm size)	28551	-2.1790	1.0934	-4.8283	3.6425
R&D intensity	28551	0.0026	0.0175	-0.0109	1.1385
advertising intensity	28551	0.0006	0.0032	0	0.1365
Herfindahl	28551	0.0172	0.0438	0.0040	0.7202
ln(capital intensity)	28551	3.5098	1.2085	-4.8929	8.1624
mean export intensity	28551	0.1006	0.0637	0	0.4487
ln(mean domestic sales)	28551	11.1595	0.7845	9.2731	15.1185

Source: NBS, 2005-2007.

Table 3: Summary statistics of the pharmaceutical industry

Variable	Obs	Mean	Std. Dev.	Min	Max
ln(domestic sales)	12224	10.2162	1.3029	1.8859	16.3260
export intensity	12309	0.0532	0.1761	0	1
foreign presence	12309	0.2585	0.0947	0.1329	0.4140
ln(firm size)	12309	-2.1168	1.0249	-4.8283	2.9882
R&D intensity	12309	0.0082	0.0333	-0.0973	1.5681
advertising intensity	12309	0.0078	0.0316	0	0.7261
Herfindahl	12309	0.0109	0.0040	0.0063	0.0217
ln(capital intensity)	12309	4.3785	1.1102	-3.0445	8.5674
mean export intensity	12309	0.0754	0.0610	0.0196	0.1815
ln(mean domestic sales)	12309	11.2261	0.4299	10.3420	11.8631

Source: NBS, 2005-2007.

Table 4: Regression results of the textile industry

	Coef.	Std. Err.	z	P>z
ln(dsales)				
Constant	12.0980	0.0541	223.65	0
Eintensity	-15.2199	0.6865	-22.17	0
Fp	6.3429	0.4253	14.91	0
ln(firmsize)	1.1406	0.0272	41.94	0
Rdint	6.3807	1.9733	3.23	0.001
Adint	-0.6161	2.1631	-0.28	0.776
Herfindahl	-7.7562	1.8028	-4.3	0
Eintensity				
Constant	0.8864	0.0833	10.65	0
ln(dsales)	-0.0736	0.0076	-9.7	0
Fp	0.3978	0.0200	19.91	0
ln(firmsize)	0.0811	0.0050	16.13	0
Rdint	0.4086	0.1301	3.14	0.002
ln(k)	0.0027	0.0019	1.42	0.156
Herfindahl	-0.9541	0.0984	-9.69	0
Fp				
Constant	-1.1826	0.0204	-58.06	0
Meintensity	0.9737	0.0056	173.58	0
ln(mdsales)	0.1205	0.0018	66.11	0
Number of obs	53204			

Note: year dummies are included in the regressions.

Table 5: Regression results of the transportation equipment manufacturing industry

	Coef.	Std. Err.	z	P>z
ln(dsales)				
Constant	11.1039	0.0667	166.55	0
eintensity	-17.9687	1.0487	-17.13	0
Fp	6.4990	0.3394	19.15	0
ln(firmsize)	1.2362	0.0272	45.52	0
Rdint	2.3149	0.7887	2.94	0.003
Adint	8.0623	3.0496	2.64	0.008
herfindahl	1.4601	0.4563	3.2	0.001
eintensity				
Constant	0.5754	0.0598	9.62	0
ln(dsales)	-0.0514	0.0055	-9.33	0
Fp	0.3666	0.0099	37.21	0
ln(firmsize)	0.0647	0.0048	13.45	0
Rdint	0.1358	0.0508	2.67	0.008
ln(k)	-0.0025	0.0012	-2.13	0.034
herfindahl	0.0151	0.0236	0.64	0.523
Fp				
Constant	-0.2007	0.0122	-16.51	0
meintensity	1.3912	0.0133	104.57	0
ln(mdsales)	0.0378	0.0011	35	0
Number of obs	28112			

Note: year dummies are included in the regressions.

Table 6: Regression results of the pharmaceutical industry

	Coef.	Std. Err.	z	P>z
ln(dsales)				
Constant	11.7479	0.0442	265.52	0
Eintensity	1.8871	0.1952	9.67	0
Fp	0.2556	0.1381	1.85	0.064
ln(firmsize)	0.7954	0.0105	75.88	0
Rdint	-1.4775	0.2793	-5.29	0
Adint	0.2429	0.2224	1.09	0.275
herfindahl	-13.3867	2.8788	-4.65	0
Eintensity				
Constant	-5.3220	0.9579	-5.56	0
ln(dsales)	0.4453	0.0871	5.11	0
Fp	-0.1307	0.0752	-1.74	0.082
ln(firmsize)	-0.3512	0.0731	-4.81	0
Rdint	0.6305	0.2176	2.9	0.004
ln(k)	0.0164	0.0165	0.99	0.322
herfindahl	9.2189	1.6001	5.76	0
Fp				
Constant	-1.5871	0.0160	-99.38	0
meintensity	0.5526	0.0098	56.52	0
ln(mdsales)	0.1609	0.0014	113.59	0
Number of obs	12224			

Note: year dummies are included in the regressions.